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15 The Economics of Shipbuilding and Scrapping

Build me straight, O worthy Master!
Staunch and strong, a goodly vessel,
That shall laugh at all disaster,
And with wave and whirlwind wrestle!

Day by day the vessel grew,
With timbers fashioned strong and true,
Stemson and keelson and sternson-knee,
Till, framed with perfect symmetry,
A skeleton ship arose to view!

And around the bows and along the side
The heavy hammers and mallets plied,
Till after many a week, at length,
Wonderful for form and strength,
Sublime in its enormous bulk,
Loomed aloft the shadowy hulk!

('The Building of the Ship', Henry Wadsworth Longfellow, *The Poetical Works of Longfellow*, Frederick Warne & Co., London 1899, p. 143)

15.1 THE ROLE OF THE MERCHANT SHIPBUILDING AND SCRAPPING INDUSTRIES

The shipbuilding industry supplies new ships, while shipbreakers ('recyclers') are the last-resort buyers of old ships which cannot be operated profitably in the shipping market. In terms of their economic structure, the two industries are very different. Shipbuilding is a heavy engineering business, selling a large and sophisticated product built mainly in facilities located in the industrialized countries of Japan, Europe, South Korea and now China. It requires substantial capital investment and a high level of technical and management expertise to design and produce a merchant ship. The ship scrapping industry, in contrast, is located mainly in the low-cost countries, particularly the Indian subcontinent, and is one of the world's most labour-intensive industries – in some countries ship scrapping takes place on the beach, with labour equipped with only the most primitive of hand tools and cutting equipment.

In the first part of this chapter we will examine the regional distribution of shipbuilding capacity and the relationship between the level of shipping and shipbuilding activity. We then consider shipbuilding market economics, looking in particular at the shipbuilding market cycle, the price mechanism and the influences on the supply of and demand for shipbuilding output. The section on shipbuilding ends with a discussion of competitiveness and the related issues of capacity measurement, the production process and international comparisons of productivity. The final section discusses how ships are scrapped, the market for scrap products and the international structure of the ship scrapping industry. Finally, in this chapter we introduce a new unit of measurement, the compensated gross ton (cgt). The compensated gross tonnage of a ship is derived from its gross tonnage (gt), but weighted to take account of the work content of that particular ship type – detailed definitions can be found in Appendix B.

15.2 THE REGIONAL STRUCTURE OF WORLD SHIPBUILDING

Who builds the world's merchant ships?

About 30 countries have a significant merchant shipbuilding industry (see Table 15.1), and it has a changeable history. Ship production trebled from 8.4 million gt in 1960 to 27.5 million gt in 1977, then halved to 13 million gt in 1980, edged up to 16 million gt by 1990 and more than doubled to 44.44 million gt in 2005. This volatility was accompanied by a realignment of regional shipbuilding capacity. Europe's market share fell from 66% to 10% while Asia's grew from 22% to 84%. Japan and South Korea now dominate the industry, between them producing over two-thirds of the world's ships, with China coming up very fast and trebling its production between 2000 and 2005, aiming to be the biggest shipbuilder. The remaining production is spread over many countries, mainly in eastern and western Europe. The shipbuilding output of most European countries declined during the 1980s, and several, including Sweden, stopped building merchant ships. Meanwhile Asia's dominant role increased as South Korea and China grew rapidly despite the general market problems in the shipbuilding industry. Finally, the market upturn in the early 2000s, during which newbuilding berths were in short supply, brought a surge of new Asian shipyards in emerging countries such as Vietnam, the Philippines and India.

Shipbuilding is a long-cycle business. Ships take several years to deliver, and once built they remain in service for 25–30 years. Since ships trickle in and out of the merchant fleet at only a few per cent a year, the pace of change in shipbuilding demand is slow. Trends develop over decades rather than years, and we need to step well back

Table 15.1 Merchant ships completed during years, 1960–2005 ('000 GT)

	1960	1977	1980	1985	1990	1995	2000	2005
Asia								
Japan	1,839	11,708	6,094	9,503	6,663	9,263	12,020	16,100
South Korea	—	562	522	2,620	3,441	6,264	12,228	15,400
Chinese PR	—	110	—	166	404	784	1,647	5,700
Taiwan	—	196	240	278	685	488	603	500
Singapore	—				49	99	17	
Total Far East	1,839	12,576	6,856	12,567	11,242	16,898	26,515	37,700
% world	22%	46%	52%	69%	70%	75%	84%	85%
Europe								
Belgium	123	132	138	133	60	11	0	0
Denmark	214	709	208	458	408	1,003	373	500
France	429	1,107	283	200	64	254	202	0
Germany FR	1,124	1,595	376	562	874	1,120	974	1200
German DR	—	378	346	358 in German FR				
Greece	—	81	25	37	19	0	0	0
Irish Republic	—	40	1	0	0	0	0	0
Italy	447	778	248	88	392	395	569	300
Netherlands	682	240	122	180	190	205	300	200
Portugal	—	98	11	41	74	18	47	
Spain	173	1,813	395	551	366	250	462	100
UK	1,298	1,020	427	172	126	126	105	0
Finland	111	361	200	213	256	317	223	0
Norway	254	567	208	122	91	147	114	100
Sweden	710	2,311	348	201	27	29	33	0
Total Europe	5,565	11,230	3,336	3,316	2,945	3,875	3,402	4,400
% world	66%	41%	25%	18%	18%	17%	11%	10%
Eastern Europe								
Bulgaria	—	144	206	173	92	92	21	0
Poland	220	478	362	361	141	524	630	700
Romania		296	170	204	175	229	139	0
USSR/Russia		421	460	229	430			
Yugoslavia	173	421	149	259	462			
Russia						83	17	—
Ukraine						185	5	0
Croatia						179	342	600
Total	393	1,760	1,347	1,226	1,300	1,291	1,154	1,300
% world	5%	6%	10%	7%	8%	6%	4%	3%
Others								
Brazil		380	729	581	255	172	10	0
USA	379	1,012	555	180	23	7	92	300
Other countries	586	573	278	286	288	225	523	744
Total	965	1,965	1,562	1,047	566	404	626	1,044
% world	12%	7%	12%	6%	4%	2%	2%	2%
World total	8,382	27,531	13,101	18,156	16,053	22,468	31,696	44,444

Source: Lloyd's Register of Shipping, Clarkson *World Shipyard Monitor*

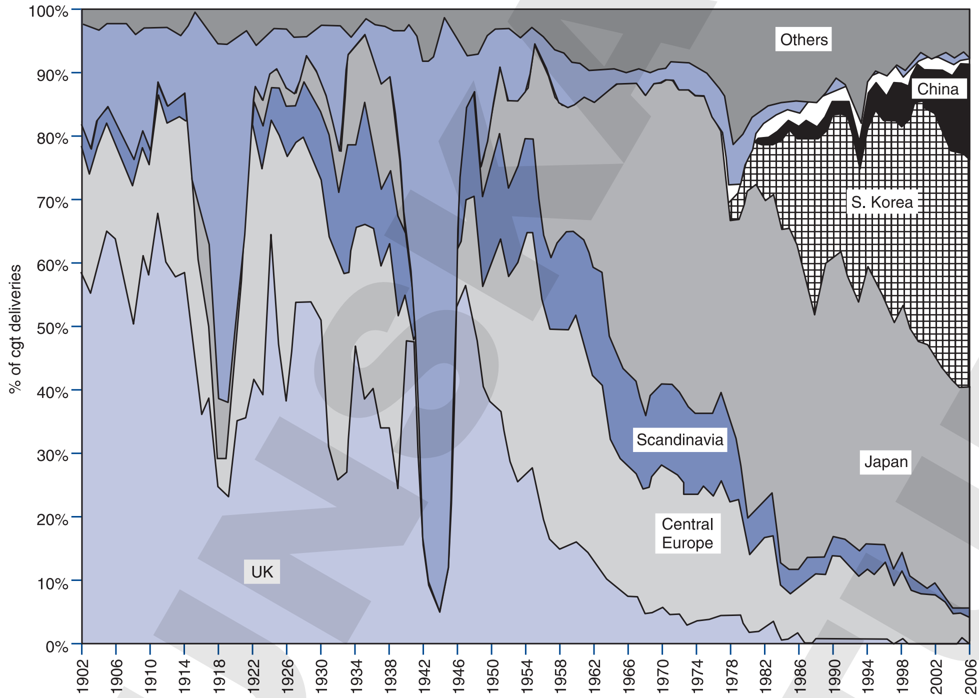

Figure 15.1
Shipbuilding market shares, 1902–2006
Source: Lloyd's Register of Shipping, Clarkson Research

to see them. Nowhere is this more apparent than in the changing regional location of shipbuilding activity, shown vividly in Figure 15.1. A century ago, shipbuilding was dominated by Great Britain. Gradually Continental Europe and Scandinavia squeezed Britain's share down to 40%. Then in the 1950s Japan overtook Europe, achieving a market share of 50% in 1969.

In the 1980s South Korean shipbuilding output grew rapidly, challenging Japan's dominant position and finally establishing the Far East as the centre of world shipbuilding. Then in the 1990s China started to increase in importance, achieving a 14% market share in 2006. Following this sequence of events we might ask what it is about shipbuilding that allows a single country to obtain the commanding position achieved by Britain, Japan, South Korea and China; and why has the balance changed so much over the years? To answer these questions it is instructive to take a brief look at the recent history of the shipbuilding industry, and in particular the relationship between the shipping and shipbuilding industries.[1]

The decline of British shipbuilding

In the early 1890s Britain dominated the maritime industry, producing over 80% of the world's ships and owning half the world fleet. In 1918 the Board of Trade Departmental

Committee on Shipping and Shipbuilding commented: ‘there are few important industries where the predominance of British manufacture has been more marked than shipbuilding and marine engineering’.[2] Britain held this dominant position until 1950 when it started to lose market share. The downward trend is apparent in Figure 15.2, as is the close correlation with the decline of the UK merchant fleet. At the beginning of the twentieth century, the UK merchant fleet had a 45% market share and shipbuilding about 55%, but by the end of the century the share had dwindled to virtually nothing.

It is not difficult to explain how British shipping achieved this dominant position. In the 1890s the Empire was at its height and Britain controlled massive trade flows, giving its shipping companies effective control of many liner routes in the Atlantic and Pacific, particularly between the colonies. In the tramp shipping market, Britain – an island nation – was the major importer of raw materials and foodstuffs such as grain, while the export trade in manufactures and coal was equally prominent. As the control of trade slipped away, so did shipping. With each world war the British Empire diminished in size, the merchant marine was weakened by wartime losses and its trading partners became better able to carry their own trade.[3] By 1960 the UK fleet had slipped to only 20% of world tonnage and British shipbuilding accounted for about the same proportion of world shipbuilding output, and by 2005 its market share of shipping had fallen below 2% and merchant shipbuilding was limited to very small ships.

One reason put forward for the decline of British shipbuilding was the industry’s failure to graduate from a production process based on manual skills to the more closely integrated production technology that was developed in Sweden and Japan during the twentieth century.[4] But there was also a link between the fortunes of shipping and shipbuilding. Discussing the rise of the British shipbuilding industry during the nineteenth century, Hobsbawm argues strongly for the existence of this link in the following terms:

> During the age of the traditional wooden sailing ship Britain had been a great, but by no means unchallenged producer. Indeed her weight as a shipbuilder had been due not to her technological superiority, for the French designed better ships and the USA built better ones … British shipbuilders benefited rather because of the vast weight of Britain as a shipping and trading power and the preference of British shippers (even after the abrogation of the Navigation Acts, which protected the industry heavily) for native ships.[5]

This link between trade, shipping and shipbuilding is too common to be a coincidence. In Britain relationships existed between shipowners and shipbuilders that went beyond normal competitive ties. Many British shipping lines had a long association with particular shipyards, which reinforced the tradition of building at home. Even in the 1970s there were shipyards in Britain that relied heavily on one or two domestic owners. As we shall see when we look at other regions, this was not a uniquely British state of affairs and shipbuilders are very dependent upon the fortunes of their home fleet.

But the commercial performance of the shipyards is also important and Britain was slow in adapting to the new highly competitive shipbuilding market after the

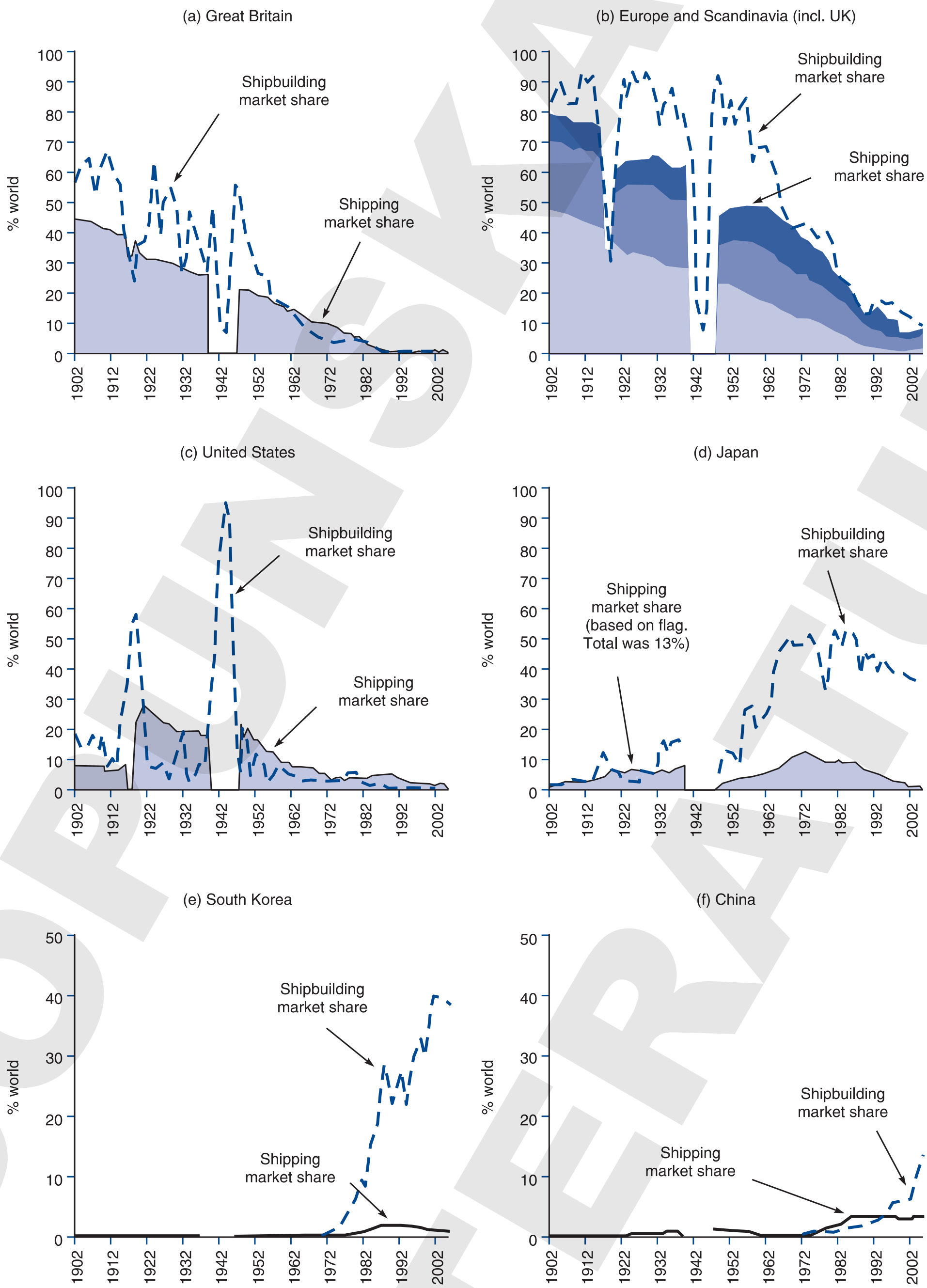

Figure 15.2
The link between shipping and shipbuilding market shares by region
Source: Lloyd's Register of Shipping
Note: This figure shows, for each region, the merchant fleet as a percentage of the world fleet and shipyard output as a percentage of world output.

Second World War. The battle was probably lost in the 1960s when British manufacturing industry as a whole was struggling with entrenched management practices and confrontational labour relations. Despite considerable capital investment, the British yards never achieved the high productivity levels of the German or Scandinavian yards. Typically it took twice as many man-hours to build a ship in the United Kingdom as in Scandinavia or Japan. A major strategic loss was the first container-ship which was started in the UK, but had to be towed to Germany to be completed. German shipyards continued to dominate the container business in Europe for the next 30 years.

The final blow was the UK's strong exchange rate when North Sea oil came on stream during the 1980s, at the trough of the 1980s recession. In 1988 the sterling price of a 30,000 dwt bulk carrier, £8 million, was only sufficient to buy the materials and left no margin for labour and overheads, an impossible position.[6] Slowly the industry slipped away.

European shipbuilding, 1902–2006

In Europe as a whole shipbuilding went through much the same cycle of growth and decline as in the UK. No individual country achieved prominence in the shipbuilding market on a scale comparable with Japan or the UK, but in the early 1900s European shipyards, including the UK, accounted for over 80% of world production, similar to the market share the Asian shipyards achieved a century later. This is shown in Figure 15.1 along with the market share of their shipping fleets. Until 1945 the shipbuilding market share was 20–30% higher than the shipping market share, and Europe was a net exporter of ships. But by the late 1950s this export dominance had been lost and the decline of the European shipping fleet in the 1960s and 1970s was accompanied by a decline in the market share of shipbuilding. By 2005 the market share of the fleet had fallen to 14% of the gross tonnage delivered, whilst the shipbuilding share was reduced to 6%. Of course these statistics have limitations, since during this period much of the fleet 'flagged out' (see Chapter 16) and gross tonnage does not fully reflect the high value-added of European shipbuilding, but there is no doubt that over the period Europe switched from being a net exporter to an importer of ships.

The experience of the Scandinavian shipbuilding industry was similar. Although none of the Scandinavian countries has sufficient population or heavy industry to make it a major participant in seaborne trade, they all have a strong maritime tradition. In this sense, the Scandinavian fleets may be regarded as part of the international shipping industry, in much the same way as Greece. In 1902 the Scandinavian shipyards had only a 3% market share, well below the 10% share of the Scandinavian merchant fleet. Shipbuilding capacity lagged behind the merchant fleet during this period because the Scandinavian shipyards had difficulty switching from wooden ships to the more capital-intensive process of building steel ships. Petersen comments:

> In the 1870s Norway had a large number of small shipyards employing expert master carpenters and experienced workers. These men were able to build all the sailing ships Norway needed, using only simple tools and home grown timber.

> The building of steam ships, on the other hand, demanded the import of raw materials and the erection of large shipyards with expensive, heavy machinery, and cranes. Steamship building did not gain momentum until the 1890s.[7]

Shipbuilding output in Scandinavia remained nominal until the First World War, when the industry started a rapid growth that eventually reached a peak market share of 21% in 1933. This position was maintained until the early 1970s when Scandinavian shipyards led the world in terms of productivity and production technology. For example Kockums shipyard in Sweden, which specialized in VLCCs, was generally regarded as the most productive yard in the world. But this success could not offset the high labour costs, and a decline in the market share of the Scandinavian fleet coincided with a fall in the market share of Scandinavian shipbuilding.

The fall in the European fleet, due partly to the transfer of registration to flags of convenience, was accompanied by a decline in Europe's market share, especially in the high-volume bulk markets. This undoubtedly reflects the growing competitive strength of the Japanese industry, and demonstrates that high productivity alone is not enough to maintain market share. But although many yards closed, some were successful in diversifying into high value-added ships for niche markets in which the Far East yards did not compete. These markets included container-ships, cruise ships, gas tankers, chemical tankers and many small vessels such as dredgers. All of these vessels are equipment-intensive, and this allowed the European equipment industry to maintain a leading role in design and development, for example in engines, cranes and engine room equipment.

Merchant shipbuilding in the United States

Historically the USA has had an unusual role in world shipbuilding. Apart from a spell in the early nineteenth century as the leading shipbuilder, which was brought to an end by the Civil War (1861–5), in peacetime the USA was not internationally prominent as a merchant shipbuilder or shipowner. With the exception of the two wars and the inter-war period, Figure 15.2(c) shows that its market share was only a few per cent. Of course, the USA had major shipping interests but, as we will see in Chapter 16, US shipowners were at the forefront of developing international registries. Despite this, much of the world's shipping and shipbuilding technology originated in the USA and during the two world wars the USA demonstrated its ability to mount a massive, if rather expensive, shipbuilding programme.

During the First World War, US shipbuilding output increased from 200,000 grt in 1914 to 4 million grt in 1919 – the USA alone produced 30% more ships in that year than the whole of world shipbuilding output before the beginning of the First World War. Production on this scale was achieved by using standard ships and standard production methods at the Hog Island complex which consisted of 50 building berths in five groups of ten along the Delaware River. The complex built a standard merchant ship in three sizes constructed as far as possible from flat plate. The building time was approximately 275 days. This was the first step towards standardized shipbuilding practices, though the yards did not achieve the degree of prefabrication introduced later.

The Second World War saw an even more extensive shipbuilding programme for the American Liberty ship, which was a standard dry cargo vessel of 10,902 dwt, and the T2 tanker of 16,543 dwt. These ships were mass-produced, with major sub-assemblies constructed off the berths – a development made possible by introducing welding in place of riveting. Production commenced in 1941 and reached a peak in 1944 when a total of 19.3 million grt of new ships were launched in the US – almost ten times the total world shipbuilding output in 1939. A total of 2,600 Liberty ships and 563 T2 tankers were built. After the war some of the Liberty ships were sold to private operators, others were traded, and the remainder, about 1,400, were laid up as part of the US strategic reserve fleet. By the 1960s their slow speed of 11 knots and full-bodied design made them unattractive in commercial operation and a series of Liberty replacement designs such as the SD14 and the Freedom took their place.

The activities of the US merchant shipbuilding industry during the twentieth century demonstrate two important points. The first is the speed with which, given the right circumstances, a major shipbuilding programme can be set up and dismantled. On these two occasions the USA developed a massive shipbuilding capacity and dismantled it again within an equally short period. The second is that, despite the obvious efficiency of the US shipbuilding industry, it could not compete commercially in the world shipbuilding market. In the 1930s, and again during the post-war era, the US government provided construction subsidies to US merchant shipbuilders to offset the difference between the construction in American and foreign yards. At different times the levels of subsidy varied from 30% to 50% of the cost of construction.[8] Like Scandinavian shipyards, high productivity was not enough, though the isolation of the industry from international market forces and the focus on the very different craft of warship building make it very difficult to judge what the underlying competitiveness of the industry really was.

The Japanese shipbuilding industry

The rise of Japan as the dominant force in the world shipbuilding market provides yet another example of the shipbuilding growth model. Like Britain, Japan is an island nation and the growth of the economy after the Second World War made intense demands on seaborne transport. Initially the development of the Japanese shipbuilding industry drew strength from a coordinated shipping and shipbuilding programme. For example, Trezise and Suzuki comment:

> In the early post war period … the industries selected for intensive governmental attention included the merchant shipping industry. A planned shipbuilding programme for the merchant fleet was instituted during the occupation, in 1947, and is still being pursued essentially along the lines laid down at this time. Each year the government – that is to say the Ministry of Transport – in consultation with its industry advisors in [the] Shipping and Shipbuilding Rationalisation

> Council – decides on the tonnage of ships to be built, by type (tankers, ore carriers, liners, and so on) and allocates production contracts and the ships among the applicant domestic shipbuilders and shipowners. The selected shipping lines receive preferential financing and in turn are subject to close government supervision.[9]

During the period 1951–72, 31.5% of the total loans made by the Japan Development Bank were for marine transportation. This domestic shipbuilding programme undoubtedly contributed to the success of the Japanese shipbuilding industry, but the Japanese merchant marine never achieved the degree of market domination that the British merchant fleet had established in the nineteenth and early twentieth centuries. One reason was that by the 1960s the growth of flags of convenience and high Japanese costs meant that much of the fleet was chartered in from independent shipowners, especially in Hong Kong, under *shikumisen* contracts. Figure 15.2(d) shows that, although the market share of the Japanese fleet increased from 1% in 1948 to 10% in 1984, this fell well short of the 50% market share achieved by Japanese shipbuilders in the 1980s.

There are two explanations for this. One is that the Japanese flag was uncompetitive and many of the ships commissioned for the carriage of Japanese trade were purchased by international owners in Hong Kong or Greece and registered under flags of convenience. In 2005, 89% of the Japanese-owned fleet was operating under foreign flags, so the low shipping market share in Figure 15.2(d) is misleading. The second is that the Japanese shipbuilding industry became highly competitive and built for the emerging export market, particularly the market for large tankers and bulk carriers bought by independent European, US and Hong Kong shipowners. Their strategy was similar to their approach in other major industries. They built large modern shipyards and used the domestic market as the volume baseload for selling highly competitive ships into the export market. The new facilities had building docks capable of mass producing VLCCs and large bulk carriers at a rate of 5–6 vessels per annum. Production engineering, strict quality control, sophisticated material control systems and pre-outfitting were all used effectively to reduce costs and maintain delivery schedules. Some shipyards were built in the main industrial centres (e.g. the Mitsui Shipyard at Chiba, the IHI Shipyard at Yokohama and the Kawasaki Shipyard at Sakaide), while others were in remote areas (e.g. the Mitsubishi Shipyard at Koyagi).

During the 1990s Japan was challenged by South Korea, and its shipyards faced high labour costs and a strengthening currency. However, the Japanese shipyards were remarkably successful in maintaining their competitive position despite these disadvantages. Unlike the European yards which focused on high value-added ships, such as cruise liners, the medium-sized Japanese yards developed a very successful business building bulk carriers, generally regarded as the simplest of vessels. By employing production planning, production engineering and subcontracting they increased productivity and in 2005 Japan was still the market leader, producing 16.1 million gross tons of ships, compared with South Korea's 15.4 million gross tons (see Table 15.1).

The rise of South Korean shipbuilding

The entry of South Korea into the world shipbuilding market was, like that of its near-neighbour Japan, the result of a carefully planned industrial programme. In the early 1970s a major investment programme was planned, starting with the construction of the world's largest shipbuilding facility by Hyundai at Ulsan, designed in the UK, with a 380 metre dry dock capable of taking vessels up to 400,000 dwt. Later in the decade a second major facility was built by Daewoo, with a 530 metre dry dock capable of taking vessels up to 1 m.dwt. This started production in the early 1980s. Two other South Korean industrial groups, Samsung and Halla Engineering, built new shipbuilding facilities and by the mid-1990s South Korea had a 25% market share and four out of the world's five largest shipyards.[10] By 2005 South Korea had matched Japanese output in gross tons and overtaken Japan in cgt terms.

Perhaps the most interesting aspect of the South Korean shipbuilding development model is that from the outset it focused on the export market. This is clearly visible in Figure 15.2(e). Unlike Britain or Japan, which had, to different degrees, built up their shipbuilding capacity to service domestic customers, from the beginning Korea targeted the export market. Whilst South Korea has a rapidly growing economy, this remains very much smaller than the Japanese or European in terms of trade volume. The success of Korean shipbuilding almost certainly reflects the growing internationalization of the bulk shipping industry where, with the development of international registries and multinational companies, the link between ship, shipowner and national interest is increasingly tenuous. The industry was also much more focused, with a small number of very large yards focusing on large vessels for the international market. In 2005 Hyundai, Samsung and Daewoo were the world's three largest shipbuilders and accounted for two-thirds of South Korea's production.

The Chinese shipbuilding industry

In the shipbuilding market there is always a new entrant preparing to challenge the market leaders and in the 1990s China emerged as the next challenger. However China's approach was very different from that of South Korea. It has a long history of shipbuilding, stretching back to the fifteenth century and the construction of Admiral Zheng He's famous treasure ships, some of which were reportedly up to 540 feet long, with a capacity of 1,500 tons, though the size of these ships is controversial.[11] During the 1980s and early 1990s China had an active shipbuilding industry, with many domestic yards and a full infrastructure, including research institutes. Some ships were built for export, at very competitive prices, but the volume of business was limited and Chinese-built ships generally sold at a discount in the second-hand market.

The major expansion of China's shipbuilding capacity gathered speed in the late 1990s, as part of the Chinese industrial expansion. Initially the expansion came from existing shipbuilding facilities, with just one major new shipyard built, the Dalian New yard. However expansion of the existing Chinese shipyards allowed shipbuilding production to increase from 784,000 gt in 1995 to 5.7 million gt in 2005 and 11 million gt in 2007. At that stage over 90 established shipyards in China were building a wide range of vessel sizes and types and about 30 major new shipyards were under construction, or at an advanced stage of planning. Shipbuilding is in three areas spread around the Bohai Rim in the North, Shanghai, and with a few shipyards in the Pearl River in the South. It is widely anticipated in the shipbuilding market that the Chinese industry will take a leading share of the world market within the coming decade.

Other countries

Eastern Europe is a long established participant in the world shipbuilding market, with a development pattern closer to western Europe than Asia. In fact Table 15.1 shows that between 1980 and 2005 eastern Europe's production was steady at about 1.3 million gt per annum. Poland increased its output, but others such as Ukraine declined under pressure from rising wage rates and exchange rates. However, in 2008 a number of new shipbuilding countries were emerging in Asia, including Vietnam, the Philippines and India, whilst Russia and Pakistan are developing plans to enter the shipbuilding market.

Conclusions from a century of shipbuilding development

This short overview of the evolution of shipbuilding suggests that the business lends itself to a few dominant producers, with a succession of new challengers creating a highly competitive market environment which drives technical change. It also suggests that the market focus on domestic customers in the first half of the twentieth century gave way in the second half to the broader role of the export market which exists today. However, the individual regions dealt with this complex commercial environment in very different ways.

Britain built its supremacy early in the century on its large home market which allowed it to develop craft-based skills, but then failed to evolve technically, leaving the industry vulnerable to recessions and adverse currency movements. The European and Scandinavian yards were more effective in improving their production technology, but ultimately this could not overcome their high labour costs and aggressive competition from efficient Asian yards using the same techniques. Many European yards closed, but others developed successful niche markets and survived, leaving Europe with a substantial market share in the high value-added ships. Japanese yards were very successful in developing sophisticated production systems, but also drew commercial strength from their strong home market which acted as a base for winning export orders. As South Korean competition and Japanese labour costs increased, the Japanese yards adopted a very different defensive strategy from the Europeans, concentrating on mass-producing highly engineered bulk vessels, especially dry bulk carriers. Starting with low labour costs and large, efficient facilities, South Korea was the first to build its business primarily around the export market, with a product range focused on large vessels. China followed on with many more yards but much the same formula.

So there are many permutations, but the common theme is that newcomers combine low labour costs and decent capital investment with the capacity to work hard and move with the market. Whatever the technology, shipbuilding remains a business where someone has to get their hands dirty.

15.3 SHIPBUILDING MARKET CYCLES

From a commercial viewpoint, these changes in the regional structure were accompanied by long periods of intense competition as each new entrant, Continental Europe, Scandinavia, Japan and then South Korea, fought for market share. This harsh commercial climate was intensified by the cyclical nature of shipbuilding demand. Over the last century there have been 12 separate cycles which are charted in Figure 15.3 and summarized in Table 15.2. The left-hand half of Table 15.2 shows the peak of each cycle, the number of years to the next trough, and the percentage fall in world shipbuilding output at the trough, whilst the right-hand half shows the same information for each trough and upswing. The length of each cycle from peak to peak is shown in the last column.

The average cycle lasted 9.6 years from peak to peak, but the spread was very wide, ranging from 5 years to over 25 years. The average reduction in output from peak to trough was 52%, and the maximum peacetime reduction was 83% during the recession of the early 1930s. As with the shipping cycles we discussed in Chapter 4, these cycles were not just random fluctuations designed to make life difficult for the shipyards, but are part of the mechanism for adjusting shipbuilding capacity to the changing needs of world trade. During the period since 1886 there were four periods of change which drove this process.

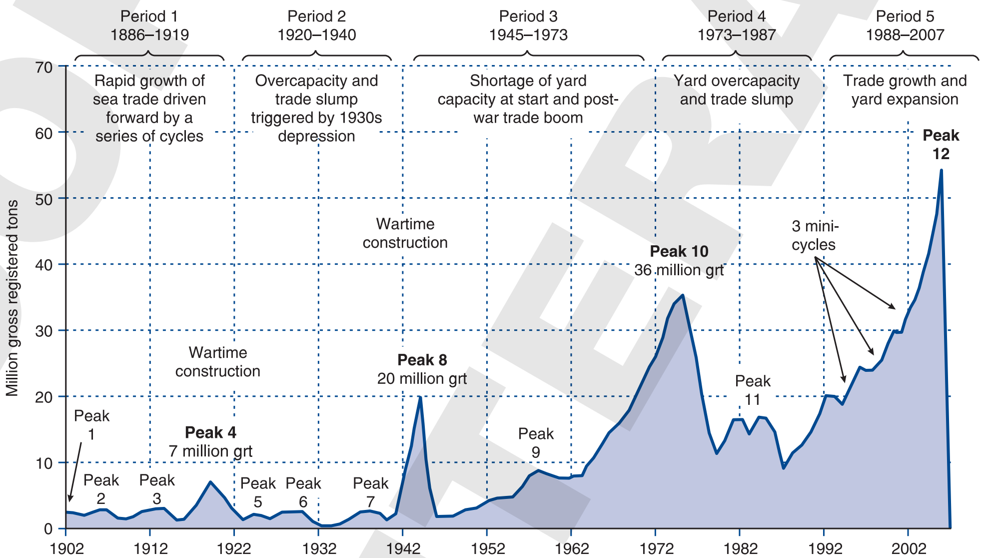

Figure 15.3
World shipbuilding launches, 1902–2007
Source: Lloyd's Register of Shipping

Table 15.2 Shipbuilding cycles, 1902–2007

Cycle no	Cyclical peak and downswing				Cyclical trough and upswing				Full cycle years
	Year	Peak '000 grt	Peak to next trough years	%	Year	Trough '000 grt	Trough to next peak years	%	
1	1901	2,617	3	–24%	1904	1,987	2	47%	5
2	1906	2,919	3	–45%	1909	1,602	4	108%	7
3	1913	3,332	2	–59%	1915	1,358	4	426%	6
4	1919	7,144	4	–77%	1923	1,643	1	37%	5
5	1924	2,247	2	–26%	1926	1,674	4	73%	6
6	1930	2,889	3	–83%	1933	489	5	520%	8
7	1938	3,033	2	–42%	1940	1,754	4	1057%	6
8	1944	20,300	3	–90%	1947	2,092	11	343%	14
9	1958	9,269	3	–14%	1961	7,940	14	352%	17
10	1975	35,897	4	–67%	1979	11,787	3	47%	7
11	1982	17,289	5	–43%	1987	9,770	20	534%	25
12	2007	61,900	Based on the orderbook output likely to double by 2010						
Analysis of cycles									
Average length			3.1	–52%			6.5	322%	9.6
Standard deviation			0.9	25%			5.9	313%	6.4

Source: Compiled by Martin Stopford from Lloyd's Register and other sources

The first period, which is only partly shown in Figure 15.3, lasted from 1886 to 1919 and was a period of 'cyclical growth', with output increasing with each peak, interspersed by periods of recession. As we saw in Chapter 1, this was a period of very rapid technical change as steel-hulled steamships of rapidly increasing size and efficiency replaced sail. The shipbuilding cycles seem to have followed the world trade cycles and the level of output responded sharply to each change in the market. During this period the cycles drove investment by drawing in a flood of new ships with the latest technology during the market peaks and then driving out the old and technically obsolete vessels during the lengthy troughs – a crude but effective way of adopting new technology, while deriving the maximum economic value from the existing stock of ships.

During the second period, from 1920 to 1940 the industry faced persistent market problems dominated by the 1931 depression. The period started with overcapacity because Europe had expanded its shipyards to replace wartime shipping losses and in 1919 the industry was capable of producing 7 million grt of ships a year, three times the underlying level of peacetime demand. In addition, the war had convinced some European governments that it was important to have a domestic maritime capability, and they devoted public funds to building up their industries. When combined with volatile trade, this capacity pressure contributed to two decades of almost continuous problems in the shipping market, with slumps interspersed by periods of moderate market improvement. Contemporary press statements illustrate the mood of the period. For example:

> In the early part of 1924 it was generally believed that depression in the shipbuilding industry had touched its lowest point. It could not be imagined that the

> signs of revival would be so short lived … the immediate outlook is now exceedingly grave.[12]
>
> The year 1926 was one of great depression in shipbuilding.[13]
>
> As far as shipbuilding is concerned 1930 has been a most trying time … only one berth in four occupied.[14]
>
> The year 1935 in the shipbuilding industry may be regarded as a year of marking time with only one-third of the greatly reduced capacity being utilised.[15]

In Britain, which dominated the shipbuilding market at that time, shipbuilding employment fell steadily from 300,000 in 1920 to 60,000 in 1931.[16] Unlike the pre-war period, this was not simply cyclical unemployment that was soon absorbed by the next boom; it was a steady downward trend. Broadly speaking, the 1920s were dominated by removing the surplus shipyard capacity. There was intense international competition, indicated by ‘incidents’ such as a Furness Withy order placed in Germany in 1926 at a price 24% below the lowest British price with marginal overhead recovery. Then in the 1930s the Great Depression undermined demand and resulted in an 83% fall in shipbuilding output between 1930 and 1933, the biggest of any of the 12 cycles shown in Table 15.2.

The third period, covering the period from 1945 to 1973, was one of exceptional growth. Although the industry started with output of 7 million grt (more than six times the pre-war level of demand – Figure 15.3), three-quarters was built under the US wartime construction programme, and at the end of the war the US effectively withdrew from the world shipbuilding market. Since war damage had reduced the output of the German and Japanese industries, there was an acute shortage of shipbuilding capacity. This persisted into the late 1950s and, for a few years it was a seller’s market. It was not until 1958 that a major economic recession in the US, and over-ordering of tankers following the Suez closure in 1956, precipitated the first post-war shipbuilding depression, which lasted into the early 1960s. World shipbuilding output fell from a peak of 9 million grt in 1958 to a trough of 8 million grt in 1961 (Figure 15.3). By 1963, however, trade grew rapidly as Europe and Japan modernized their economies, bringing a steady upward trend in orders that resulted in an unprecedented expansion of shipbuilding capacity to 36 million grt in 1975 – in a single year the industry produced more shipping tonnage than was built in the whole period between the two wars.

The fourth period, which started after the 1973 oil crisis and continued until 1987, was grim for the shipyards. Trade growth was sluggish, volatile and unpredictable. The pace of technical obsolescence slowed, with few major advances in ship technology and a more stable size structure, especially in the tanker fleet. Shipyard overcapacity was increased by the entry of South Korea as a major shipbuilder. In these circumstances the shipbuilding industry swung sharply from rapid growth to deep recession.

At the start of this period in 1975, world shipbuilding output peaked at 36 m.grt, representing 50–100% overcapacity. After two decades of continuous growth, seaborne trade first stagnated and then abruptly declined, particularly in the oil sector, and the demand for new ships fell sharply from the pre-1975 level. This already difficult situation in the shipbuilding market was further aggravated by the entry of South Korea with a bid for a major share of the world market. As a result there was a three-way battle between Japan, Korea and western Europe for a share of the diminishing volume of orders.

During the late 1970s the restructuring of shipbuilding capacity started. Many shipyards were closed and output fell by 60% to 14 million grt in 1979. The time taken for this decline to occur reflects the large orderbook held by the world shipbuilding industry in 1974. A recovery in the world economy during the late 1970s brought renewed trade growth which, combined with the sizeable reduction in world shipbuilding capacity, was sufficient to produce a brief recovery in the world shipbuilding market. Laid-up tonnage fell to a minimal level, and during 1980–1 the world shipbuilding industry enjoyed a brief revival. However, following the brief market peak in 1980–1, demand again declined, fuelled by the collapse of world seaborne trade which fell from 3.8 bt in 1979 to 3.3 bt in 1983, a reduction of 13%. Severe downward pressure on shipbuilding prices and new ordering drove shipyard output in 1987 to a trough of 9.8 million gross tons, the lowest since 1962 and a decline of 73% from the 1975 peak. Employment in the world shipbuilding industry halved[17] and many of the marginal shipyards were closed. In 1986 new ships could be bought for prices not far above the cost of materials, and even the highly competitive South Korean shipyards announced major losses.

Following this appalling episode, the fifth period, from 1987 to 2007, saw an equally dramatic revival of world shipbuilding capacity as the expansion of Asia and China generated a recovery in trade, and this coincided with more capacity being needed to replace the ageing fleet built during the 1970s construction boom. By 1993 the volume of output had doubled to 20 million gt and by 2007 it had reached 62 million gt, five times the 1987 trough. In the process South Korea had consolidated its position as the leading shipbuilder, with China positioning itself in a bid for market leadership, opening the way for the next phase of competition.

Which leaves the question of how this fifth period will develop. Readers may know the answer to this, but in 2007 investors were still not sure. Some saw the cycle ending with a lengthy period of overcapacity, but others believed it was a new situation and still had a long way to go. Such uncertainty is the main reason why shipbuilding, like shipping, is a risky business. In a century of shipbuilding it is difficult to find many 'normal' years. The 12 cycles may have averaged 9.5 years in length, but they came in all shapes and sizes, driven by long-term swings in trade growth, combined with capacity imbalances caused by shipping market cycles. Add a constantly changing competitive structure and we can only conclude that shipbuilding is not a business for the faint hearted.

15.4 THE ECONOMIC PRINCIPLES

Causes of the shipbuilding cycle

It is easy to understand why the shipbuilding market is so volatile. The market mechanism uses the volatility to balance the supply and demand for ships, whilst at the same time drawing in new low-cost shipbuilders and driving out high-cost capacity. This mechanism is basically unstable, as can be illustrated with a simple example. If the merchant fleet is 1,000 m.dwt and sea trade grows by 5%, an extra 50 m.dwt of ships are needed. If, in addition, 20 m.dwt of ships are scrapped, the total shipbuilding demand is 70 m.dwt. But if sea trade does not grow, no extra ships are needed and shipbuilding demand falls to 20 m.dwt. So a 5% change in trade produces a 70% change in shipbuilding demand. Five per cent changes in seaborne trade are common, and sometimes much larger swings occur (see Figure 4.2).

This basic instability is reinforced by two other characteristics of the shipbuilding market. Because new ships are not delivered until several years after they are ordered, investors really have no way of knowing whether they will be needed or not, and, in the absence of believable forecasts, market sentiment often takes over. As a result, ordering often peaks at the top of a cycle, but by the time the ships are delivered the business cycle is already driving demand down and the flood of new ships increases the surplus and prolongs the downturn. This process is reinforced by the inflexibility of modern shipyard capacity. Because it is difficult for the shipyards to adjust output, they often drop their prices to encourage speculative ‘counter-cyclical’ orders and liquid investors often take advantage of the bargains. This combination of demand-side opportunism and supply-side inflexibility tends to slow the market adjustment process, leading to some very long shipbuilding cycles.

Shipbuilding cycles are, of course, close relatives of the shipping cycles discussed at length in Chapter 3, but with special features due to the industry’s different economic structure. Volk, in a lengthy study of shipbuilding cycles, takes much the same view, concluding that: ‘Shipbuilding is characterised by heavy fluctuations of demand over the short-term and by high inertia of supply. This fact leads to brief phases of prosperity and long phases of depression.’[18] In one sense, this is all there is to be said. Until the demand for ships becomes regular or shipyards find a way of adjusting their capacity when it is not needed, the shipbuilding industry must live with long cycles. From an economic perspective, however, this is just the beginning of our study. In the previous section we saw that over the course of the last century this simple mechanism has produced radically different commercial environments. Applied economists in shipping or shipbuilding who understand the underlying relationships can recognize the way a particular market is likely to develop. This is what we will focus on in the remainder of this chapter, starting with the general economic relationships and then going on to a discussion of the microeconomic aspects of shipyard production.

Shipbuilding prices

Shipbuilding cycles are controlled by the price mechanism, and this is where we must start. Shipbuilding is one of the world’s most open and competitive markets. Shipowners invariably take several quotations before ordering a ship, and there are not the usual trade barriers in the form of distance, transport costs and tariffs to provide shipbuilders with a protected home market. Prices swing violently upwards or downwards depending upon the number of shipyards competing for a given volume of orders.

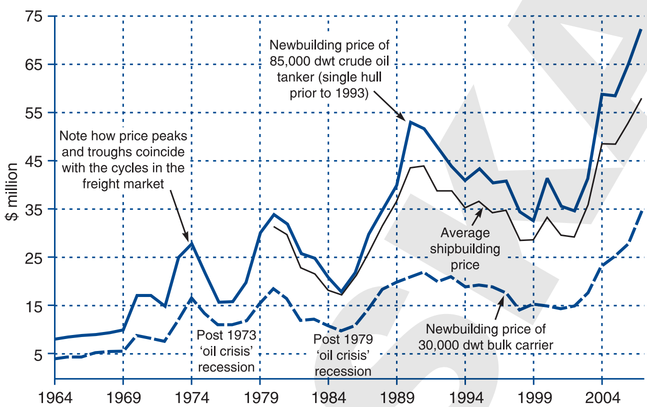

Figure 15.4
World shipbuilding prices, 1964–2007
Source: compiled from several sources including Fearnleys, CRSL

This point can be illustrated by following the development of the contract price for a 30,000 dwt bulk carrier and an 85,000 dwt tanker during the period 1964–2007 (Figure 15.4). Between 1969, when a 85,000 dwt tanker cost \$10 million, and 2007, when it cost \$72 million, we see price fluctuations on a scale which few capital goods industries can match. The price of the ship almost trebled to \$28 million in 1974, fell to \$16 million in 1976, increased to \$40 million in 1981, fell to \$20 million in 1985, increased to \$43 million in 1990 and then edged down to \$33 million in 1999, before more than doubling to \$72 million in 2007. Faced with such volatile prices, it is hardly surprising that shipbuilders and their customers have difficulty in planning for the future. Because price movements for different types of ships are closely correlated – when the price of tankers goes up, so does the price of bulk carriers and ro-ros – there is no real refuge in finding market 'niches'. Most shipbuilders can compete for a wide range of ship types and, if their orderbook is short, will bid for ships they would not normally consider building.

These price fluctuations, and the large sums involved, make the shipbuilding market a tricky place to do business, and shipyards have to be very clever in their price strategy. In rising markets shipyards run the risk of filling their orderbook with ships contracted at low prices, only to find that by the time they deliver the ships, prices have doubled and costs have also increased. This happened to some shipyards in 2003 when they sold VLCCs for \$70 million, only to find when they delivered them in 2006 that their value had escalated to \$125 million and rising steel prices meant they had made a loss. Investors face the opposite problem – investors who ordered new tankers at the top of the cycle often found that by the time their tankers were delivered their value has slumped. But, of course, they can never be sure.

Shipbuilding demand, supply and the price model

In this highly competitive market, the price at which a new ship is sold depends on the trade-off between the demand for new ships (i.e. the orders placed in a year) and the available supply of newbuilding berths for that particular ship type. If there are more potential orders than berths, the price rises until some investors drop out, and if there are more berths than orders, prices fall until new buyers are tempted into the market.

So explaining price movements depends on understanding what determines the demand for building slots and the supply of berths.

Because shipbuilding is a capital goods industry selling to an international market, its price model is more complex than the freight rate model we discussed in Chapter 4. However, the experience of the last two decades tells us that, for a given price, shipbuilding demand is influenced by shipping freight rates, second-hand prices, market expectations and sentiment, and liquidity and credit availability, while shipbuilding supply is influenced by available shipbuilding berths, shipyard unit costs, exchange rates, and production subsidies.

The way *freight rates* influence the demand for new ships is easy to understand – as earnings increase, ships become more profitable and shipowners want to increase the size of their fleets. The longer high freight rates persist, the more cash they have to do this. Historically there has been a close relationship between peaks in the freight market and peaks in ordering new ships. However, the time-lag between ordering and delivery and the long service life of ships mean that current freight rates are only a partial influence on new prices. The second major influence is *second-hand prices*. Potential investors want ships immediately, so initially when freight rates rise they try to buy second-hand ships, bidding up prices. Only when second-hand prices increase do newbuildings start to look a better deal and the rise in second-hand prices works through into newbuilding prices (note also that at high freight rates old ships which would otherwise have been scrapped continue trading, maintaining the supply). Because the new ships do not arrive immediately, they are not a precise substitute, which means that how keen investors are to order new ships depends on *market expectations*, the third major influence on newbuilding demand. A convincing 'story' about why the future will be prosperous can be very important and explains bouts of heavy ordering when freight rates are low, as happened in the early 1980s, or for bulk carriers in 1999. Finally, the *availability of credit* allows owners to leverage up their internally generated revenue, and broadens the market to include many entrepreneurial shipowners without large sums of capital.

Turning to shipbuilding supply, there are also four influences to consider. Firstly there is available *shipyard capacity*. In the short term, supply depends on how many shipyards are operational, their forward orderbook and how many berths they are willing to sell at prevailing prices. In physical terms, production facilities place an upper limit on output, whilst productivity determines the number of ships built. But the available capacity at a point in time also has an economic dimension. Shipyard *unit costs* depend on labour costs, labour productivity, material costs, exchange rates, and subsidies (which determine whether the shipyard is able to sell at prices which result in an acceptable return on capital). It does not matter how many facilities a shipyard has, or how high its productivity is – if the price on offer does not cover its costs, it will not bid. So capacity is not an absolute, it is a function of price. *Exchange rates* are enormously important because they determine the cash the shipyard receives in local currency. A 5% weakening of the domestic currency is equivalent to a 5% increase in the dollar price. The exception is if the shipyard is prepared to make a loss, for example to avoid cutting the workforce. This is an expensive strategy, but may be the cheapest option if the yard wants to keep its skilled workforce intact until the market recovers. Finally, local or state governments may decide to offer *production subsidies* to support their shipyards through a difficult patch, artificially flattening the supply curve.

The whole process is dynamic. Across the market shipowners ponder possible future earnings and whether it is better to buy a prompt second-hand ship, order a new ship which will not arrive for several years, or sell a second-hand ship, or do nothing. Depending on all these factors, they make their bid and if market sentiment is strong many others will be thinking along the same lines. Since owners are competing for limited second-hand ships or newbuilding berths, prices start to rise and vice versa. The speed with which this can happen is illustrated by price movements during the dry bulk boom in 2007. In January a five-year-old Panamax bulk carrier cost $37 million and a newbuilding for delivery in 2010 was $40 million. But freight rates surged during the year and by December the price of the second-hand ship had almost doubled to $72 million, whilst the new price had increased by 37% to $55 million. Clearly the market had made a judgement that the value of a prompt second-hand ship had increased considerably more than the value of a ship which would not arrive for three years.

On the other side of the negotiation, the shipyards are anxiously weighing up how many berths to offer for sale. Again price is the focus. If their orderbook is very short they may be under pressure to sell berths immediately, which puts them in a weak negotiating position and they may have to drop their price to attract a buyer. But if they have a long orderbook they must decide whether to sell the berths now or wait in the hope that prices will rise. For example, if they are confident about the future they may decide not to offer any berths, in the hope that the price will rise. That means investors are competing for fewer berths, pushing up the price. For this reason expectations are just as important in determining the supply of berths for sale.

Finally, we can define the time-scale for adjusting supply. In the *short term*, either the shipyard berths are full and supply is inelastic or some shipyards have empty berths and are desperate to fill them, leading to price cutting. In the *medium term* (two or three years' time) the yards have berth spaces and the price depends on the level of demand relative to the available berths. If there is a shortage, raising prices brings in the high-cost yards, expanding supply. In the *long term*, shipbuilders which are profitable at current prices can expand their capacity and unprofitable builders can close uneconomic yards. These are the general factors involved in the shipbuilding price model and in the rest of this section we will look more rigorously at how it works.

The shipbuilding supply function

The first question is how many ships will be supplied or, in other words, how much capacity is available. The answer is provided by the *shipbuilding supply function*.[19] A typical short-term supply function (S1) is shown in Figure 15.5, which illustrates the relationship between the capacity available at a point in time, shown on the horizontal axis in million cgt of ships supplied, and the price. The bars show the capacity available in each of the shipbuilding areas, China, South Korea, Japan and Europe. They all have different cost levels. In China the average ship costs $34 million, compared with

$36 million in South Korea, $38 million in the small Japanese yards, and $43 million in the big Japanese yards. The European yards have costs of $52 million, but they mainly build specialized ships so that is what bulk ships would cost if they switched capacity into the bulk market. Assuming yards only bid when they can at least break even, the available capacity increases from 5 million cgt at a price of $33 million for a standard ship to 22.5 million cgt at $52 million. The supply curve (S1) links these points. Note that when demand hits 25 million cgt and all the yards are bidding, there is an auction for any remaining berths that the yards have held back in the hope of such a situation arising. At this point the supply function is nearly vertical.

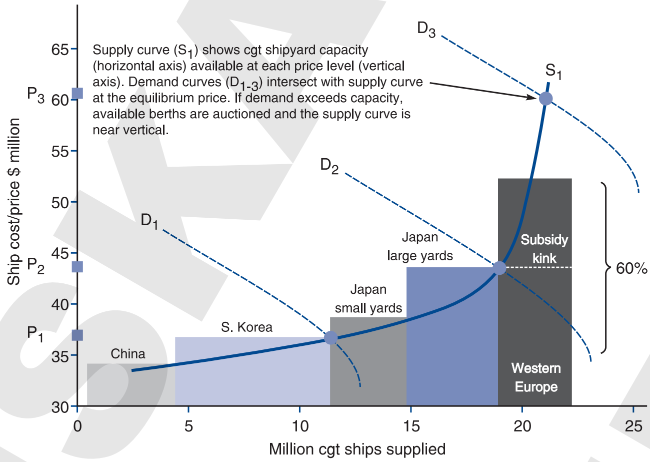

Figure 15.5
Short-run bulk shipbuilding demand and supply functions
Source: Martin Stopford 2007

The short-term shipbuilding demand function

The *shipbuilding demand function* shows how many ships investors will want to buy. Three examples of demand functions are shown in Figure 15.5, labelled D1, D2 and D3. For example, the demand curve D2 shows that if the ship price is $50 million investors will only order 14 million cgt, but if the price drops to $35 million orders will increase to 24 million cgt. This demand curve implies that price does have an effect on ordering activity, and economists analyse this degree of responsiveness by calculating the demand curve's *price elasticity* which is defined as the percentage change in demand divided by the percentage change in price:

$$e_{sbp} = \frac{\%\ \text{change orders}}{\%\ \text{change price}} \tag{15.1}$$

If the price elasticity is greater than 1 demand is price elastic, and if it is less than 1 it is price inelastic. In this example demand is relatively price elastic, but it is very difficult to be sure because so much depends on expectations. If shipping investors have plenty of funds and positive expectations they may order the same amount of ships regardless of price, in which case the demand curve would be vertical. But the usual assumption is that as prices rise the financial case for investment weakens and only those investors with a very profitable market opportunitiy or an urgent need for new ships are willing to pay. Others prefer to take their chances and wait until prices fall, by perhaps extending the life of their existing ships, especially since rising prices are generally associated with a long delivery date. Conversely, as the price falls the financial case for new orders improves and the demand for new ships increases until, at some point, constraints on finance or market expectations limit the number of new orders placed and no further ships are ordered however low the price falls.

Shipbuilding market short-term equilibrium

Putting the supply and demand curves together, we have a sort of battlefield in which yards with different cost levels compete for business at the best price they can negotiate with their customers, the shipowners. There always seems to be a spectrum of yards with different cost levels and market cycles forming the backdrop to a running battle between low-cost new entrants and the established builders. Five hundred years ago it was the Dutch newcomers versus the Venetians. Later it was the Japanese newcomers versus the Europeans, then the South Koreans versus the Japanese. Over long periods shipbuilding cycles work like a pump, sucking the low-cost capacity in and pumping the high-cost capacity out. When demand is strong enough at D3 in Figure 15.5 even the high-cost yards can fill their berths and survive, limping from one peak to another. But they are vulnerable to recessions, and if demand falls to D2 the highest-cost yards will lose money and eventually give up, making way for the low-cost newcomers which enter the market because at D2 demand levels they can make a very decent profit.

As the low-cost yards make more profits they start to expand, moving the supply curve to the right and undermining the position of the high-cost yards even more. Meanwhile, the newcomers which entered the market during the boom when prices were at D2 have their own obstacles to overcome. Some will be small established yards moving into the international market place, and they will have to establish a reputation for quality and delivery that will carry them through recessions when orders are hard to get. Others will be 'greenfield' yards established to develop a country's industrial base. In the latter case the new shipyards carry high capital costs and may need to import specialized materials and marine equipment during the startup-up phase. Governmental financial aid is sometimes available to assist the development of upcoming yards. But all must find a way to compete. No wonder the shipbuilding market feels like a battlefield.

In the short run, equilibrium is achieved at the price where the demand for new ships equals the supply offered by shipbuilders. This is illustrated in Figure 15.6. At a price of \$1,000 per cgt the 32 million cgt offered by the shipyards exactly matches the 32 million cgt the owners are willing to buy. If the shipyards try to increase prices to \$1,500 per cgt, demand falls to only 20 million cgt, leaving shipyards with 10 million cgt of unutilized capacity. Conversely, at \$750 per cgt the owners would want to order 37 million cgt, but the shipyards would offer only 30 million cgt of ships. There would be a shortage of berths and the price would be bid up. In this way the price mechanism matches existing capacity to demand on a day-to-day basis.

In the longer term, the shipyards respond to the market cycles by adjusting capacity. The low-cost shipyards which are profitable even in weak markets build new facilities, or expand existing ones, moving the supply curve to the right. For example, in Figure 15.7(a) we see an initial supply function (S1) with the equilibrium price of P1. At this price the low-cost shipyards make excess profits, but as they add new capacity, the supply curve moves to the right and at this increased level of output the equilibrium price falls from P1 to P2. As supply expands and prices fall, the high-cost yards start to make losses and eventually some of them will close or diversify – the market has replaced high-cost yards with low-cost yards, which is exactly what the market process is all about. Through this ratchet process capacity expands and the competitive yards gradually drive out the inefficient ones, making better use of economic resources.

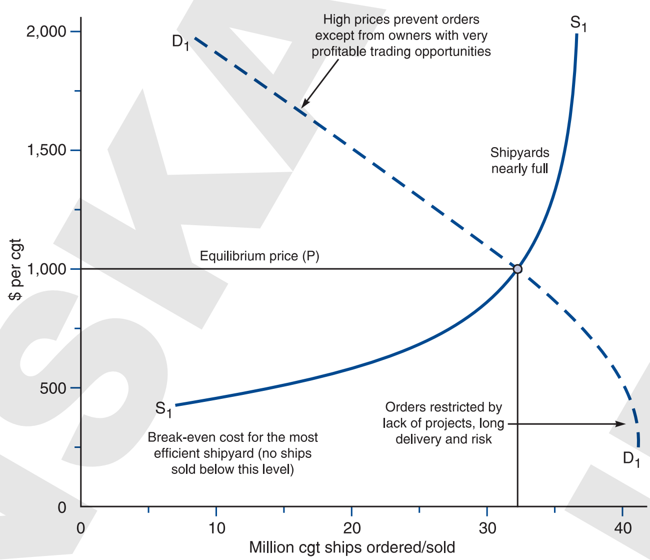

Figure 15.6
Shipbuilding supply and demand functions
Source: Martin Stopford 2007

But demand also plays a part in this market adjustment process. For example, the demand curve D1 in Figure 15.7(b) represents a situation where ship demand is growing at 3% per annum, requiring Q1 cgt of new ships (about 33 million CGT) at an equilibrium price of P1. But if total ship demand growth slips to a new trend of 2.8% per annum, only 30 million cgt of deliveries are needed each year and the demand curve

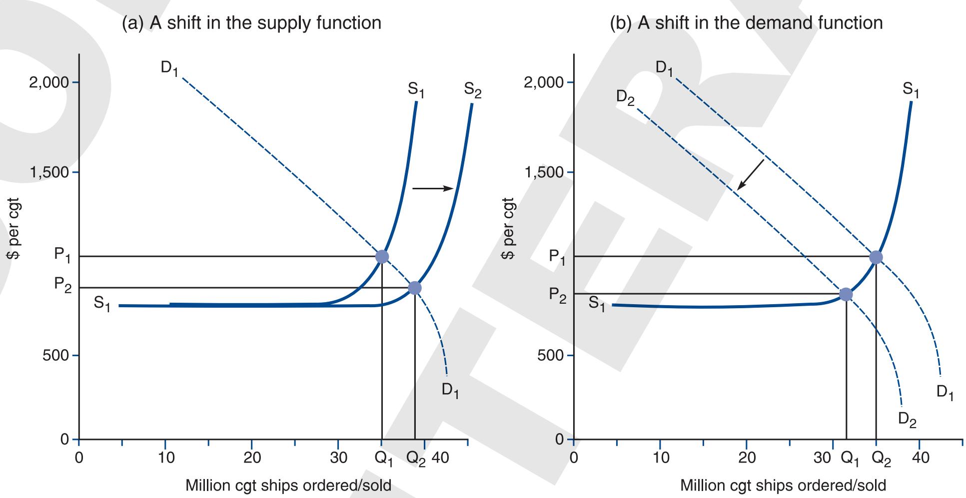

Figure 15.7
The effect on price of movements in shipbuilding supply and demand
Source: Martin Stopford 2007

moves left to D2. As a result the equilibrium price falls to P2. At this lower price the high-cost shipyards cannot cover their costs and eventually they close.

Putting the supply and demand dynamics shown in Figure 15.7 together, we have the basic model which drives the shipbuilding cycles we reviewed in Figure 15.3. During periods of expansion such as the long upswing from 1963 to 1977, or from 1988 to 2007, the demand curve is constantly moving to the right, with the shipyard capacity unable to keep up. As demand surges ahead so do prices, but when supply surges ahead, prices slump. The shape of the curves makes volatility normal.

The long-term shipbuilding demand

The volatility of shipbuilding demand means that planning ahead is a priority for the shipbuilding and the marine engineering industries, and that calls for long-term forecasts of demand for new ships. The long-term demand forecasting model splits shipbuilding demand into two parts: *expansion demand* (X) which is the tonnage of new ships needed to carry trade growth in a given period, and *replacement demand* (R), which is the tonnage of new ships required to replace ships scrapped or removed from the fleet in the same period. Both are important. For example, between 1963 and 2005 expansion demand accounted for 57% of demand for new merchant ships and replacement demand for 43%. Using this model, which is discussed further in Appendix A, shipbuilding demand forecasts are made by estimating future values of X and R.

This long-term shipbuilding demand forecasting model is given by

$$SBD_t = X_t + R_t \tag{15.2}$$

where

$$X_t = \frac{\partial DD_t}{P_t} = \frac{DD_t - DD_{t-1}}{P_t} \tag{15.3}$$

$$R_t \approx F_{t-\sigma} \tag{15.4}$$

Here, for forecast year t, SBD is the requirement for new ships (in deadweight or compensated gross tonnage terms, for example) X the expansion demand, R the replacement demand, DD is the tonnage of cargo transported, P is ship productivity (measured by dividing weight of cargo delivered by ship deadweight), F is the fleet of ships by year of delivery, and σ is the economic life of ship in years (e.g. 25 years).

Shipbuilders often use this basic model to forecast shipbuilding requirements for their own strategic planning and as a basis for international discussion of capacity levels. Expansion demand is estimated from trade growth and the incremental shipping capacity needed to carry it is calculated by applying the productivity factor P_t. So if trade is projected to grow by 70 million tonnes and the productivity is 7 tonnes per deadweight per annum, the expansion demand forecast for year t would be 10 million deadweight. Forecasting replacement demand involves two steps. First, the economic life of the fleet is determined and its age profile is used to estimate the tonnage of ships likely to be replaced in the forecast period. For example, if tankers have an expected economic life of 25 years and the fleet has 10 m.dwt of tankers 25 years old, the expected replacement demand would be 10 m.dwt. Put the two together as shown in equation (15.2) and the forecast shipbuilding demand in year *t* is 20 m.dwt.

Like so many aspects of shipping economics, the long-term shipbuilding model is simple in principle, but complex in practice. The model is illustrated in Table 15.3 which calculates shipbuilding demand from expansion demand and the replacement demand. We start in column 1 with a memo item, the actual growth of the world fleet between 1990 and 2006. The total at the bottom of this table shows that the fleet increased by 308 m.dwt during this period. This gives us a base in reality with which to compare our shipbuilding demand calculations. Next, in columns 2–4, we calculate the expansion demand. Column 2 shows total world trade, whilst column 3 estimates ship demand, by assuming the average ship carries 7 tonnes of cargo per deadweight per year. Analysts often employ complex commodity-based models to make this calculation, but we will keep it simple. Shipbuilding expansion demand is shown in column 4. It is quite volatile from year to year, but the trend

Table 15.3 Shipbuilding demand model, 1990–2006, showing expansion and replacement demand in million deadweight (except where otherwise stated)

	1	2	3	4	5	6	7	8	9
	memo:	Expansion demand			Replacement demand			Total	memo:
	Fleet (1st jan)	World trade (Mt)	Total ship demand	Expansion demand X_t	Ships scrapped	Other removals	Total replacement R_t	ship-building demand SDM_t	ship-building deliveries
1990	587.2	4,126	589	10.6	4.6	1.4	6.1	16.6	20.7
1991	603.2	4,313	616	26.7	3.8	4.5	8.2	34.9	20.6
1992	617.7	4,479	640	23.8	15.8	0.9	16.7	40.5	24.2
1993	626.2	4,623	660	20.6	16.8	1.2	18.0	38.5	27.5
1994	636.6	4,690	670	9.6	18.9	2.3	21.2	30.8	27.6
1995	639.4	5,083	726	56.1	15.5	1.2	16.7	72.9	33.0
1996	663.6	5,218	745	19.2	17.9	3.5	21.4	40.6	37.4
1997	679.7	5,506	787	41.2	15.7	4.0	19.7	60.9	36.5
1998	696.4	5,666	809	22.8	24.9	1.5	26.4	49.2	34.8
1999	704.5	5,860	837	27.7	30.4	1.1	31.5	59.2	39.8
2000	712.7	6,273	896	59.0	22.2	1.4	23.6	82.6	44.4
2001	733.8	6,167	881	-15.2	28.1	4.2	32.3	17.1	44.6
2002	746.4	6,276	897	15.6	28.2	2.6	30.8	46.4	48.4
2003	764.1	6,598	943	45.9	26.9	2.4	29.4	75.3	55.6
2004	787.6	6,893	985	42.3	9.8	3.8	13.6	55.9	61.8
2005	834.0	7,122	1,017	32.7	5.7	3.2	8.9	41.6	70.2
2006	895.4	7,407	1,058	40.7	6.5	2.7	9.2	49.9	75.3
Total increase	308.2			479.3	291.6	42.1	333.8	813.1	702.4

Notes

Col. 1	Clarkson fleet at year end from SRO
Col. 2	World Trade UNCTAD
Col. 3	Ship demand based on 7 tons per dwt pa
Col. 4	Increase in col. 3 since previous year
Col. 5	Demolition in year
Col. 6	Other removals in year
Col. 7	Sum col. 5 and col. 6
Col. 8	col. 4 + col. 7
Col. 9	Memo: deliveries in year

moves from around 20 m.dwt in the early 1990s to around 40 m.dwt per annum in 2006. Then, in columns 5–7 we calculate the replacement demand. Since we are dealing with history, scrapping and removals are used as the indicator of replacement demand. However, forecasters would use a model based on the life expectancy of ships.

Total shipbuilding demand is shown in column 8, and this model can be used to project scenarios of future shipbuilding requirements by forecasting the components in columns 2–7 at whatever level of detail is appropriate (many of the considerations about the shipping supply and demand model discussed in Chapter 4 are relevant to such an analysis).

This analysis raises two problems with this sort of long-term forecasting. Firstly, we must be very careful to define where supply and demand were at the start of the forecasting period. Estimated expansion demand between 1990 and 2006 shown at the bottom of column 4 is 479.3 m.dwt, but during this period the fleet only grew by 308.2 m.dwt. The explanation is that in 1990 there was surplus shipping capacity, which during the decade was gradually removed. Such factors need to be taken into account, which is not easy. Secondly, scrapping is not a precise indicator of replacement demand, since it includes a market component. As the markets tightened towards the end of the period, scrapping fell, possibly creating a backlog of ‘over-age’ tonnage. For both reasons what happens in practice can differ from the theoretical shipbuilding demand calculation, and these dynamic issues need to be taken into account. Finally, actual shipbuilding deliveries in column 9 provide a ‘reality check’ to see how the estimated demand compares with actual deliveries. It looks as though deliveries were below demand for the first half of the period, but drawing ahead towards the end.

15.5 THE SHIPBUILDING PRODUCTION PROCESS

For a better understanding of the shipbuilding supply model, we must now turn to the production process. In 2006 there were over 250 major merchant shipyards world-wide. The number of docks/berths and the layout and equipment of the shipyard place an upper limit on the number of vessels which can be built over any given period. There is great diversity. Some yards are fully operational, while others are uncompetitive and underutilizing their facilities.

Categories of shipyard

Although modern shipyards are highly flexible in the type of ship they build, physical and commercial factors tend to subdivide the shipbuilding market into a number of sectors. The world’s shipyards today fall broadly into three categories – small, medium and large.

Small shipyards specialize in vessels below about 10,000 dwt. These facilities generally have a workforce of below 1,000 employees, sometimes as few as 100–200. Some specialize in particular ship types, such as dredgers or offshore supply craft, but the product range is very wide, comprising small cargo ships, mini-bulkers, chemical tankers and a whole range of service craft such as tugs and dredgers. Consequently, most small shipyards tend to be very versatile in their product range. This sector is comparatively self-contained and it is unusual to find large shipyards competing for orders in the small ship market.

Medium-sized shipyards build vessels in the size range 10,000–40,000 dwt, although some may take vessels up to Panamax size. The constraint is usually the size of berth/dock and the facilities to process large quantities of steel. Typically, medium-sized shipyards have a workforce of about 500–1,500, though this varies greatly. In product terms the mainstay of these yards are container-ships, bulk carriers and small tankers. More sophisticated yards handle vessels such as short-sea ro-ros, ferries and gas tankers.

Finally, some very large shipyards have docks capable of accommodating tankers of up to 1 m.dwt and in a few cases a workforce of 10,000 or more, though some have fewer than 1,000. These facilities generally have highly automated equipment for steel preparation and assembly.

The ship and the shipyard

The merchant ship is the world's largest factory-produced product. A 30,000 dwt bulk carrier might typically contain 5,000 tons of steel and 2500 tons of other components, ranging from the main engine to many thousands of minor items of cabling, pipes, furniture and fittings – and, by modern standards, this is a small vessel. Over half of the cost of the ship is materials. Figure 15.8 shows a rough breakdown of the main items. Steel represents about 13% of the cost, the main engine 16% and other materials 25–35%. The remainder of the cost is direct labour and overheads. The material content is higher for high-outfit ships such as cruise liners and lower for simple cargo ships such as large bulk carriers. Because of their size and value, virtually all merchant ships are built to order and the construction period is a long one, falling anywhere in the range 12 months to 3 years, depending on the ship size and the length of orderbook held by the shipbuilder.

The hull of a merchant ship is basically a box built from thin steel plate, reinforced by internal bulkheads and sections to give strength. Within the hull are various items of equipment required to propel and control the ship, handle cargo, accommodate the crew and monitor performance. The complexity in shipbuilding lies in minimizing the materials

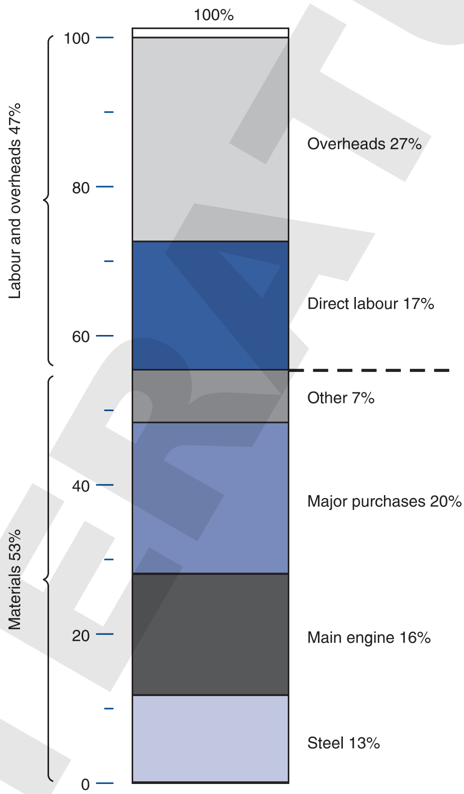

Figure 15.8
Cost structure of merchant ship
Source: Complied by Martin Stopford from various sources

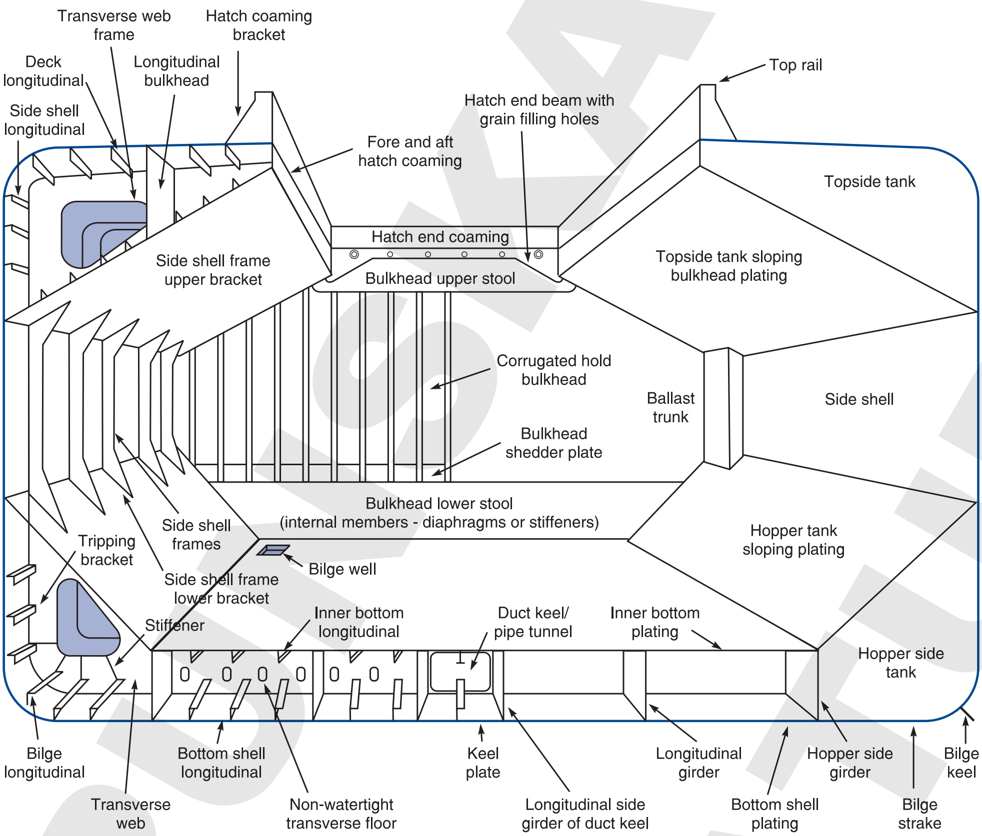

Figure 15.9
Cross-section of bulk carrier hull
Source: Lloyd's Register of Shipping

and labour required to construct a ship to the structural standards ('scantlings') laid down by the classification societies. The way naval architects resolve this problem depends on the ship. The bulk carrier hull shown in Figure 15.9 uses steel plate to construct the sides, double bottom, sloping plates, bulkheads and shaped components such as the transverse web. Sections are welded to the flat plate, for example as side or bottom shell longitudinals, to give rigidity. Although this structure looks simple, its structure is complex. The main deck is broken up by hatch openings and the hull derives its strength from the double bottom, the hopper tanks, the hatch coamings and the frames which run along the hull. Into the hull are fitted the many components, main engine, auxiliaries, pipe work, control systems, wiring and pumps. The entire structure must be coated with an efficient paint system, offering a long working life with minimum maintenance.

The shipbuilding production process

To build ships the shipyard must accomplish three main tasks – the design and planning of the ship, the construction of the steel hull, and the outfitting of the hull with machinery, equipment, services and furnishings. These operations are not necessarily sequential and there is much overlap. An example of a shipyard layout is shown in Figure 15.10, with arrows indicating how work flows from the delivery of materials to the steel stockyard through to the assembly of the ship in the dock. This shipyard layout illustrates the different stages unusually well, though not all shipyards are designed in such a logical way. It is common to find these facilities spread around the yard, with units moved from one location to another on low loaders. The ten manufacturing stages are itemized in Box 15.1 and the numbers in brackets following the stage titles refer to the location in the shipyard diagram in Figure 15.10 where that stage takes place.

The production process is essentially one of assembly, and few of the individual tasks require sophisticated technical skills, though some automation of cutting, welding and repetitive assembly is possible. The skill comes in planning and implementing the tens of thousands of operations that contribute to the production of a merchant ship – materials must be ordered and arrive on time; steel parts, fabrication and pipe work must fit accurately without the need for rework and must be delivered to the work

BOX 15.1 TEN STAGES IN THE SHIPBUILDING PRODUCTION PROCESS

The notes below are designed to be read in conjunction with the shipyard layout plan in Figure 15.10.

Stage 1: *Design and estimating (1)*

The design, cost estimates and vessel building strategy and production plans are produced by shipyard staff, initially in outline and then, if the ship is sold, gradually developed in greater detail to produce detailed working drawings and parts lists. Computer graphic equipment allows digital information developed during the design and estimating process to be used to plan and control the production of the vessel. Materials are ordered. Developing comprehensive and accurate information at an early stage in the design programme is one of the most crucial areas for improving productivity and product quality in modern shipbuilding.

Stage 2: *Materials reception (2, 15)*

Materials account for about 50–60% of the cost and labour and overheads for the remainder (see Figure 15.8), and a large merchant ship may involve several thousand separate purchase orders. A cost estimate must be prepared, often before the full design has been finalized, and materials, particularly long lead items such as the main engine, must be ordered. Items of equipment are delivered to the shipyard's material reception facility (2) where they are stored until needed. Pipes and other subcontracted components are delivered to the outfit storage area (15). The prompt delivery of materials is essential, as is quality control. Material supply problems can disrupt production programmes.

Stage 3: *The steel stockyard (3, 4)*

The steel is one of the first items to be ordered, and when it arrives it is stored in the steel stockyard. The two principal steel components used in ship manufacture are

BOX 15.1—cont'd

plates and rolled sections, which are used primarily to stiffen the plates. They are delivered to the yard by sea or road. The stockyard is laid out in an orderly manner and materials are retrieved using an overhead gantry crane.

Stage 4: *Surface preparation (5)*

Steel plates and sections are retrieved from the steel stockyard and processed through a surface preparation plant to ensure they meet the precise standards required for construction. This involves rolling plates and straightening sections to ensure that they are true, followed by shot blasting to remove rust and priming to protect the plate from further rusting and provide a foundation for paint. The edges of plate to be welded are chamfered ready for the welding machines.

Stage 5: *Plate and stiffener preparation (6)*

The primed steel plates are cut to the precise required size using numerically controlled profile burning machines. Any plates that do not need cutting are transferred to the flame planer to have their rough edges removed, and create the proper edge profile for welding. If required, they are bent to shape using a press or rolls. Framing members (e.g. as shown on the left-hand side of Figure 15.9) are prepared from steel sections, cut to size and then bent to shape using a frame-bending machine. By this process the many thousands of steel components for constructing the ship's hull are prepared, cut to size and numbered in accordance with the drawings. In practice, this is a flow process with a steady stream of components moving through the steel preparation bays.

Stage 6: *Assembly into blocks (7, 8, 9)*

The next stage is to build the steel components into the 'sub-assemblies' and 'blocks' weighing up to 800 tons from which the ship is constructed in the dry dock. The larger flat plates that make up most of the hull are transferred to the panel assembly line (7) where they are welded together, and framing members are welded in place to form 'straight hull blocks'. Shaped steel used to build curved hull blocks (e.g. bow and stern sections, double bottoms) requires different processes such as line heating which are carried out in the curved hull assembly shop (9). Smaller sub-assemblies are constructed in the sub-assembly shop (8). As each block is finished it is taken to the storage area (10) where it waits until the next stage of processing.

Stage 7: *Coating (11, 12)*

Once the blocks have been assembled all surfaces must be treated with anti-corrosion coatings under carefully controlled conditions, ideally in a properly designed paint cell. From a production viewpoint, this is particularly challenging because coatings are easily damaged and can become a production bottleneck. The blocks and sub-assemblies are taken to the block surface preparation unit (11) where surfaces are prepared and coatings applied under controlled conditions. Depending on the coatings used they will then be taken to the accelerated

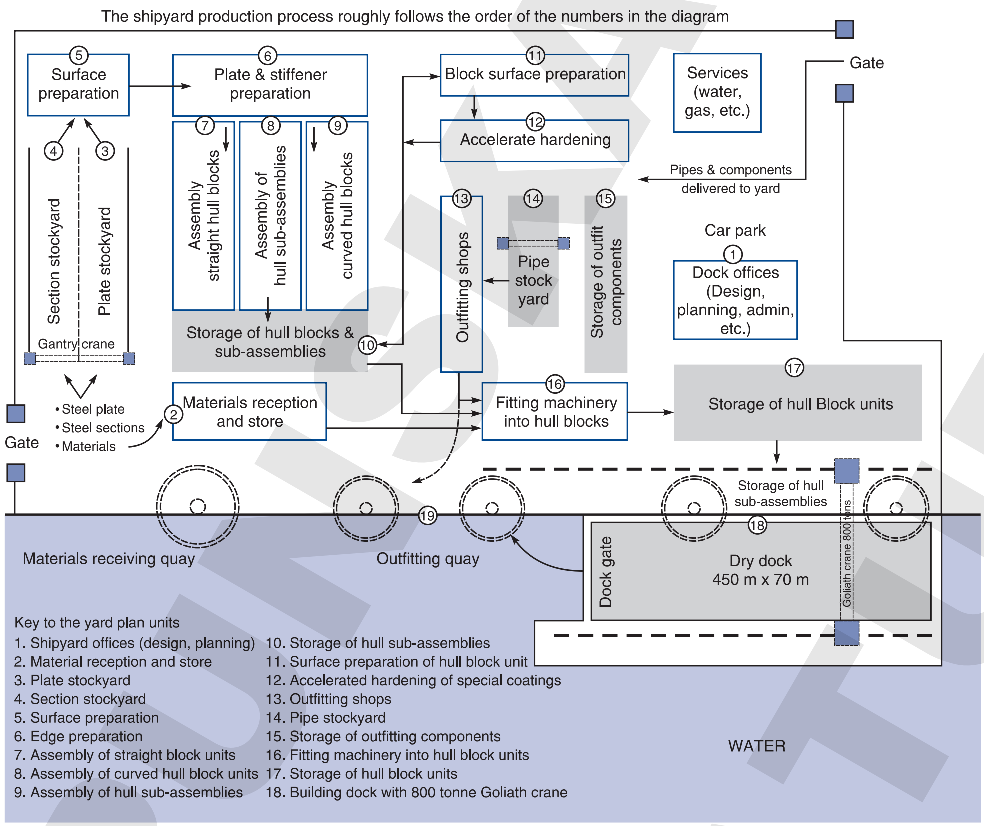

Figure 15.10
Shipyard layout plan
Source: loosely based on Odense Lindo shipyard, part of A.P. Møller

BOX 15.1—cont'd

hardening unit (12) to finish the process. When complete the blocks are taken back to the storage area (10) to await the next stage.

Stage 8: *Pre-outfitting (13, 16)*

The next step is to fit into the blocks and sub-assemblies as many as possible of the thousands of outfit items such as pipes, electrical cables, switchboards, furnishings and machinery. Most of this is done in the block outfitting hall (16). Blocks are brought there from the storage area and pipes and components from the pipe stockyard (14) and storage area (15) are fitted into them. This method allows better access and material scheduling control than is possible when working on the hull in the dock and is an important way of increasing shipyard productivity. Advance outfit requires sophisticated information management, accuracy control and tight organization. Plans must be made, and materials ordered and delivered to the work zone at precisely the right moment so that assembly can proceed smoothly. When materials

BOX 15.1—cont'd

arrive in the yard they must be precisely as specified and fit into the assembly without adjustment or rework. However, in the real world things inevitably go wrong and the greatest skill is the ability to adjust schedules when things do not go as planned. This sounds easy, but calls for great care in planning and accuracy control. After pre-outfitting the blocks are taken to the storage area (17).

Stage 9: *Assembly in the dock (18)*
Finally, prefabricated sections of the ship, together with those items of outfitting already installed, are lifted into the assembly dock and lowered in place, using the 800-tonne Goliath crane. They are carefully aligned, then welded into position. Outfit installations such as pipe runs are linked up.

Stage 10: *Outfit at outfit quay (19)*
When the hull is complete, the dock is flooded and the vessel is floated to the outfit quay where the outfitting of the ship is completed, systems are commissioned to ensure that on-board systems are operating correctly, and basin (or dock) trials of the main engines and auxiliary machinery are carried out.

station exactly when they are needed. Achieving this day after day is not as easy as it sounds, requiring considerable effort at the design and planning stage along with a production capability to manage material handling and production planning.

The major advances in shipbuilding techniques have been in planning and managing this process – for example, the introduction of pallets for material handling; the pre-outfitting and painting of assemblies before installation in the ship; and information systems to support these processes. The application of these techniques can yield dramatic results in terms of the man-hours required to build the ship.

15.6 SHIPBUILDING COSTS AND COMPETITIVENESS

In practice the level of efficiency and costs varies considerably from one yard to another. Although attention often focuses on the facilities as the main determinant of competitiveness, in reality there are many factors to consider. Broadly speaking, the price competitiveness of a shipyard depends on the key variables summarized in Figure 15.11 – material supply, facilities, availability of skilled labour, wage rates, labour productivity, cross exchange rates and, in some cases, subsidy all play a part in determining the cost and the revenue received by the shipbuilder.

Material costs

Materials account for 60% or more of costs. Countries with large numbers of shipyards such as Japan, South Korea and China can support a full range of material suppliers, including engine builders, equipment manufacturers, subcontractors and manu-facturers of specialist items such as stern frames. Long production runs give these suppliers a competitive advantage, as does the ability to deliver a wide range of components from stock. Equipment which requires high levels of research and development is often supplied by local manu-facturers operating under licence. For example, marine diesel engines are developed and marketed by B&W MAN and Wärtsilä which have a major market share, and production is undertaken locally to their specifications. Shipyards in areas with little ship-building activity have a more difficult time. Even if they can obtain supplies abroad, timing and delivery issues can make this a difficult strategy to implement.

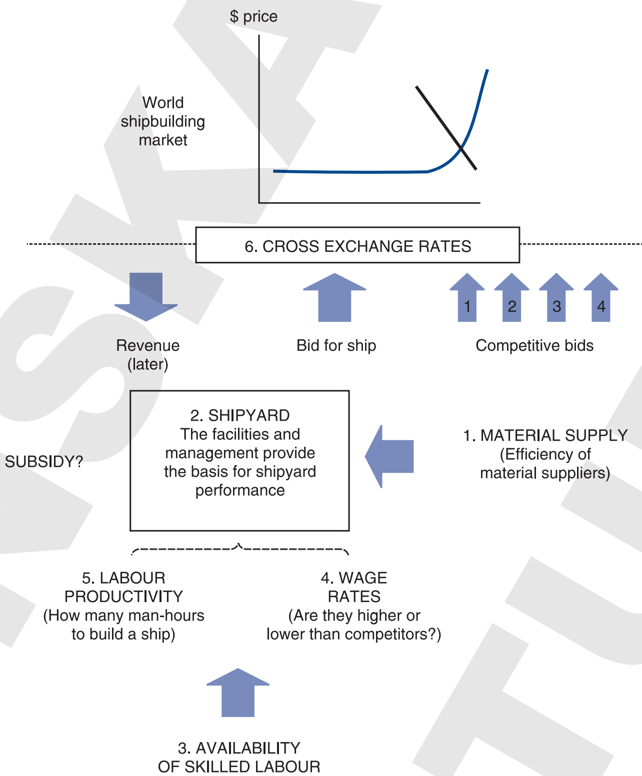

Figure 15.11
Influences of shipbuilding competitiveness
Source: Martin Stopford 2007

Shipbuilding productivity

There are enormous differences in the productivity of shipyards around the world. Facilities explain some of these differences, setting an upper limit on the size and volume of ships that can be built. However, the productivity of the shipyard is more important. Unlike a process industry where achieving maximum production merely involves switching on the machinery and feeding in the required volume of raw materials, building a merchant ship requires the managerial skills to organize and control the fabrication and assembly process. Ultimately the maximum throughput will depend not just upon the size of the facilities, but upon the efficiency with which they are used. Some shipyards take ten times as many man-hours as others to build the same ship.

This naturally raises the question of how productivity can be measured As a rule, labour productivity is measured in man-hours per unit of output. Unfortunately there are practical difficulties in applying this formula to measuring and comparing shipyard productivity on an international basis. There are four main problems:

- *Output measurements*. There is no standard unit of shipyard production, and this is even more problematic at an industry level where production consists of a variable mix of large ship types. Although there have been a few successful standard ship designs such as the SDI4, even where ships have an apparently similar specification, for example Panamax bulk carriers, there is considerable scope for varying the design, machinery and general quality of finish. The best measure currently available is compensated gross tons (cgt), but this has limited value when dealing with sophisticated or complex ships.
- *Differences in subcontracting*. Shipyards differ in the amount of work that is subcontracted and there are few consistent detailed statistics about the labour used. For example, a shipyard which subcontracts electrical and joinery work will spend fewer man-hours building the ship, but its material costs will increase. The accounting practice of most shipyards is to treat subcontract labour as 'outside goods and services' and to include it in material costs. As a result, a comparison of man-hour productivity between two ships will be distorted if such differences in subcontracting are not taken into account, and this is extremely difficult to do at an international level.
- *Delivery peaks and troughs*. Ship deliveries from a yard may not represent the underlying level of production owing to the size and mix of ships. It is possible for a shipyard to be productively employed all year but not actually deliver any ships because of the irregular distribution of delivery dates. For this reason, throughput needs to be calculated from several years' deliveries if an accurate figure is to be obtained.
- *Joint product manufacture*. There are practical difficulties in measuring employment engaged on merchant shipbuilding because many shipyards undertake other activities such as warship construction, offshore and ship repair.

For these reasons any calculation of shipbuilding productivity and cost competitiveness is unlikely to be very accurate. However, to illustrate the general method involved, Table 15.4 shows the calculation of average shipbuilding productivity for some of the major shipbuilding countries in 2005. The first column estimates employment on merchant shipbuilding, while the second shows the tonnage completed in each country. Finally, productivity measured in cgt/per man-year is calculated in column 3 by dividing completions by employment. The range of productivity is very wide. Japan is at the top of the list with productivity of 183 cgt per employee, followed by S. Korea at 145 cgt per employee and Denmark at 91 cgt per employee. At the bottom of the range is Poland with 42 cgt per employee. For the reasons mentioned above, the productivity figures should only be regarded as a rough guide to the differences between shipyards, but they do at least illustrate the diversity that exists within the industry.

Labour costs and competitiveness

Labour accounts for 40–50% of the cost of the ship, so wages have a major impact on competitiveness. The labour cost determines the total wage bill for producing the ship and depends upon the basic wage, to which must be added overtime payments and any bonuses paid to the workforce. In order to compare hourly wage costs it is necessary to convert them to a common currency; for present purposes, the US dollar has been used. There are significant differences in the wage rate in different countries, as can be seen in the right-hand half of Table 15.4. Applying the labour cost per man-year to the cgt productivity per man year gives an estimate of the labour cost per cgt, which is shown in column 5 of Table 15.4.

Shipyards facing competitive pressures due to rising wage rates, materials costs, or increasing price competition from other yards will, if they are to survive, have to reduce the man-hours required to build the ship. This can be done by improving facilities, systems and labour productivity. Automation is important, but improved organization, systems and product development may all play a part. For example, some Japanese shipyards tackled the challenge of rising labour costs by developing bulk carrier designs which were heavily engineered to assist the production process and thus reduce man-hours. In contrast, the Italian shipyards focused on the cruise market and mastering the skills needed to bring together the production of the hull with the very different task of outfitting the ship as a seagoing hotel and leisure centre. One way or

Table 15.4 Merchant shipbuilding productivity by country

	1	2	3	4	5
	PRODUCTIVITY			LABOUR COST	
	Numbers employed on merchant new work, 2005	Tonnage completed 2005	Productivity cgt per man-year	Hourly pay 2005	Labour cost $ per CGT
Country		('000 cgt)		US$[a]	
South Korea[b]	38,600	5,600	145.1	13.56	159
Poland	11,818	500	42.3	4.54	182
Japan[c]	14,605	2,668	182.7	21.76	202
Spain	2,222	200	90.0	17.78	336
Italy	8,689	500	57.5	21.05	622
Denmark	3,300	300	90.9	33.47	626
France	3,500	200	57.1	24.63	733
Germany	14,600	1,100	75.3	33.00	745
Netherlands	4,300	300	69.8	31.81	775
Finland	4,290	200	46.6	31.93	1,164
Total	65,153	11,568	177.6		

Source: CESA, KSA (all figures are approximate)

[a]Hourly pay is very sensitive to exchange rate of local currency against the US$

[b]Data for 2001 employment excludes 25,300 subcontractors source KSA

[c]Japanese data for 1998, Source KSA 'Proposal for the criteria of the derivation of productivity'

another these very different solutions increase the value added by the yard, but there is no simple formula for increasing productivity to offset high wage rates. Each shipyard must find its own solution.

Currency movements and competitiveness

Although currency movements seem far removed from the shipyard, they are the single most important factor in determining shipbuilding cost competitiveness. Since the world economy moved to floating exchange rates after the breakdown of the Bretton Woods system in 1971, shipbuilders have faced a major problem with exchange rates. Unit costs vary proportionately with the exchange rate, and given the volatility of exchange rates during the 1980s and 1990s this is clearly a very major factor in determining shipbuilding cost competitiveness.

An example illustrates the point. A shipyard was negotiating the sale of a small bulk carrier. The yard's cost was £10 million and the $/£ exchange rate was 1.40, so the best price they could offer was $14 million. Unfortunately the owner would not pay more than $10 million, so to win the order the shipyard needed to cut its price by 30%. Since bought-in materials accounted for 60% of the shipyard cost, that was not possible, but while the negotiation dragged on over a period of six months the exchange rate fell to 1.06. At this exchange rate the shipyard could offer a price of $10 million and the contract was signed. Although such large currency movements are uncommon, it demonstrates just how vulnerable shipyards are to exchange rate fluctuations.

As we pull all of these factors together we build up a picture of how the competitive structure of the world shipbuilding industry really operates. At one extreme there are shipyards with low productivity but wages so low that man-hours hardly matter. They can undercut all comers. At the other end there are the high-productivity yards with even higher wage costs, which are slowly going out of business. This happened to the Swedish shipyards in the early 1980s, despite the fact that they had the highest productivity in the world. Between lie a whole range of shipyards with different combinations of wage costs and productivity. Washing over the whole industry are the waves of exchange rate movements that can sweep shipyards up and down the competitiveness league table in a matter of months. All of this combines to make shipbuilding a tough business that requires great management skill. Despite all these problems, or perhaps because of them, shipbuilders are some of the most tenacious businessmen in the maritime industry.

15.7 THE SHIP RECYCLING INDUSTRY

Compared with shipbuilding, shipbreaking (sometimes referred to as 'demolition' or 'recycling') is a rough business. The ships are sold at a negotiated price per lightweight ton (see Section 5.7 for a discussion of the commercial process). Shipbreakers mainly rely on manual labour to dismantle ships in whatever facilities are available, often a suitable beach. Although it is possible to increase productivity by using mechanized shipbreaking methods, these are capital-intensive and the investment has not generally been thought economic, given the volatility and small margins in the shipbreaking business.

The process of non-mechanized shipbreaking falls into three stages. At the preparatory stage, the owner of the vessel should undertake various operations including stopping up all intake apertures; pumping out all bilge water; blocking off intakes and valves; and removing all non-metal objects together with potentially explosive materials. If the vessel is a tanker it must be cleared of potentially dangerous gases. This work is often subcontracted.

The next stage is to beach the ship and remove large metal structures such as masts, pipes, superstructure, deck equipment, main engine, ancillary equipment of machinery room, decks, platforms, transverse bulkheads, propeller shafts, propeller shaft bearings, upper hull sections, bow and stern end sections. The remainder of the ship is then hauled by winches or lifted on to dry land by means of slipways, ramps or dry docks and cut into large sections. In some of the less sophisticated shipbreaking operations the vessel is simply winched on to the beach. Although this process can be undertaken satisfactorily on a beach or alongside a quay, the availability of a dry dock is a considerable advantage in terms of efficiency, safety and control of spillages.

Pumps, auxiliary engines and other equipment are removed and sold. Finally, the panels and sections obtained from the ship are cut into smaller pieces as required, using manually operated propane cutters. The scrap is then assembled for transport to its ultimate destination.

The market for scrap products

Ships provide very high-quality steel scrap, especially tankers which have large flat panels. Sometimes the scrap is simply heated and rerolled into reinforcing rods for sale to the construction industry. Rerolled steel is also ideal for sewage projects, metal roads and agricultural needs. Smaller pieces are melted down. Much of the shipbreaking industry is located in the Far East and Indian subcontinent where there is a sizeable market for reprocessed steel products of this type. In the advanced countries of Europe, scrap is generally completely melted down to make fresh steel.

Although the scrap steel provides most of the value of the ship, the most lucrative return comes from the equipment and the 2% of non-ferrous items. Diesel engines, generators, deck cranes, compasses, clocks and furniture can also be resold. Again, the market for such equipment is stronger in Asian countries than in the developed countries, where technical standards are more demanding, the costs of refurbishing are higher and there is less demand for the second-hand equipment reclaimed from the ship.

Who scraps ships?

For these reasons most shipbreaking occurs in low-wage countries in Asia where shipbreakers have a local market for their product and cheap labour to dismantle the ships.

Table 15.5 Shipbreaking, by country, (1985–2005)

	1986		1991		1995		2005	
	GT	%	GT	%	GT	%	GT	%
Taiwan	7,773	38	48	2	–	0	0	
China	4,567	23	172	7	754	9	200	3%
South Korea	2,658	13	8	0	3	0	0	
Pakistan	861	4	445	19	1,670	20	0	
Japan	770	4	81	3	146	2	0	
India	636	3	695	29	2,809	33	1000	16%
Spain	581	3	13	1	40	0	0	
Turkey	418	2	77	3	207	2	0	
Italy	311	2	8	0	1	0	0	
Bangladesh	268	1	512	22	2,539	30	4600	75%
Others	1,444	7	306	13	354	4	300	5%
Total	20,287	100	2,365	100	8,523	100	6,100	100%

Source: Lloyd's Register of Shipping

This is a relatively mobile industry. Table 15.5 shows that during the recession in the mid-1980s when scrapping was very high, almost three-quarters of the shipbreaking industry was located in Taiwan, China and South Korea. Ten years later Taiwan and South Korea had left the industry. China's market share had fallen to 9% and India, Bangladesh and Pakistan had taken over as market leaders. By 2005, when the shipping industry was booming and demolition had fallen to 6.1 million gt, Bangladesh dominated the industry.

The explanation is that this very basic industry gravitates towards countries with low labour costs. Taiwan's development as a shipbreaker illustrates the point. The shipbreaking business got started with the dismantling of ships damaged during the Second World War and expanded rapidly after import controls were lifted in 1965. Encouraged by the government to meet rising domestic scrap demand and benefiting from a purpose-built site and from plentiful cheap labour, the industry established itself as the world's leading shipbreaker, with highly efficient facilities. Demolition took place in two state-owned sites at the deep-water port of Kaohsiung, using specially built berths and dockside cranes. The ships to be demolished were moored two abreast along the quayside and systematically dismantled, with a breaking cycle of 30–40 days. With each decade the working conditions improved.[20] As the economy grew and labour costs increased, shipbreaking became less attractive and in the early 1990s Taiwan closed the demolition yards and replaced them with a container terminal. South Korea was a more recent entrant to the Far East scrapping business, but the story is much the same. In the 1980s South Korea was the third biggest shipbreaker with a 13% market share, mainly carried out in two demolition yards owned by Hyundai. As wages rose in the late 1980s and the shipbuilding industry expanded, the demolition yards were closed.

The People's Republic of China entered the ship demolition market in the early 1980s and rapidly became the world's second largest buyer of ships for scrap. There was a considerable domestic demand for steel products and, in fact, the China Steel Corporation was already importing a considerable amount of scrap steel from Taiwan. Although China continued to operate demolition yards in the 1990s, the scale of the business was restricted by government regulations controlling currency for the purchase of ships and strict environmental regulations, and China's market share fell from 23% in 1986 to 9% in 1995 and 3% in 2005.

In 2005 the main ship demolition sites were located in Pakistan, India and Bangladesh (Table 15.5), though the level of activity varies with the volume of ships available to scrap. Pakistan's main site is at Gadani Beach, with up to 100 scrapping plots, each plot covering 2500 square yards. Gadani Beach has no electricity supply or water mains and only a few plots have electric generators. Ship demolition takes place at the most basic level. Ships are driven on to the beach where an army of workers dismantle them. During busy periods, up to 15,000 labourers are employed breaking up the ships with the aid of very little mechanization. Much of the scrap material is moved manually, with the assistance of king-post trucks, blocks and pulleys, but the more profitable plots have now moved into mechanization and are using fork-lift trucks and mobile hydraulic cranes. Alang in India's Gujerat State was opened in 1983 and has 170 ship breakers along the 10 km of coastline on the west coast of the Gulf of Cambay. Strong tides and gently sloping beaches allow ships to be beached under their own motors or by tugs. The workers have access to them at low tide. There were 50,000 workers on this site in the 1990s but by 2006 that had shrunk to between 5,000 and 10,000. The Bangladeshi ship recycling yards are located near the port of Chittagong, and are the nation's main source of steel. Rerolling mills in Chittagong and Dhaka produce over 1 million tons of reinforcing rods for the construction industry.

Little shipbreaking is carried out in western Europe, owing to high labour costs and the lack of a ready market for recycled material. There are also various difficulties associated with health and safety legislation and environmental protection, both of which are more prominent than in the countries scrapping ships in Asia. The only European country of any significance in breaking activity in the recent past is Turkey. There are, however, a number of small shipbreaking companies scattered around the UK and continental Europe, mainly with 10–100 employees, specializing in breaking warships, fishing vessels and other high-value vessels.

Several features of the shipbreaking industry have recently raised concerns over the release of polluting materials such as heavy fuel oil and the effect of hazardous substances such as asbestos on workers. The IMO is currently developing a convention providing global ship recycling regulations for international shipping.

The regulation of shipbreaking

Much of the ship dismantling nowadays takes place on tidal beaches and under primitive conditions and this presents society and policy-makers with a dilemma. On the positive side, the industry provides thousands of jobs for migrant workers and recycles valuable materials, including steel, other scrap metal and equipment which can be refurbished. However, the conditions in which this is done mean that workers employed in the industry face high accident rates and health risks from the dismantling of ships containing many hazardous materials, including asbestos, polychlorinated biphenyls, tributyl, tin and large quantities of oils and oil sludge. Protection for the environment is also a problem, with the pollution of coastal areas.

Work is ongoing, involving inter-agency cooperation between the ILO, IMO and the Secretariat of the Basel Convention, to establish mandatory requirements at a global level to ensure an efficient and effective solution to the problem of ship recycling. The IMO has adopted Guidelines on Ship Recycling and a new IMO Convention on ship recycling will include regulations for the design, construction, operation and preparation of ships so as to facilitate safe and environmentally sound recycling, without compromising the safety and operational efficiency of ships; the operation of ship recycling facilities in a safe and environmentally sound manner; and the establishment of an appropriate enforcement mechanism for ship recycling.

15.8 SUMMARY

In this chapter we have discussed the international shipbuilding and scrapping industries. Although shipbuilders face the same market volatility as their customers, the shipowners, it is a very different business with large fixed overheads and many employees.

Our review of the regional structure of world shipbuilding showed a clear regional pattern. During the first half of the twentieth century the industry was dominated by Europe, then in the second half the focus moved to Asia, with Japan leading the way, followed by South Korea which took over the dominant position at the beginning of the twenty-first century, by which time China was making a bid for market leadership, with a number of smaller Asian countries also entering the market.

This process of regional change was driven by a succession of shipbuilding market cycles, first generating growth which allowed new entrants to win market share, and then recessions during which the less efficient shipyards were forced out of the business. There were 12 of these cycles during the period 1901–2007, with an average length of 9.5 years. The cycles are driven by the interaction of supply and demand and coordinated by price movements. The shipbuilding supply function reflects differences in international cost competitiveness and typically has a J shape, whilst the demand curve is more difficult to define but is generally thought to be relatively inelastic. Movements in the demand curve result in changes in ship prices, which in turn move the supply curve to the left (reducing supply when prices are low) or the right (increasing supply when prices are high).

Shipbuilding production is an assembly process involving 10 steps. However, the competitiveness of the shipyard does not just depend on how efficiently it assembles the ship. Wage rates, the cost and availability of good-quality materials, and, most importantly, the exchange rate all play a part. Labour costs and productivity vary enormously from one country to another.

Finally, we discussed the shipbreaking industry, a very different industry from shipbuilding. Although ideally demolition takes place in a dry dock, gently sloping sandy beaches are often used. The industry at the beginning of the twenty-first century was mainly located in areas with plentiful cheap labour and a market for the steel and equipment recovered from the ship. India, Pakistan and currently Bangladesh undertake most of the ship demolition. Regulation governing health and safety in the recycling yards and the construction of ships from recyclable materials is increasing.

In conclusion, shipbuilding and demolition are fascinating industries, in some ways very close to shipping, and in others very different. Their global location is constantly shifting and this, combined with fixed capacity and a volatile market, makes it a tough business. But the shipbuilders, who are tough people themselves, do not seem to mind that, and as long as there is seaborne trade and salt water, they will remain a distinctive and essential part of the maritime business.

16 The Regulation of the Maritime Industry

Whosoever commands the sea commands the trade; whosoever commands the trade of the world commands the riches of the world and consequently the world itself.

(*Judicious and Select Essays and Observations by the Renowned and Learned Knight Sir Walter Raleigh, upon the First Invention of Shipping*, H. Moseley, 1650)

16.1 HOW REGULATIONS AFFECT MARITIME ECONOMICS

Shipowners, like most businessmen, find that regulation often conflicts with their efforts to earn a reasonable return on their investment. When Samuel Plimsoll first started his campaign against the notorious ‘coffin ships’ in the 1870s, British shipowners argued that the imposition of load lines would put them at an unfair competitive advantage. Fayle, writing in the 1930s, observed that:

> In their efforts to raise both the standard of safety and the standard of working conditions afloat, the Board of Trade frequently found themselves, during the last quarter of the nineteenth century, at loggerheads with the shipowners. They were accused of cramping the development of the industry by laying down hard-and-fast rules which in effect punished the whole of the industry for the sins of a small minority, and hampering British shipping in international competition, by imposing restrictions from which foreign ships were free, even in British ports.[1]

The same, sometimes legitimate, resistance to regulation is found in most industries, but the world’s oceans provide the shipping industry with an unrivalled opportunity to bypass the clutches of regulators and gain an economic advantage. The goal of maritime regulators is to close the net and ensure that shipping companies operate within the same standards of safety and environmental responsibility which apply on land. As a result, in the last 50 years the regulatory regime has played a significant part in the economics of the shipping market.

It would, however, be wrong to think that the regulatory process is only concerned with pursuing villains. A few regulations are made in response to particular incidents.

The *Titanic*, the *Torrey Canyon*, the *Herald of Free Enterprise*, the *Exxon Valdez*, the *Erica* and the *Prestige* all provoked a public outcry which led to new regulations. But these are the exceptions. Over the last century the shipping industry and the maritime states have gradually evolved a regulatory system covering all aspects of the shipping business. Ship design, maintenance standards, crewing costs, employment conditions, operating systems, company overheads, taxation, oil pollution liability, environmental emissions and cartels are all subject to regulation in one way or another. However, the emphasis changes and during the last decade the environment, emissions by ships, ballast water, and ship recycling have all received more attention. Needless to say, all of this has economic consequences and a knowledge of maritime regulation is an essential part of the maritime economist's toolkit.

16.2 OVERVIEW OF THE REGULATORY SYSTEM

The aim of this chapter is to discuss the international regulatory system and the legal and political issues that have influenced, and in some cases dominated, the maritime scene since the mid-1960s. The chapter seeks to answer three questions: *Who* regulates shipping and commerce? *What* do they regulate? *How* do regulations affect shipping economics?

The first step is to identify the regulators more precisely. In an ideal world there would be a supreme legislative body which makes a single set of international laws, with an international court that tries cases and an enforcement agency. Reality does not live up to this ideal, and some experts doubt whether what passes for international law is really 'law' at all.[2] There is an International Court of Justice, but its rulings on shipping matters are purely advisory. We should not be surprised at this state of affairs. Each of the 166 countries with an interest in shipping has its own priorities. Gaining agreement on a body of international law, far less approving an international executive to enforce the laws, is hardly likely to succeed.

Maritime regulation is currently organized through the more pragmatic system set out in Figure 16.1. The difficult task of coordinating the many interests and gaining agreement to a consistent body of maritime law falls to the United Nations. The United Nations Convention on the Law of the Sea (UNCLOS 1982) sets the broad framework, whilst the task of developing and maintaining workable regulations within this framework is delegated to two UN agencies, the IMO and ILO. The IMO is responsible for regulations on ship safely, pollution and security and the ILO is responsible for the laws governing the people on board ships. These two organizations produce 'conventions' which become law when they are enacted by each maritime state.[3] The enactment of the maritime conventions is in some cases patchy because not all the 166 states sign up to some conventions, but the major ones such as SOLAS and MARPOL (see Table 16.5 below) have been made law by every significant flag state.

Each maritime state has two different roles, first as a 'flag state' and second as a 'coastal state' (see centre of Figure 16.1). As a 'flag state' it makes and enforces laws governing ships registered under its flag. For example, as a flag state Greece is legally

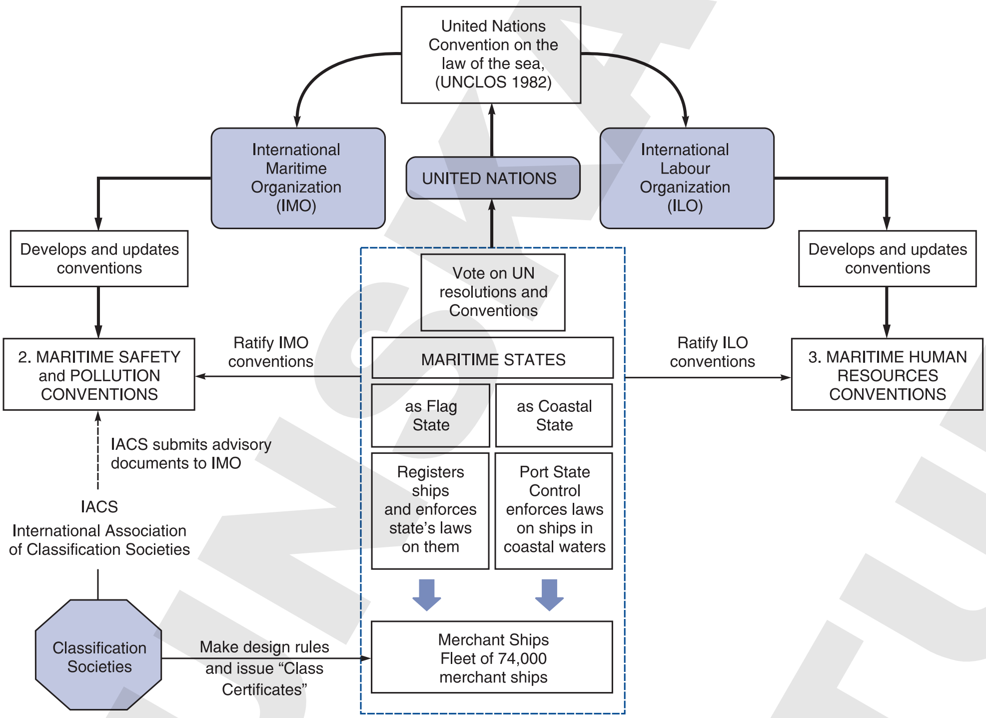

Figure 16.1
The maritime regulatory system showing the role of the 166 maritime states
Source: Martin Stopford 2007

responsible for ships flying the Greek flag, wherever they are in the world, whilst as a coastal state it enforces maritime laws on ships in Greek territorial waters. This is known as 'port state control'. Generally the laws maritime states enforce comply with maritime conventions, but not always. For example when the USA passed the Oil Pollution Act (1990), a law designed to phase out single-hull tankers in US waters, there was no maritime convention on this issue.

The other major 'players' in the regulatory process are the classification societies. Most major maritime nations have their own classification society and they are, in effect, the technical advisers to the maritime regulators. Over the last decade their role as recognized organizations (ROs) has increased and they assist the regulators in making and implementing maritime laws with a technical, human or environmental focus. In addition, they develop technical standards in their own right and award the classification certificate which is required by insurance underwriters. They are paid for these services, but have no legal powers of enforcement beyond withdrawing their services.

In summary, the regulatory system discussed in this chapter involves six principal participants in the regulatory process:

- The *classification societies*: the shipping industry's own system for regulating the technical and operational standard of ships. The classification societies make rules for ship construction and maintenance and issue a classification certificate to reflect compliance.

- The *United Nations*, which sets the broad framework of maritime law.
- The *flag states*. The primary legal authority governing the activities of merchant ships is the state in which the ship is registered, the flag state. By custom this state is responsible for regulating all aspects of the commercial and operational performance of the ship. International laws are developed by the participation of flag states in treaties or conventions.
- The *coastal states*. A ship is also subject to the laws of the coastal state in whose waters it is trading. The extent of each state's territorial waters and the scope of regulation vary from one country to another.
- The *IMO*, the UN agency responsible for safety, the environment and security.
- The *ILO*, responsible for regulations governing people on board ship.

In the following sections we will consider each of these regulatory regimes.

16.3 THE CLASSIFICATION SOCIETIES

The shipping industry's own regulatory system arose from the efforts of insurers to establish that the vessels for which they were writing insurance were sound. In the mid-eighteenth century they formed the first classification society and during the intervening period their activities have become so closely involved with the regulatory activities of governments that it is often difficult for laymen to understand the difference between the two. In this section we will focus on the role of classification societies and explain why they were set up, how they have evolved, the functions they undertake today and their impact on maritime regulation.

Origin of the classification societies

Like many other shipping institutions, the classification societies are the product of their past, so knowing something of their history helps to explain the current structure. Lloyd's Register of Shipping, the first classification society, can trace its origins back to Lloyd's Coffee House in the early 1700s. The proprietor, Edward Lloyd, presumably in an effort to attract clients, started to circulate lists giving details of vessels which might appear for insurance.[4] The next step came in 1764 when a committee of London insurers and insurance brokers compiled a book containing details of ships that might require insurance. When published the book was known as *Lloyd's Register*. This register classified ships according to their quality, listing a grade 'conferred on the ship by the Committee's appointed surveyors'.[5] The condition of the hull was classified A, E, I, O or U, according to the excellence of its construction and its adjudged continuing soundness (or otherwise). Equipment was graded G, M or B – good, middling or bad. Any ship classified AG was thus as sound as it could be, whilst one rated UB was obviously a bad risk from the underwriter's point of view. In time, G, M and B were replaced by 1, 2 or 3.[6]

The ‘green book’, as it was known, was compiled by insurers for the sole use of members of the society and contained details of 15,000 ships. All went well until the 1797–8 register introduced a new grading system which based the ship’s class on its river of build, favouring ships built on the Thames. This was disputed by many shipowners, and in 1799 a rival register was published, the *New Register Book of Shipping*, known as the ‘red book’. A period of punitive competition followed, bringing both registers close to bankruptcy. In 1834 the differences were settled and a new society was set up to produce a shipping register which was acceptable to all sections of the industry. The new publication was Lloyd’s *Register of British & Foreign Shipping* and its governing body had 24 members, eight each from the merchants, the shipowners, and the underwriters. This made it representative of the shipping industry as a whole.[7]

The new society had 63 surveyors and a system of regular inspection for ships was instituted. The main function continued to be the production of a register grading ships, but a new classification system was introduced. Under this system, ships that had not passed a prescribed age and had been kept in the highest state of repair were classed A; ships which, though not fit for carrying dry cargo, were considered perfectly safe for carrying cargoes not damaged by the sea were classed E; and ships unsuitable for dry cargo, but fit for short voyages (not out of Europe) were classed I. The condition of the anchor cables and stores when satisfactory was indicated by 1 and when unsatisfactory by 2. This system gave rise to the familiar expression ‘A1 condition’. In the first five years 15,000 vessels were surveyed and ‘classed’.

As the class movement developed in the nineteenth century, the role of classification societies changed. At first the main job was to grade ships. As time passed they started to set the standards to which ships should be built and maintained. Blake comments:

> As its authority grew, the Committee took upon itself something like disciplinary powers. Any new vessel for which an A1 classification was sought must undergo *a survey under construction*, which meant in effect that its progress was closely inspected at least three times while the hull was still on the stocks.

A1 became a requirement rather than a grade in a scale.

Technical committees were set up to write rule books setting the precise standards to which merchant ships should be built and maintained. These rules set the standards and the society policed them through their network of ship surveyors.

Other classification societies were set up in the nineteenth century. The American Bureau of Shipping (ABS) has its origins in the American Ship Masters Association which was organized in 1860 and incorporated in 1862 through an Act of Legislature of the State of New York. Like Lloyd’s Register of Shipping it is a non-profit making organization with general management vested in the membership comprising individuals prominent in the marine and offshore industries and related fields. Most class societies today are managed by a Board drawn from all parts of the maritime industry – shipbuilders, shipowners, insurers, etc. Although underwriters still participate in general management through membership of these boards, the classification societies can no longer be seen as acting exclusively for the insurers.

The classification societies today

There are currently more than 50 classification societies operating world-wide, some large and prominent, others small and obscure. The list of the ten larger societies and the number of cargo ships they class, shown in Table 16.1, gives a rough idea of the relative prominence of the various institutions. These are all well-known names in shipping circles and together they cover over 90% of the cargo and passenger fleet (note that these numbers do not include the many small non-cargo-carrying vessels which the societies also class).

Today the main job of the classification societies is to 'enhance the safety of life and property at sea by securing high technical standards of design, manufacture, construction and maintenance of mercantile and non-mercantile shipping'. The classification certificate remains the mainstay of their authority. A shipowner must class his vessel to obtain insurance, and in some instances a government may require a ship to be classed. However, the significance of the classification certificate extends beyond insurance. It is the industry standard for establishing that a vessel is properly constructed and in good condition.

In addition to their role as regulators, the major classification societies also represent the largest single concentration of technical expertise available to the shipping industry. For example, Lloyd's Register, the largest classification society, has over 5,400 people, of whom half are qualified engineers, operating from 240 offices in 80 countries world-wide. They class ships against their own rules (around 6600 ships annually),

Table 16.1 The major classification societies, November 2006

		Fleet classed		Average ship	
		Number	Million gt	Thousand gt	Age
IACS members					
Nippon Kaiji Kyokei	NK	6,494	142.9	22.0	12.8
Lloyd's Register (LR)	LR	6,190	125.8	20.3	18.4
American Bureau of Shipping	ABS	6,292	103.2	16.4	19.6
Det Norske Veritas	DNV	4,010	102.0	25.4	16.5
Germanischer Lloyd	GL	4,712	54.9	11.7	16.5
Bureau Veritas	BV	4,877	46.6	9.5	18.9
Korean Register	KR	1,648	21.9	13.3	17.4
China Classification Society	CCS	1,897	21.6	11.4	19.4
Russian Register	RS	3,174	12.5	3.9	25.2
Registro Italiano	RINA	1,345	12.0	9.0	23.8
Others					
Indian Register		352	1.5	4.2	17.6
11 Others (under 1,000 ships)		1,819	5.3	54.6	24.8
Total		42,810	650.2	15.2	0

Note: The statistics cover only vessels included in Clarkson Registers carry out statutory certification against international conventions, codes and protocols, and offer a range of quality assurance, engineering and consultancy services. In 2007, ABS and its affiliated companies had a global staff of more than 3,000 people, primarily surveyors, engineers and professionals in the areas of risk assessment and mitigation. ABS maintains offices or is represented in more than 80 countries. To put this into perspective, the IMO has a permanent staff of about 300 and many important bulk shipping companies have fewer than 100 shore-based staff. In these circumstances it is easy to see why, in addition to the classification role, the class societies have a major role as technical advisers to shipowners and undertake technical inspection work on behalf of governments. Since government regulations cover much of the same ground as classification rules, this sometimes leads to confusion over the role of the classification societies and government regulators.

Although the major societies do not distribute profits, they depend on selling their services to cover their costs and are subject to commercial pressures. As self-funding organizations, their survival depends on maintaining a sufficiently large fee-paying membership to recover their costs. There is, therefore, intense competition between classification societies to attract members, leaving them in the tricky position of competing for the business of shipowners on whom they will often have to impose financial penalties as a result of their regulatory inspections.

The regulatory activities of the classification societies

The role of the class societies today has two fundamental aspects, developing rules and implementing them.

Developing rules includes both new initiatives and the continuous updating of existing rules to reflect changes in marine technology and conventions. Procedures vary, but most societies develop their rules through a committee structure, involving experts from various scientific disciplines and technical activities including naval architects, marine engineers, underwriters, owners, builders, operators, materials manufacturers, machinery fabricators and individuals in other related fields. This process takes into account the activities of IMO and IACS unified requirements.

The second stage involves applying the rules to practical shipbuilding and shipping activities. This is a four-step procedure:

1. *Technical plan review*. The plans of new ships are submitted to the classification society for inspection to ensure that the structural details in the design conform to the society's rules. If the plans are found satisfactory they are passed and construction can proceed. Sometimes modifications are required, or explanations required on certain points. Alternatively, the society may be asked by the shipyard to help out in developing the design.
2. *Surveys during construction* to verify that the approved plans are implemented, good workmanship practices are employed and rules are followed. This includes the testing of materials and major components such as engines, forgings and boilers.

3. *Classification certificate*. On satisfactory completion of the vessel the class is assigned and a certificate of classification is issued.
4. *Periodic surveys* for the maintenance of class. Merchant ships are required to undergo a scheme of surveys while in service to verify their acceptability for classification. The ship's classification society carries out these inspections and keeps records which, for example, a prospective buyer of the ship may ask to inspect.

The classification procedures for existing ships are, in general terms, agreed by IACS for its members and associates. The regulations typically require a hull and machinery annual survey, a hull and machinery special survey every 5 years, a dry-docking survey every 2½ years, a tail shaft inspection every five years, and a boiler survey every 2½ years. The hull and machinery survey is very demanding, involving detailed inspection and measurement of the hull.

As the ship grows older, the scope of this inspection widens to cover those areas of the ship which are known to be most vulnerable to ageing. For example, as oil tankers grow older the area of the deck plates subject to tests for corrosion increases. To avoid the lengthy time out of service, the classification societies allow owners to opt for a *continuous survey* consisting of a programme of rolling inspections covering one-fifth of the ship each year.

As more governments have become involved in flag state regulation over the last 30 years, the activities of classification societies as government representatives has increased. The most common authorizations are in connection with tonnage measurement and load lines, SOLAS, MARPOL and IMO set standards on the transportation of dangerous goods. In carrying out statutory work, the classification society applies the standards relevant to the country of registry.

Finally, it is worth mentioning the vetting inspections carried out by charterers of ships, particularly corporations in the oil and steel industries.

The International Association of Classification Societies

Over the last thirty years classification societies have been under pressure from shipowners and regulators to standardize their rules. Non-standard rules mean design work classed by one society may not be acceptable to another, causing unnecessary cost and inconvenience. For regulators legislating on the technical standards of ship construction, particularly through the IMO, the lack of a common standard complicates their job. To address this problem, in 1968 the International Association of Classification Societies was set up. Its ten members are listed in Table 16.1 and account for about 90% of world classification activity. The IACS has two main aims: to introduce uniformity into the rules developed by class societies and to act as the interface between class societies. A related function is to collaborate with outside organizations and in particular IMO. In 1969 IMO granted IACS 'consultative status'. The fact that it is the only non-governmental organization with observer status at the IMO neatly illustrates the position of the classification societies as intermediaries between the commercial shipping industry and governments.

Over the last 30 years IACS has developed more than 160 sets of unified requirements. These relate to many factors, of which a few are minimum longitudinal strength, loading guidance information, and the use of steel grades for various hull members. However, a significant step forward came in December 2005 when the IACS Council adopted Common Structural Rules for tankers and bulk carriers. For the first time this integrated the rule-making activities of the societies into a single design standard. The Common Structural Rules were implemented on 1 April 2006.

16.4 THE LAW OF THE SEA

Why the law of the sea matters

Since maritime law is made and enforced by nation states, the next task is to examine the legal framework which determines the rights and responsibilities of nations for their ocean-going merchant ships. There are two obvious questions. First, which nation's law applies to a ship? Second, what legal rights do other nations have over that ship as it moves about the world? The answers were not developed overnight, they were evolved over the centuries as a set of customary rules known as the *law of the sea*.

The law of the sea: flag state versus coastal state

The debate over the legal responsibility for ships stretches back to the days when naval power was the deciding factor. A country's navy protected the ships flying its flag and this established the principle, which survives today, of flag state responsibility. However, coastal states also had a claim over ships visiting their ports or sailing in their coastal waters, if only because they could sink them with their cannons if they did not behave. Indeed, early writers suggested that the distance controlled by shore-based cannons should be the criterion for determining the extent of the coastal seas. In a world of rapidly growing commerce, agreeing the rights of the flag and coastal states has become a major issue. Can a country ban alcohol on board foreign ships in its territorial waters? If it considers a foreign ship unsafe, has it the right to detain it? The answers to these questions, in so far as there are answers, are to be found in the UN Convention on the Law of the Sea (UNCLOS 1982), the culmination of three Conferences on the Law of the Sea, referred to as UNCLOS I (1958), UNCLOS II (1960) and UNCLOS III (1973).

The process of developing these conventions started in 1958 when the United Nations called the UNCLOS I. Eighty-six states attended. The aim was to define the fundamental issues of the ownership of the sea, the right of passage through it and the ownership of the sea bed. The latter issue was becoming increasingly important as offshore oilfields started to be developed. Four conventions were eventually finalized, dealing with the Territorial Sea and Contiguous Zone, the High Seas, the Continental Shelf, and Conservation of Fisheries.

A second conference, UNCLOS II, was called in 1960 to follow up on some items not agreed in UNCLOS I. In the 1960s the growing awareness of the mineral wealth on the sea bed placed new significance on the law of the sea, and in 1970 the United Nations convened a third conference to produce a comprehensive Convention on the Law of the Sea. Work started in 1973 (UNCLOS III), attended by 150 states. With so many participants, discussion was extended. It was not until 1982 that the UNCLOS 1982 was finally adopted, to enter into force 12 months after it had been ratified by 60 states. It finally came into force on 16 November 1994, at last providing a 'comprehensive framework for the regulation of all ocean space … the limits of national jurisdiction over ocean space, access to the seas, navigation, protection and preservation of the marine environment'.[8]

As far as the flag of registration is concerned, UNCLOS 1982 endorses the right of any state to register ships, provided there is a 'genuine link' between the ship and the state. Since the flag state can define the nature of this link, in practice it can register any ship it chooses. Once registered, the ship becomes part of the state for legal purposes. The flag state has primary legal responsibility for the ship in terms of regulating safety, labour laws and on commercial matters. However the coastal state also has limited legal rights over any ship sailing in its waters.

The rights of the coastal states are defined by dividing the sea into the 'zones' shown in Figure 16.2, each of which is treated differently from a legal point of view: the

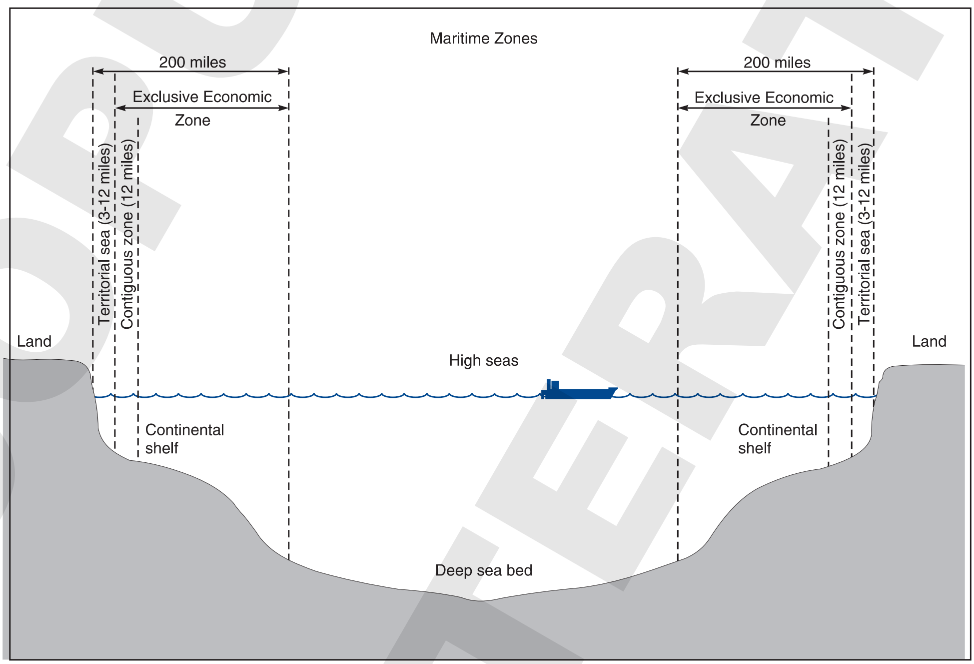

Figure 16.2
Maritime zones
Source: Martin Stopford 2007

BOX 16.1 MARITIME ZONES RECOGNIZED BY THE UN CONVENTION ON THE LAW OF THE SEA 1982

The territorial sea

This is the strip of water closest to the shore. UNCLOS recognizes a maximum width of 12 nautical miles, but in practice countries use many different limits, as can be seen in Table 16.2. Three miles is the smallest limit, 12 miles the most common, while 200 miles is the furthest. Ships have the right of innocent passage through territorial waters. Coastal states only have the right to enforce their own laws relating to specific topics listed in Article 21 such as safe navigation and pollution. They are entitled to enforce international laws.

The contiguous zone

This is a strip of water to the seaward of the territorial sea. It has its origins in the eighteenth-century 'Hovering Acts' enacted by Great Britain against foreign smuggling ships hovering within distances of up to 8 leagues (i.e. 24 miles) from the shore. Coastal states have limited powers to enforce customs, fiscal, sanitary and immigration laws.

The exclusive economic zone

The exclusive economic zone (EEZ) is a belt of sea extending up to 200 miles from the baseline (i.e. the legally defined shoreline). It is mainly concerned with the ownership of economic resources such as fisheries and minerals. Within this zone third parties enjoy freedom of navigation and the laying of cables and pipelines. From a shipping viewpoint the EEZ is more like the high seas. However, the exception concerns pollution. Article 56 confers on the coastal state 'jurisdiction as provided for in the relevant provisions of this convention with regard to the protection and preservation of the marine environment'. The 'relevant provisions' relate to the dumping of waste and other forms of pollution from vessels. This gives the coastal state the right to enforce oil pollution regulations in the EEZ, a matter of major economic importance for shipowners.

The high seas

The high seas are 'all parts of the sea that are not included in the exclusive economic zone, in the territorial sea or the internal waters of a state'. In this area vessels flying a particular flag may proceed without interference from other vessels. This convention establishes the basis on which nationality can be granted to a merchant ship and the legal status of that ship. Article 91 of the 1982 Convention on the High Seas states that:

> Each state shall fix the conditions for the grant of its nationality to ships, for the registration of ships in its territory, and for the right to fly its flag. Ships have the nationality of the state whose flag they are entitled to fly. There must exist a genuine link between the state and the ship.

This paragraph was unchanged from the 1958 Convention and was the end-product of a heated debate about whether countries such as Liberia and Panama had the right to establish open registries. Since the Convention does not define what constitutes a 'genuine link' between state and ship, it was left to each state to define this link for itself.

territorial sea (the strip closest to land); the contiguous zone; and the exclusive economic zone. The fourth zone is the high seas, which nobody owns. None of the zones are precisely defined. Although the 1982 Convention fixes the limit to the territorial sea at 12 miles, Table 16.2 shows that many different limits are in use. The most common is 12 miles, but a few countries have adopted much more extensive limits. The contiguous zone and the exclusive economic zone are mainly of interest to shipowners because pollution control and prevention rights are granted to the coastal states in these areas. These zones are briefly defined in Box 16.1.

Table 16.2 Limits of the territorial sea

Distance miles	Number countries
3	20
4	2
6	4
12	81
15	1
20	1
30	2
35	1
50	4
70	1
100	1
150	1
200	13
None	5
Total	137

Source: Churchill and Lowe, (1983, Appendix)

16.5 THE REGULATORY ROLE OF THE FLAG STATE

Economic implications of flag state regulation

In recent years the flag state issue has been crucial for maritime economics because it provided shipowners with a way of reducing their costs. When a ship is registered in a particular country (the flag state), the ship and its owner must comply with its laws. The unique feature of shipping is that because the ship moves around the world anyway, it is easy to change legal jurisdiction. For a shipowner there are four principal consequences of choosing to register a ship in one state rather than another:

1. *Tax, company law and financial law*. A company that registers a ship in a particular country is subject to that country's commercial laws. These laws will determine the company's liability to pay tax and may impose regulations in such areas as company organization, auditing of accounts, employment of staff and limitation of liability. All of these affect the economics of the business.
2. *Compliance with maritime safety conventions*. The ship is subject to any safety regulations the state has laid down for the construction and operation of ships. Registration under a flag that has ratified and rigidly enforces the 1974 Safety of Life at Sea (SOLAS) Convention means complying with these standards. Conversely, registration under a flag state that has not ratified SOLAS, or does not have the means to enforce it, allows shipowners to set their own standards on equipment and maintenance (but they are still subject to port state regulation).

3. *Crewing and terms of employment*. The company is subject to flag state regulations concerning the selection of crew, their terms of employment and working conditions. Some flag states, for example, insist on the employment of nationals.
4. *Naval protection and political acceptability*. Another reason for adopting a flag is to benefit from the protection and acceptability of the flag state. Although less important today, there were examples during the war between Iran and Iraq in the 1980s when shipowners changed to the US flag to gain the protection of US naval forces in the Gulf.

Any of these factors may be sufficient to motivate shipowners to seek a commercial advantage by changing their flag of registry. Table 16.3 shows that this has a long history, and one that gathered momentum during the twentieth century as taxation and regulation came to play an increasing part in the shipowner's commercial operations. This naturally raises the question whether a shipowner is free to change his flag. To answer this question we must look at how ships are registered. In some countries the shipowner is subject to the same legal regime as any other business, while in others special legislation is introduced covering merchant shipping companies.

Registration procedures

A ship needs a nationality to identify it for legal and commercial purposes, and it is obtained by registering the ship with the administration of a national flag. The way registration works varies from one country to another, but the British regime provides an illustration.

Under the Merchant Shipping Act 1894, British ships must be registered within Her Majesty's dominions (in practice, because of the constraints presented by the legislation of UK Dependent Territories, that registration may have to be in the UK). A peculiarity of British registration is that the ship is registered as 64 shares, at least 33 of which must be owned by a British subject or a company established under the law of some part of Her Majesty's dominions and having its principal place of business in those dominions.[9] Under the UK Companies Acts, any person of any nationality may register and own a company in the United Kingdom, so a national of any country may own a British ship.

Interestingly, there are no legal penalties for failing to register a ship, possibly because it was felt that the practical penalties are such that no legal enforcement is required to provide an additional inducement. A ship registered in the UK can fly the British flag, i.e. the Red Ensign, but is not obliged to do so. Nor is there any legal constraint on a British subject or British companies registering ships outside Britain if they wish to do so. All that is necessary is for the requirements of the recipient register to be met.

There is much variation in the requirements for registration. Some flag states require the ship to be owned by a national. This is the case in Liberia, but nationality is easily established by setting up a Liberian company, which qualifies as a national for the purposes of registration. Panama has no nationality requirements, while the Greek flag falls

Table 16.3 History of ship registration and port state control

Period	Flag of registry	Motivation
16th century	Spanish	English merchants circumvented restrictions limiting non-Spanish vessels from West Indies trade.
17th century	French	English fishermen in Newfoundland used French registry as a means to continue operation in conjunction with British registry fishing boats.
19th century	Norwegian	British trawler owners changed registry to fish off Moray Firth.
Napoleonic War	German	English shipowners changed registry to avoid the French blockade.
	Portuguese	US shipowners in Massachusetts changed registry to avoid capture by the British.
1922	Panamanian	Two ships of United American Lines changed from US registry to avoid laws on serving alcoholic beverages aboard US ships.
1920–1930	Panamanian	US shipowners switched registry to reduce operating costs by employing cheaper shipboard labour.
1930s	Panamanian	Shipowners with German-registered ships switched to Panamanian registry to avoid possible seizure.
1939–1941	Panamanian	With encouragement from the US government, shipowners switched to Panamanian registry to assist the Allies without violating the neutrality laws. European shipowners also switched to Panamanian registry to avoid wartime requisitioning of their vessels.
1946–1949	Panamanian	More than 150 ships sold under the US Merchant Sales Act of 1946 were registered in Panama - as it offered liberal registration and taxation advantages.
1949	Liberian	Low registration fees, absence of Liberian taxes, absence of operating and crewing restrictions made registry economically attractive.
1950–late 1970s	Flags of convenience develop as preferred registration for the independent shipping industry	As registry in USA and other countries became increasingly uneconomical, many countries competed to become 'flags of convenience' for ship registrations; only a few succeeded in attracting significant tonnage.
1982–2007	National flags start to enforce regulations on ships in their coastal waters	1982 Paris Memorandum of Understanding in which 14 European states agreed to work together to ensure that ships visiting their ports complied with international conventions on safety and pollution. Others followed.

Source: Cooper (1986)

somewhere between the two, requiring 50% ownership by Greek citizens or legal entities.[10] Dual registration is also possible to deal with situations where, for example, the ship is financed under a different jurisdiction from its legal ownership (dual registration is discussed below).

In 2004 the IMO adopted a scheme for issuing a unique number to each company and registered owner. Its purpose is to assign a permanent number for identification purposes to each company and/or registered owner 'managing ships of 100 gross tonnage and inwards … involved in international voyages'.[11]

Types of registry

Ship registers can be broadly divided into three groups: national registers, international registers and open registers.

- *National registers* treat the shipping company in the same way as any other business registered in the country. Certain special incentives or subsidies may be available but, broadly speaking, the shipping company is subject to the full range of national legislation covering financial, company and employment regulations.
- *International registers* were set up by some national flag administrations to offer their national shipowning companies an alternative to registering under open registries. They treat the shipping company in broadly the same way as an open register, generally charging a fixed tax on the tonnage of the ship (tonnage tax) rather than taxing corporate profits. The aim is to provide a national flag environment which offers shipowners the commercial advantages available under an open register. In 2005 there were eight international registers, of which Singapore, Norwegian International Registry, Hong Kong, Marshall Islands and the Isle of Man were the biggest.
- *Open registers (flags of convenience)* offer shipowners a commercial alternative to registering under their national flag, and they charge a fee for this service. The terms and conditions depend on the policy of the country concerned. The success of an open register depends on attracting international shipowners and gaining the acceptance of the regulatory authorities. In 2005 there were 12 open registries, which are listed in Table 16.4. Panama, Liberia, Bahamas, Malta and Cyprus were the biggest.

The distinction has more to do with how registered ships are treated than access to the flag. Most national registers are open to any shipowner, whatever his nationality, who wishes to apply for registration and satisfies the necessary conditions. For example, the United Kingdom is open to any Greek, Norwegian or Danish shipowner who wishes to register his vessels under the UK flag, provided he satisfies certain requirements.[12] Confronted with a choice of flags under which to register, the shipowner must weigh up the relative advantages and disadvantages of each of the alternatives.

Table 16.4 World merchant fleet by ownership and registration, January 2005

(1)	(2)	(3)	(4)	(5)
Flag state		**'000 dwt**		
1. NATIONAL REGISTERS				
		Registered		**% on home**
	Home	**Overseas**	**Total**	**register**
Greece	50,997	104,147	155,144	33%
Japan	12,611	105,051	117,662	11%
Germany	9,033	48,878	57,911	16%
China	27,110	29,702	56,812	48%
United States	10,301	36,037	46,338	22%
Norway	14,344	29,645	43,989	33%
Hong Kong	17,246	23,747	40,993	42%
Republic of Korea	10,371	16,887	27,258	38%
United Kingdom	10,865	14,978	25,843	42%
Singapore	12,424	9,909	22,333	56%
Russian Federation	6,845	10,022	16,867	41%
Denmark	8,376	8,491	16,867	50%
India	11,729	980	12,709	92%
Sweden	1,530	3,889	5,419	28%
Others	70,915	80,963	151,877	47%
Total national registers	274,697	523,326	798,022	
2. INTERNATIONAL REGISTERS				
		Fleet Owned by		**% owned by**
	Total	**Nationals**	**Foreigners**	**nationals**
Singapore	40,934	12,424	28,510	30%
Norwegian Int. Registry	21,262	12,424	8,838	58%
Hong Kong (China)	43,957	17,246	26,711	39%
Marshall Islands	38,088	10,828	27,260	28%
Isle of Man	12,073	4,700	7,373	39%
Danish Int. Ship Registry	8,859	8,330	529	94%
French Antarctic Territory	5,427	1,769	3,658	33%
Netherlands Antilles	2,132	616	1,516	29%
Total international registers	131,798	55,913	75,885	42%
3. OPEN REGISTERS ('FLAGS OF CONVENIENCE')				
		Fleet Owned by		**% owned by**
	Total	**Nationals**	**Foreigners**	**nationals**
Panama	177,866	0	177,866	—
Liberia	76,372	0	76,372	—
Bahamas	41,835	0	41,835	—
Malta	30,971	0	30,971	—
Cyprus	31,538	459	31,079	1%
Bermuda	6,206	—	6,206	—
St Vincent & Grenadines	6,857	0	6,857	0
Antigua & Barbuda	8,383	0	8,383	0
Cayman Islands	4,040	0	4,040	0
Luxemburg	794	0	794	0
Vanuatu	2,077	0	2,077	0
Gibraltar	1,281	0	1,281	0
Total open registers	388,220	—	387,761	0%
World total* (sum of col 2)	794,715			

Source: United Nations Review of Maritime Transport, 2005. Section 1 "National Registers" is from Table 16, p. 33; Sections 2 "International Registers" and 3 "Open Registers" are from Table 18 p. 37

* Of which: National registers 35%; International registers 17%; Open registers 48%

The economic role of open registers

The movement towards open registers started in the 1920s, when US shipowners saw registration under the Panamanian flag as a means of avoiding the high tax rates in the United States, while at the same time registering in a country within the stable political orbit of the United States. There was a spate of registrations during this period, but the real growth came after the Second World War when the US government sold off Liberty ships to US owners. Anxious to avoid operating under the American flag, US tax lawyers approached Liberia to set up a ship register designed to attract shipowners to register under that flag on the payment of an annual fee.[13] Shortly afterwards, Panama adapted its laws to attract shipowners from anywhere in the world, and thus the two major international open registers were established.

The use of an open register generally involves payment of an initial registration fee and an annual tonnage tax, which enables the register to cover its costs and make a profit. In return, the register offers a legal and commercial environment tailored to the requirements of a shipowner trading internationally. There are major differences in the way registers approach this task, but in general the areas addressed are:

- *Tax*. There are generally no taxes on profits or fiscal controls. The only tax is the subscription tax per net registered ton.
- *Crewing*. The shipping company is free to recruit internationally. There is no requirement to employ nationals either as officers or crew. However, international conventions dealing with crew standards and training may be enforced, depending on the policy of the register.
- *Company law*. As a rule, the shipping company is given considerable freedom over its corporate activities. For example, ownership of the stock in the company need not be disclosed; shares are often in 'bearer' form, which means that they belong to the person who holds them; liability can be limited to a one-ship company; and the company is not required to produce audited accounts. There are generally few regulations regarding the appointment of directors and the administration of business.

In effect, open registers are businesses and the service offered is determined by the register's maritime laws and the way they are enforced. Supervising safety standards is expensive and during the 1980s recession some open registers paid little attention to this aspect of the business, but this has proved a difficult stance to maintain. To be successful an open register's ships must be acceptable in the ports of the world and to bankers lending against a mortgage on the ship. As the scrutiny of ships by shippers and port authorities has increased it has become more important for open register flags to comply with international conventions, and most open registries, whilst offering shipowners freedom in the areas of taxation and company law, enforce legislation regarding the operational and environmental safety of ships registered under their flag.

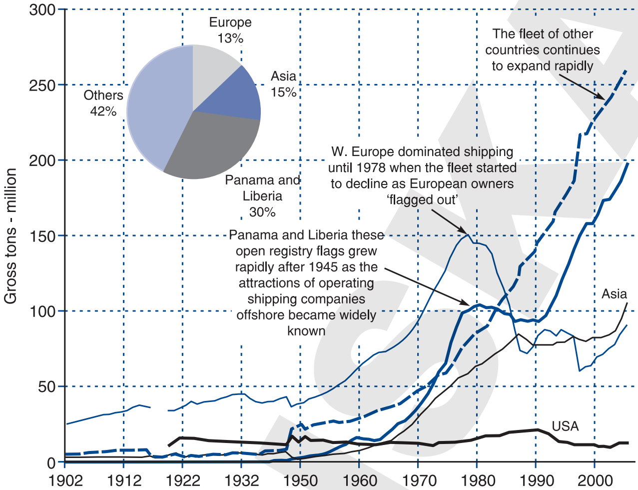

Figure 16.3
World merchant fleet by flag, 1902–2006
Source: Lloyd's Register of Shipping and CRSL

Figure 16.3 shows that by the late 1950s the Panamanian and Liberian fleets had reached 16 million grt and open registers were becoming a major issue for the established shipping states. Inevitably the question was raised whether a country such as Liberia has the right to offer registry to a shipowner who is not a national of that country. This issue was discussed at UNCLOS I in 1958 and put to the test in 1959 when the newly formed Inter-governmental Maritime Consultative Organization (IMCO) met in London and elected its Maritime Safety Committee. The terms of the election of the Committee stated that eight members of the committee should be the largest shipowning nations. Initially the eight nations elected were the USA, UK, Norway, Japan, Italy, the Netherlands, France and West Germany. However, objections were raised that Liberia, which ranked third in world tonnage, and Panama, which ranked eighth, should have been elected instead of France and Germany.

The dispute was submitted to the International Court of Justice for an opinion on whether the election was legal in terms of the 1948 Convention that established the IMCO.[14] It was argued by the European shipowners that for a ship to register in a country there had to be a 'genuine link' between registration and ownership, and that in the case of international open registry flags this link did not exist. Predictably Liberia, Panama, India and the USA took the opposite view. The European argument was not accepted by the Court which by a 9–5 vote held that, by not electing Liberia and Panama to the Maritime Safety Committee, the IMCO assembly had failed to comply with Article 28(a) of the 1948 Convention. As a result, international open registry flags were legitimized in international law.

In a world of high taxation, offshore registration was enormously attractive, and once this facility became available it was widely adopted. Today about half the world merchant fleet is registered under open registers. The principal open registry flags, Panama, Liberia, Bahamas, Malta, Cyprus, and Bermuda, plus half a dozen smaller flags including St Vincent and Antigua, are listed in Table 16.4. The fact that so few ships under these flags are owned by nationals confirms their status as open registries (see Table 16.4.3, column 3). Because in addition to tax concessions open registers allowed freedom in crew selection, in the 1980s and 1990s many large shipping corporations bowed, often reluctantly, to commercial pressures and abandoned their national flag in favour of open registers.

Although open registers acquired a mixed reputation in the 1980s, their success could not be overlooked and several established maritime nations set up their own 'international registry', designed to offer similar conditions and bring shipowners back under the national flag. The eight listed in Table 16.4 show that by 2005 these international registers had been successful in attracting 17% of the world fleet, though the fleet under open registers is considerably bigger and many shipowners in Greece, Japan, and the USA continue to register under their domestic flags. In the meantime the open registers have, in the main, fallen in line with regulatory practice and this form of ownership has become less controversial than it was a decade ago.

Dual registration

In some circumstances it is necessary for a shipowner to register a ship under two flags. For example, the owner may be required to register the ship under his domestic flag, but this flag may not be acceptable to the financing bank, so for mortgage purposes it is registered under a second jurisdiction. The way this works is that the ship is first registered in country A and its owning company then issues a bare boat charter which is registered in country B where it enjoys the same rights, privileges and obligations as any other ship registered under the flag. Obviously this only works if the registration authorities in country B are prepared to accept a bare boat charter, but several flags such as Malta and Cyprus are willing to do so for registration purposes, provided the registers are compatible.[15] Separating ownership from operation in this way can be used, for example, to allow the company to register in country A to maintain the nationality of the ship, whilst using the second register to circumvent restrictive national regulations such as crewing or to gain access to certain ports.

Company structures associated with ship registration

The use of open registers in shipping has given rise to a distinctive structure of company organization designed to protect the 'beneficial owner'. A typical company structure is shown in Figure 16.4. There are four active components:

1. *The beneficial owner*. The ultimate controlling owner who benefits from any profits the ship makes. He may be located in his home country or an international centre such as Geneva or Monaco.

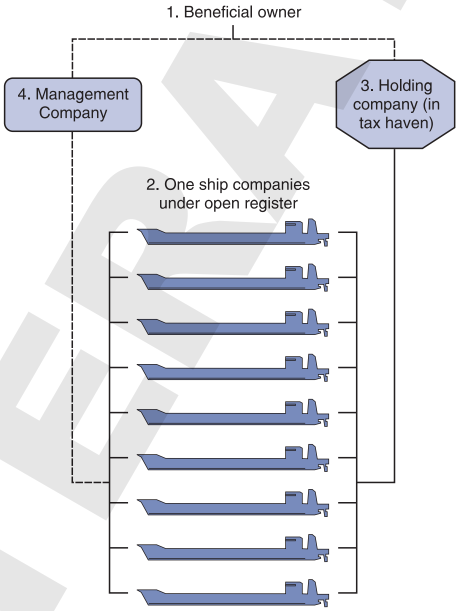

Figure 16.4
Shipping company ownership structure
Source: Martin Stopford, 2007

2. *One-ship company*. A company, usually incorporated in an open registry country, set up for the sole purpose of owning a single ship. It has no other traceable assets. This protects the other assets of the beneficial owner from claims involving the one-ship company.[16]
3. *Holding company*. A holding company is incorporated in a favourable tax jurisdiction for the purpose of owning and operating the ships. The only assets of this company are the shares in each one-ship company. The shares in this company are held by the beneficial owner, which could be a company or an individual.
4. *Management company*. Day-to-day management of the ships is carried out by another company established for this purpose. Usually this company is located in a convenient shipping centre such as London or Hong Kong.

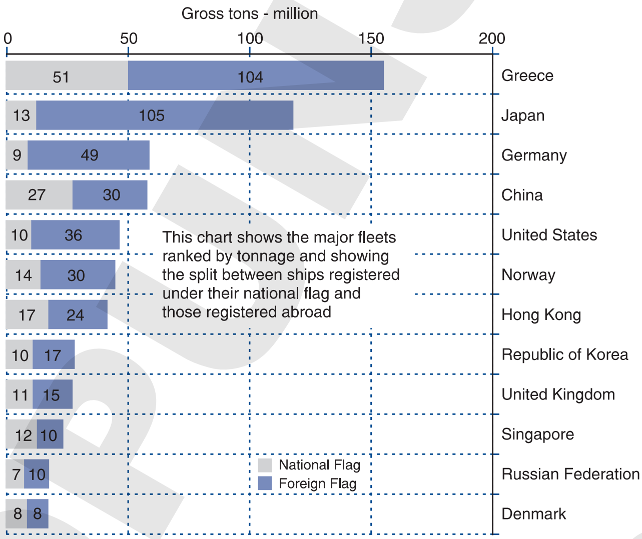

Figure 16.5
National merchant fleets using open registry flags, 2005
Source: Table 16.4

Beneficial ownership of the shipowning, management and holding companies takes the form of bearer shares. This device is used to insulate the beneficial owners of the ships from authorities seeking to establish tax and other liabilities. Its use is not universal and depends on the relative merits of the domestic flag. If we take the largest shipowning nations in 2005, we find that most had some vessels registered under foreign flags (Figure 16.5). For example, Greece, the nation with the biggest merchant fleet, had 67% of the tonnage registered abroad, leaving 33% under the domestic flag, whilst Japanese and US owners, both exceptionally high-cost flags, had had 89% and 78% registered abroad respectively. Germany had over 80% of its fleet flagged out. Norway had 67% flagged out, but many Norwegian owners use the Norwegian International Ship Register (NIS). In 1987 the Norwegian government, concerned about the trend towards flagging out, set up the NIS to give Norwegian owners most of the benefits they would receive under an international flag. Several other countries followed suit and their 'international flags' are listed in Table 16.4, including the Danish International Registry, Singapore, Hong Kong, Marshall Islands (the United States), Isle of Man (UK), French Antarctic Territory, Netherlands Antilles, and Belgium. All of these were established with the specific intention of providing a national alternative for domestic shipowners on commercial terms comparable with those available from open registries. There is a stark contrast between the open registries, which have few nationals using their flag, and the national registers shown at the top of Table 16.4 where most of the registered tonnage belongs to domestic shipowners (though more is flagged out).

16.6 HOW MARITIME LAWS ARE MADE

The role of maritime laws

There are good practical reasons for developing an internationally accepted body of maritime law. It is common sense that if ships are to trade efficiently, the maritime states they trade between should have the same regulations on such matters as safety and the environment. Different rules about, for example, how hazardous cargoes should be stowed or the hull design mean that a ship complying with one country's rules could not trade with another, wasting economic resources. It would also make designing specialized ships more difficult because the designer needs to know precisely where it will trade. But an enforceable body of maritime law must also be seen as just by the various maritime interests involved in carrying world trade, and the institutions which enforce those laws must be accepted as satisfying the same principles of justice.[17] History proves that the shipping industry is too diverse to police autocratically, so the regulatory process must carry the shipping industry as well as the regulators with it.

Persuading maritime states to agree the conventions which are the framework of maritime law will never be easy. The issues dealt with are often controversial, emotional and involve commercial interests, especially those triggered by a particular maritime incident, so developing a workable solution calls for patience and pragmatism. In the nineteenth century, British law was widely used as the framework for national maritime law, providing a common base. More recently, governments of maritime nations have taken more formal steps to standardize maritime law. This is achieved by means of international 'conventions', which are jointly drawn up between maritime states, setting out agreed objectives for legislation on particular issues. Each country can, if it wishes, introduce the measures set out in these conventions into its own national law. All nations that do this (known as signatories to the convention) have the same law on the subject covered by the convention.

The topics covered by maritime law

Today's body of maritime law has evolved gradually. Taking Britain as an example, in the mid-nineteenth century there were few rules and regulations and virtually no construction or safety standards for merchant ships. Many were sent to sea badly built, ill found, grossly overloaded and often over-insured. These 'coffin' ships 'frequently took their unfortunate crews to the bottom of the oceans of the world'.[18] As a result of the agitation for reform from a Member of Parliament called Samuel Plimsoll, the

'Plimsoll Act' became law in 1876 and the Board of Trade was empowered, as the responsible government department, to survey ships, pass them fit for sea, and have them marked with a load line indicating the legal limit to which they could be submerged.

In due course other laws were introduced as they became necessary, and the UK built up a body of maritime law which was specifically geared to tackling the problems that arise when operating an extensive merchant shipping fleet. As other countries developed their own laws they often drew on British practical experience as a basis for drafting their legislation. The first step towards a system of internationally accepted regulations (conventions) came in 1889 when the US government invited 37 states to attend an international marine conference. On the agenda at this conference was a list of problem areas in the maritime industry where it was felt that the standardization of the international regulations would be an advantage, including:

- rules for the prevention of collisions;
- regulations to determine the seaworthiness of vessels;
- draught to which vessels should be restricted when loaded;
- uniform regulations regarding the designation and marking of vessels;
- saving life and properties from shipwrecks;
- necessary qualifications for officers and seamen;
- lanes for steamers and frequented routes;
- night signals for communicating information at sea;
- warnings of approaching storms;
- reporting, marking and removing dangerous wrecks and obstructions to navigation;
- notice of dangers to navigation;
- the uniform system of buoys and beacons;
- the establishment of a permanent international maritime commission.[19]

In fact the conference succeeded in dealing with only the first item on the agenda, but the full agenda neatly illustrates the areas that were thought to be important and that were addressed by subsequent international conferences and conventions. But the most important outcome was to set the pattern for the present system under which maritime laws are developed by consensus between maritime states.

Procedures for making maritime conventions

The conventions which form the building blocks of maritime law are not laws; they are internationally agreed 'templates' which maritime states use as a base for enacting their national maritime legislation. This does not guarantee that every country will have exactly the same maritime law since some modify it and others do not even sign up. But it helps to avoid badly thought-out and inconsistent maritime legislation and on important issues such as safety, most maritime countries now have the same maritime law. The procedure for making or changing a maritime convention involves four steps, which are broadly summarized in Box 16.2.

BOX 16.2 FOUR STEPS IN MAKING A MARITIME CONVENTION

Step 1: *Consultation and drafting convention*. The issue requiring legislation is identified by interested governments and a conference is called to discuss it, at which written submissions from various interested states and parties are discussed. If there is enough support the agency (e.g. IMO or ILO) drafts and circulates to member states a convention setting out in detail the proposed regulation or an amendment or annex to an existing regulation.

Step 2: *Adoption of draft convention*. The conference is reconvened to consider the draft regulation, and when agreement has been reached on the text, it is adopted by the conference. The discussion serves the dual purpose of showing whether or not there is a consensus that the regulation is required and, if so, refining the form it should take.

Step 3: *Signature*. The convention is 'opened for signature' by the governments; by signing, each state indicates its intention to ratify the convention by making it legally binding in its own country.

Step 4: *Ratification*. Each signatory country ratifies the convention by introducing it into its own domestic legislation so that it becomes part of the law of the country or dominions, and the convention comes into force when the required number of states (usually two-thirds) have completed this process – the precise conditions of entry into force form part of the original adoption of the convention. Once the necessary conditions have been met, the convention has the force of law in those countries that have ratified it. It does not apply in countries where it has not been ratified and any legal cases must be tried under the prevailing national law.

An example of this process is provided by UNCLOS 1982 discussed in section 16.4. This was instigated by UN General Assembly Resolution 2749, which noted the 'political and economic realities' of the preceding decade and 'the fact that many of the present State Members of the United Nations did not take part in the previous United Nations Conferences on the law of the sea'. It called for a new conference on the law of the sea. The conference was convened in 1973, and discussions continued until 30 April 1982 when the draft convention was adopted by vote (130 in favour, 4 against, with 17 abstentions). The convention was opened for signature in Montego Bay, Jamaica, on 10 December 1982. On the first day signatures from 117 states were appended. In addition, one ratification was deposited.

Considerable time and effort is required to organize conferences, draft conventions and resolve differences and misunderstandings. This work is carried out by the IMO and the ILO. Each deals with a particular range of maritime affairs, as detailed in the following sections.

16.7 THE INTERNATIONAL MARITIME ORGANIZATION

History and organization of IMO

The IMCO came into operation in 1958, with responsibility for adopting legislation on matters relating to maritime safety and pollution prevention on a world-wide basis and acting as the custodian of a number of related international conventions. Subsequently, in 1982, the IMCO changed its name to the International Maritime Organization (IMO). It has been responsible for developing a large number of conventions, ranging from the Convention for the Safety of Life at Sea (SOLAS) to conventions on tonnage measurement and oil pollution.

The IMO has 166 member states and two associate members. Its governing body is the Assembly, which meets every two years. In between Assembly sessions a Council, consisting of 32 member states elected by the Assembly, acts as the governing body. The technical and legal work is carried out by five committees:

- The *Maritime Safety Committee* deals with a whole range of issues concerning safety at sea. Sub-committees deal with a wide range of issues which cover safety of navigation; radio communications and life-saving; search and rescue; standards of training and watch keeping; ship design and equipment; life-saving appliances; fire protection; stability and load lines; fishing vessel safety; carriage of dangerous goods, solid cargoes and containers; carriage of bulk liquids and gases; and flag state implementation.
- The *Marine Environment Protection Committee* deals with all issues relating to pollution, particularly oil.
- The *Technical Co-operation Committee* handles the technical cooperation programme which is designed to help governments implement the technical measures adopted by the organization.
- The *Legal Committee* is responsible for considering any legal matters within the scope of the organization.
- The *Facilitation Committee* is concerned with easing the flow of international maritime traffic by reducing the formalities and simplifying the documentation required of ships when entering or leaving ports or terminals.

To support these committees the IMO has a secretariat of about 300 staff located in London.

In its early years the IMO developed a comprehensive body of maritime conventions, codes and recommendations which could be implemented by member governments. The 16 most important conventions are listed in Table 16.5 along with a brief summary of their scope and the percentage of world tonnage which has ratified each one. Its most important convention, SOLAS, is now accepted by countries whose combined merchant fleets represent 98.8% of the world total. Although the initial emphasis was on drafting conventions, since the 1980s the focus has changed. By then the IMO had developed a comprehensive series of measures covering safety, pollution

Table 16.5 Major IMO conventions relating to maritime safety and pollution prevention for merchant shipping

No.		Instrument	Entry into force Date	Entry into force % fleet
1	SOLAS	International Convention for the Safety of Life at Sea, 1974* as amended, and its Protocols (1978, 1988)	25/05/80	99
2	SAR	International Convention on Maritime Search and Rescue, 1979	22/06/85	52
3	INTERVENTION	International Convention relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969, and its Protocol (1973)	06/05/75	73
4	MARPOL	International Convention for the Prevention of Pollution from Ships, 1973, and its Protocol (1978) Annex I (2 Oct. 1983); Annex II (6 April 1987) Annex III (1 July 1992); IV; Annex V (31 Dec. 1988)	02/10/83	98
5	CSC	International Convention for Safe Containers (1972)	06/07/77	62
6	OPRC	International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990	13/05/95	65
7	LC	Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 as amended, and its Protocol (1996)	30/08/75	69
8	COLREG	Convention on the International Regulations for Preventing Collisions at Sea, 1972, as amended	15/07/77	98
9	FAL	Convention on Facilitation of International Maritime Traffic, 1965, as amended	05/03/67	69
10	STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended	28/04/84	99
11	SUA	Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation, 1988, and its Protocol (1988)	01/03/92	92
12	LL	International Convention on Load Lines, 1966, as amended, and its Protocol (1988)	21/07/68	99
13	TONNAGE	International Convention on Tonnage Measurement of Ships, 1969	18/07/82	99
14	CSC	International Convention for Safe Containers, 1972 as amended	06/09/77	62
15	SALVAGE	International Convention on Salvage, 1989	14/07/96	38
16	ISM Code	Management Code for the Safe Operation of Ships and Pollution Prevention	01/12/09	

Status as at October 2006

Source: International Maritime Organization (London)

prevention, liability and compensation. It was recognized that legislation is of little value unless it is enforced so, in 1981, the Assembly adopted Resolution A500(XII) which redirected activity towards the effective implementation of the conventions. This resolution was reaffirmed for the 1990s and 'implementation' has become the major objective of IMO.[20] To promote the task the Maritime Safety Committee established a flag state implementation subcommittee.

The coverage of the conventions is briefly described in the following paragraphs.

The Safety of Life at Sea Convention (SOLAS)

The first conference organized by the IMO in 1960 adopted the International Convention for the Safety of Life at Sea 1960, which came into force in 1965 and covered a wide range of measures designed to improve the safety of shipping. This important convention has 12 chapters dealing with:

Chapter I – General Provisions
Chapter II:1 Construction: subdivision and stability, machinery and electrical installations
Chapter II:2 – Fire protection, fire detection and fire extinction
Chapter III – Life-saving appliances and arrangements
Chapter IV – Radio communications
Chapter V – Safety of navigation
Chapter VI – Carriage of cargoes
Chapter VII – Carriage of dangerous goods
Chapter VIII – Nuclear ships
Chapter IX – Management for the safe operation of ships
Chapter X – Safety measures for high-speed craft
Chapter XI:1 – Special measures to enhance maritime safety
Chapter XI:2 – Special measures to enhance maritime security
Chapter XII – Additional safety measures for bulk carriers.

SOLAS was updated in 1974 and now incorporates an amendment procedure whereby the convention can be updated to take account of changes in the shipping environment without the major procedure of calling a conference. The 1974 SOLAS Convention entered into force on 25 May 1980, and by October 2006 had been ratified by states representing 99% of the registered merchant fleet. A protocol relating to the Convention in 1978 entered into force on 1 May 1981.

With the growing recognition that loss of life at sea and environmental pollution are influenced by the way companies manage their fleets, in the 1990s the IMO took steps to regulate the standards of management in the shipping industry. At the SOLAS Conference held in May 1994, the International Safety Management (ISM) Code was formally incorporated into Chapter IX of the SOLAS regulations. The Code requires shipping companies to develop, implement and maintain a safety management system which includes:

- a company safety and environmental protection policy;
- written procedures to ensure safe operation of ships and protection of the environment;
- defined levels of authority and lines of communication shore and shipboard personnel;

- procedures for reporting accidents and non-conformities (i.e. errors which occur);
- procedures to prepare for and respond to emergency situations.

The ISM Code became mandatory for tankers, bulk carriers and passenger ships over 500 gross tons on 1 July 1998 and for most other ships trading internationally on 1 July 2002. Approximately 12,000 ships had to comply by the first deadline and the second phase of implementation brought in another 13,000 ships.[21] Previously safety regulations had tended to focus on the physical rather than the managerial aspects of the shipping business, so the ISM Code represented a new direction in maritime regulation. Inevitably it raised many new problems over the implementation and policing of such a complex system.

Collision avoidance at sea

Collisions are a common cause of accidents at sea. Measures to prevent these occurring were included in an Annex to the 1960 Safety of Life at Sea Convention, but in 1972 IMO adopted the Convention on the International Regulations for Preventing Collisions at Sea (COLREG). Included in this convention were regulations to introduce traffic separation schemes in congested parts of the world. These 'rules of the road' have substantially reduced the number of collisions between ships.[22]

Ships' load lines

The problem of dangerously overloading ships encountered in the nineteenth century was referred to earlier in the chapter. In 1930 an International Convention on Load Lines was adopted, setting out standard load lines for different types of vessels under different conditions. A new updated convention was adopted in 1966 and came into force in 1968.

Convention on Tonnage Measurement of Ships, 1969

Although this might seem an obscure subject for an international convention, it is one of great interest to shipowners because ports, canals and other organizations fix their charges on the basis of the ship's tonnage. This created an incentive to manipulate the design of ships in such a way as to reduce the ship's tonnage while still allowing it to carry the same amount of cargo. Occasionally this was at the expense of the vessel's stability and safety.

In 1969 the first International Convention on Tonnage Measurement was adopted. It proved to be so complex and so controversial that it required 25 states with not less than 65% of the world's gross merchant tonnage to ratify it before it became law. The required number of acceptances was not achieved until 1980 and the Convention came into force in 1982. The Convention established new procedures for computing the gross and net tonnages of a vessel and for the allocation of an IMO number to each ship, so that vessels could be uniquely identified.

Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), 1978

The aim of this Convention was to introduce internationally acceptable minimum standards for the training and certification of officers and crew members. It came into force in 1984. Amendments in 1995 complemented the ISM Code initiative by establishing verifiable standards, structured training and shipboard familiarization.

International Convention for the Prevention of Pollution from Ships

This convention, knowns as MARPOL, is the main international convention covering the prevention and minimization of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 and updated by amendments through the years. It currently has six technical annexes which set out the detail of the regulations:

Annex I: Regulations for the Prevention of Pollution by Oil
Annex II: Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk, including a list of 250 regulated substances
Annex III: Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (shipped in drums, etc.)
Annex IV: Prevention of Pollution by Sewage from Ships
Annex V: Prevention of Pollution by Garbage from Ships
Annex VI: Prevention of Air Pollution from Ships.

As the volume of oil shipped by sea increased in the 1950s and 1960s, regulations on marine pollution were needed. A conference to discuss the matter was held in London in 1952 and this resulted in the 1954 Convention for the Prevention of Pollution of the Sea by Oil (OILPOL). The main problem addressed by this convention was the uncontrolled discharge of oily ballast water. At the time tankers generally carried ballast water in their cargo tanks and discharged it outside the loading port. Because the ballast water contained small amounts of crude oil, it polluted the sea and beaches in these areas. To prevent this pollution OILPOL established ‘prohibited zones’ extending at least 50 miles from the nearest land. These regulations were progressively updated during the next 20 years.

During the 1960s, it became evident that there was a need for a wider-ranging convention on marine pollution, and in 1973 MAPROL was adopted. This convention applies to all forms of marine pollution except land-generated waste and deals with such matters as: the definition of violations; certificates and special rules on the inspection of ships; enforcement; and reports on incidents involving harmful substances. It required all tankers to have slop tanks and be fitted with oil discharge and monitoring equipment, whilst new oil tankers over 70,000 dwt must be fitted with segregated ballast tanks large enough to hold all ballast water for normal voyages – oil tanks could only be used for water ballast in extreme weather. At the next international conference on tanker safety and pollution prevention in 1978 additional measures were added in the form of a

Protocol to the 1973 Convention. The lower limit for tankers to be fitted with segregated ballast tanks was reduced from 70,000 dwt to 20,000 dwt and existing tankers were required to fit crude oil washing equipment.

Following a number of major oil pollution incidents, in particular the *Exxon Valdes*, in the early 1990s attention turned to tanker regulations to reduce the risk of oil spills resulting from tanker collisions and groundings. A new Annex I to MARPOL (73/78) was drafted, introducing two new regulations designed to reduce oil spills of this type. Regulation 13F required new tankers ordered after 6 July 1993 to have double hulls built to specified design parameters including a requirement that vessels over 30,000 dwt have a two-metre space between the cargo tanks and the hull. Regulation 13G created two age ‘hurdles’ for existing single hull tankers. As a defensive measure, at 25 years 30% of the side or the bottom area must be allocated to cargo-free tanks; and at 30 years all tankers must comply with Regulation 13F by fitting a double hull. The Annex was adopted on 1 July 1992.

Two major oil pollution incidents in European waters, the *Erika* in 1999 and the *Prestige* in 2002, resulted in the IMO Marine Environmental Protection Committee making further amendments to Annex 1 of MARPOL 73/78.

Firstly, the phasing-out of single hull tankers was accelerated. Under a revised Regulation 13G of Annex I of MARPOL, which entered into force in April 2005, the final phasing-out date for Category 1 tankers (pre-MARPOL tankers) was brought forward from 2005 to 2007. The final phasing-out date for Category 2 and 3 tankers (MARPOL tankers and smaller tankers) was brought forward from 2015 to 2010, though they were permitted to trade beyond the anniversary date of their delivery in 2010 at the discretion of port state administrations (double-bottomed and double-sided vessels were allowed to trade to 25 years or 2015). This was controversial because some single hull tankers would only be 15–20 years old in 2010. Secondly, it adopted the Conditional Assessment Scheme requiring a more detailed inspection of Category 2 (non-MARPOL compliant) and Category 3 (MARPOL compliant) single-hull tankers. Thirdly, a new Regulation 13H prohibited single hull tankers over 5,000 dwt from carrying heavy grades of oil from 5 April 2006 and smaller tankers of 600–5,000 dwt from 2008. These amendments entered into force on 5 April 2005. Note that in January 2007 the names of the regulations changed – Regulation 13F became Regulation 19, Regulation 13G became Regulation 20, and Regulation 13H became Regulation 21, all in MARPOL Annex 1.

In addition to oil pollution, in the late 1990s the IMO started to focus on the environmental impact of emissions from ships, including air emissions and ballast water. MARPOL Annex VI sets limits on sulphur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone-depleting substances. The annex includes a global cap of 4.5% on the sulphur content of fuel oil by weight and requires IMO to monitor the worldwide average sulphur content of fuel. In 2007 air emissions by ships were at the top of the IMO’s agenda and were being studied by a working group on air pollution. Their agenda included nitrogen (NOx) emission limits for new and existing engines; sulphur and fuel oil quality; emission trading; and emissions of volatile organic compounds from tankers. The aim was to propose amendments to existing regulations for implementation in 2008.

16.8 THE INTERNATIONAL LABOUR ORGANIZATION

Since the 1920s the terms and conditions of employment for seafarers have been dealt with by the International Labour Organization (ILO), making it one of the oldest intergovernmental agencies now operating under the United Nations. Its principal concern is with the welfare of the 1.2 million people who work at sea. It was originally set up in 1919. During the twentieth century it developed 32 maritime labour conventions and 25 maritime labour recommendations dealing with working and living conditions at sea, manning, hours of work, pensions, vacation, sick pay and minimum wages.

By the end of the twentieth century the maritime industry and governments were finding this complex body of maritime conventions difficult to ratify and enforce, and it became apparent that the industry needed a more effective system if it was to eliminate substandard ships. In 2001 the international seafarers' and shipowners' organizations presented a joint resolution at ILO calling for 'global standards applicable to the entire industry'. As a result, the ILO was charged with developing 'an instrument to bring together into a consolidated text as much of the existing body of ILO instruments as it proves possible to achieve'. The comprehensive new Maritime Labour Convention for the maritime industry was adopted in 2006 and comes into force after being ratified by 30 ILO member states with a total share of at least 33% of world gross tonnage. By mid-2008 it had been ratified by Liberia, Bermuda and the Marshall Islands and was expected to be in force by August 2011 (this section focusses on the new regulations, but a list of the existing regulations can be found in *Maritime Economics*, second edition, Table 12.6 or on the ILO website).

The 2006 Consolidated Convention aimed to maintain existing maritime labour standards, while giving countries more discretion to establish national laws adapted to local circumstances. It applies to all publicly or privately owned commercial ships, but excludes traditional vessels (e.g. dhows and junks), warships, naval auxiliaries and ships under 200 gross tons in domestic trades. Fishing boats are covered in a separate convention.[23] A 'seafarer' is defined as 'any person who is employed, engaged or works in any capacity on board a ship that is covered by the Convention'. Much of the new convention is devoted to a more structured version of the existing 68 ILO maritime conventions and recommendations, and gives countries flexibility to harmonize the new maritime legislation with national labour laws.

The convention has five 'titles', summarized in Table 16.6, setting minimum standards for seafarers, including conditions of employment, hours of work and rest, accommodation, recreational facilities, food and catering, health protection, medical care, welfare and social security protection. It sets legally binding standards but also incorporates guidelines, a significant departure from traditional ILO conventions. It also introduces procedures to simplify amending the regulations, allowing amendments to come into effect within three to four years from the proposal date.

A major innovation is Title 5, which deals with compliance and enforcement of the regulations. Any ships over 500 gross tons trading internationally must carry a maritime labour certificate and a declaration of maritime labour compliance, setting out the shipowner's plans for ensuring that national regulations are complied with. The ship's

Table 16.6 ILO Consolidated Maritime Labour Regulations, 2006*

Title 1. Minimum requirements for seafarers to work on a ship
- Minimum age
- Medical certificate
- Training and qualifications
- Recruitment and placement

Title 2. Conditions of employment: seafarers' employment
- Wages
- Hours of work and hours of rest; entitlement of leave
- Repatriation
- Seafarer compensation for the ship's loss; manning levels
- Career and skill development and opportunities for seafarers' employment

*Title 3. Accommodation, recreational facilities, food and cater*ing
- Accommodation and recreational facilities
- Food and catering

Title 4: Health protection
- Medical care, welfare and social security protection
- Medical care on board ship and ashore
- Shipowner's liability
- Health and safety protection and accident prevention
- Access to shore-based welfare facilities
- Social security

Title 5. Compliance and enforcement

Flag state responsibilities
- General principles
- Authorization of recognized organizations
- Maritime labour certificate and declaration of maritime labour compliance
- Inspection and enforcement; on-board complaint procedures; marine casualties

Port state responsibilities
- Inspections in port
- Onshore seafarer complaint-handling procedures
- Labour-supplying responsibilities

Note: This regulation was adopted in 2006, but is not expected to come into force until 2011 when the necessary ratifications have been achieved

master is responsible for carrying out these plans and keeping records as evidence of compliance. The flag state is responsible for reviewing the plans and their implementation. To encourage compliance by operators and owners, the Convention sets out mechanisms dealing with on-board and onshore complaint procedures; port state inspection; and the flag state's jurisdiction and control over vessels on its register.

16.9 THE REGULATORY ROLE OF THE COASTAL AND PORT STATES

The rights of coastal states over foreign ships

Now we come to the 'coastal states' and the part they play in regulating merchant shipping. UNCLOS 1982 allows coastal states to legislate for the 'good conduct' of ships in their territorial seas, but otherwise not to interfere with them. The Convention lists eight specific areas in which legislation is permitted – the main ones are safety of navigation; protection of navigational aids; preservation of the environment and prevention, reduction and control of pollution; and the prevention of infringement of customs and sanitary laws, etc. However Article 21 of UNCLOS 1982 specifically states that the legislation of coastal states 'shall not apply to the design, construction, manning or equipment of foreign ships, unless they are giving effect to generally accepted international rules or standards'. This is intended to prevent a 'nightmare scenario' in which ships are subject to different construction and crewing standards in different territorial waters. However, it also endorses the coastal state's right to enforce international regulations in its territorial waters, and this gave rise to the port state control movement.

The port state control movement was a response to the growing number of ships registered under flags of convenience, and the recognition that some of these flags were not, for whatever reason, enforcing international maritime regulations. This made the traditional supervisory role of the flag states less reliable than previously and in response the port states started to play an increasingly important part in the regulatory system.

The port state control movement

The port state control movement started in 1978 when eight European states located around the North Sea informally agreed to inspect foreign ships visiting their ports and share information about deficiencies. In 1982 the arrangement was formalized with the signing of the Paris Memorandum of Understanding (MOU) in which 14 European states agreed to work together to ensure that ships visiting their ports comply with international conventions on safety and pollution.

Signatories to the Paris MOU undertake to maintain an effective system of port state control by ensuring that foreign merchant ships calling at their ports comply with the standards laid down in the 'relevant' maritime conventions and their protocols which they define as the Load Lines Convention 1966; SOLAS 1974; MARPOL 1973/78; STCW 1978; COLREG 1972; the International Convention on the Tonnage Measurement of Ships 1969; and the ILO Convention No. 147 Merchant Shipping (Minimum Standards), 1976. Details of the first five conventions can be found in Table 16.5, whilst ILO Convention 147 is concerned with the crew safety, employment and welfare issues dealt with under Titles 1–4 of the new consolidated regulation in Table 16.6. Each participating state undertakes to inspect 25% of the foreign merchant ships entering its ports, basing the number on the average number of port calls during the previous three years. They also agree to work together, to exchange information with other authorities and to notify pilot services and port authorities immediately if they find deficiencies which may prejudice the safety of the ship or pose a threat of harm to the marine environment.

By 2007 the number of signatories to the Paris MOU had increased to 27, stretching from Russia to Canada, and the MOU has been updated regularly. In the meantime additional port state control MOUs have been established in the following areas:

- the Mediterranean MOU (10 participating countries);
- the Tokyo MOU (18 participants);

- the Caribbean MOU (11 participants);
- the Latin American agreement (12 participants);
- the Indian Ocean MOU (11 participants).

The United States controls its own programme.

Port state control inspections

In 1995 the IMO adopted a resolution providing basic guidance on port state control inspections to identify deficiencies in ship, its equipment or its crew should be conducted. The aim was to ensure that the inspections are consistently applied across the world from port to port. These procedures are not mandatory, but many countries have followed them.[24] The range of inspections is now very broad with over 50,000 ships a year being inspected, a significant proportion of the international fleet. For example, the Paris MOU undertakes about 20,000 inspections a year, identifying an average of 3.5 deficiencies per inspection. Ships with serious shortcomings are detained and a small number are banned. Lists of detained ships are published on a website. The Tokyo MOU undertakes a similar number of inspections.

The ships to be inspected are selected from lists of vessels arriving in the port, often using statistical techniques to identify higher-risk vessels. For example, the Paris MOU uses a target factor calculator which takes into account such factors as flag, age and ship type, weighting each characteristic on the basis of previous association with defects.

The inspection has three parts: a general external inspection of the ship on boarding; a check of certificates; and a more thorough 'walk around' to inspect the condition of exposed decks, cargo-handling gear, navigation and radio equipment, life-saving appliances; fire-fighting arrangements; machinery spaces; pollution prevention equipment; and living and working conditions. Under each heading the inspector works through a detailed checklist and notes any deficiencies. A 'deficiency' exists when some aspect of the ship does not comply with the requirements of a convention. If the inspector finds significant deficiencies, a more detailed inspection may be required, and if the ship is considered too unsafe to be allowed to proceed to sea, a detention order will be made. For example, a detention could be ordered under the Load Lines Convention if some structural shortcoming is apparent such as serious pitting in the deck plating; or under MARPOL if the remaining capacity in the slop tank is insufficient for the intended voyage; or under SOLAS if the engine room is not clean, with oily water in the bilges and pipe work installation contaminated by oil.

The US Oil Pollution Act 1990

Pollution is an area in which coastal states are very active. One of the most forthright initiatives in recent years has been the US Oil Pollution Act 1990. This legislation was formulated in response to the public concern following the grounding of the *Exxon Valdez* in the Prince William Sound, Alaska, in March 1989.

The Act applies to oil spills in US inland waters; up to 3 miles offshore; and the 'exclusive economic zone' up to 200 miles to sea from the shoreline. The LOOP

Terminal is not included. It lays down wide-ranging regulations for the handling of oil spills. The 'responsible party', defined as the owner or operator of the tanker, is required to pay for the clean-up, up to a liability limit of $10 million or $1200 per gross ton, whichever is the greater. However, if there has been gross negligence these limits do not apply.

In addition to making shipowners responsible for the cost of pollution incidents, the Act laid down specific requirements for ships operating in US waters. Each ship must carry a certificate of financial responsibility, demonstrating that it has sufficient financial means to pay a claim. There was also a requirement that vessels ordered after 30 June 1990 or delivered after 1 January 1994 should have double hulls and a schedule for phasing out single-hull tankers by 2010. The coastguard is required to evaluate the manning standards of foreign vessels and to ensure that these are at least equivalent to US law. All tankers are required to carry a contingency plan for responding to an oil spill.

This legislation, particularly the requirement for double-hulled tankers, caused great controversy. However, the effect was to focus the attention of the shipping community far more rigorously on the risks associated with oil pollution. In particular, for the first time, shipowners were faced with the possibility of unlimited liability for the cost of any oil spill they are involved in. The high cost of cleaning up after the *Exxon Valdez* spill put a financial dimension on the possible scale of this problem.

16.10 THE REGULATION OF COMPETITION IN SHIPPING

The final regulatory issue we will mention in this chapter is competition. Although the shipping industry is very competitive, parts of the business have a history of collusion, notably the liner business (Chapter 13) and some of the specialist shipping segments (Chapter 12). Even bulk shipping has various pools and cartels. Most countries have some legislation dealing with these issues, but the competition policy of the European Union and the anti-trust legislation in the United States are the two areas we will concentrate on in this section.

Regulatory control of liner cartels, 1869–1983

When liner conferences were set up in the 1870s (see Section 13.10) they immediately came under attack. In 1879 the *China Mail*, a Hong Kong newspaper, set the tone for a debate which lasted a century by describing the China Conference as 'one of the most ill-advised and arbitrary attempts at monopoly which has been seen for many a year'.[25] The first legal challenge came in 1887 when the Mogul Line sought an injunction to stop the Far East Freight Conference, which had seven members, from refusing rebates to shippers using Mogul vessels. The background was that when in 1885 Mogul Line had applied for admission to the conference, it was refused because it did not bear a full share of running regular services during off-peak periods. This led to a rate war and the Conference's Shanghai agents issued a circular warning that shippers who used Mogul ships would forfeit their rebates. Mogul applied for an injunction to stop the Conference refusing the rebates, but it was refused, confirming the legality of the Conference. Some years later, however, a British Royal Commission on Shipping Rings was set up to investigate the rebate system. Its report in 1909 again confirmed that the commercial relationship between shippers and conferences was justified and that the possible abuses of the deferred rebate system should be tolerated in the interests of achieving a strong liner system.[26]

The conference system reached its peak during the 1950s. The prominence which the liner conferences had achieved by this time is demonstrated by the UNCTAD Code of Conduct for Liner Conferences which was initiated at the first UNCTAD Conference in Geneva in 1964 (see Section 12.9). Many of the developing countries which had gained independence during the previous decade had balance of payments problems and were searching for solutions. Sea freight played an important part in the price of the primary exports on which most of them relied. In addition, the freight itself was a drain on their scarce foreign currency reserves. Setting up a national shipping line seemed the obvious solution to both problems. However, the liner conferences were not generally sympathetic and the emerging nations lacked the experience in the liner business to press their case. This led to political action by the ‘Group of 77’, a pressure group of developing countries within UNCTAD, the result of which was the UNCTAD Code which aimed to give each country the right to participate in liner conferences servicing their trade.

The UNCTAD Code was developed in the 1960s and 1970s and covered four major areas of liner shipping. It provided the right to automatic conference membership for the national shipping lines of the countries served by the conference. A cargo-sharing formula gave national shipping lines equal rights to participate in the volume of traffic generated by their mutual trade, with third parties carrying the residual. For example, under a 40:40:20 cargo-sharing agreement the bilateral traders reserved 40% of the cargo for their national vessels and ‘cross traders’ carried the remaining 20% of the cargo. Finally, shipping conferences were required to consult shippers over rates, and national lines had the right of consent on all major conference decisions affecting the countries serviced.

The Code took almost 20 years to develop and by the time it came into force in 1983 the liner business had changed out of all recognition. It has never been ratified by the USA and implementing a convention of this complexity, which involved agreeing and measuring trade shares, was too difficult. Despite this, the Code achieved two things. First, it gave rights to the emerging Third World shipping industry at a time when this recognition was needed. Second, it was the first international effort to regulate the extensive, and overly weighty, system of closed conferences. By opening the conferences to new participants, it weakened the tight control which had developed and set the scene for a new regulatory attitude towards the conference system.

US regulation of liner shipping, 1983–2006

From the 1970s onwards the USA became determined to open the newly containerized liner services to market forces and to curb, but not entirely prohibit, the activities of conferences. Under US anti-trust laws, agreements which restrict competition are illegal, but the US Merchant Shipping Act 1984 excluded liner conferences from US anti-trust legislation and allowed inter-modal rate making. However, the legislation placed severe limitations on conference activities, making closed conferences and loyalty rebates illegal. In addition, tariffs fixed by conferences operating into the USA were required to be filed with the Federal Maritime Commission FMC along with all service contracts, and made public. This changed the nature of the conferences operating on the Atlantic and the Pacific, producing the various alliances discussed in Section 13.10. The Ocean Shipping Reform Act which took effect on 1 May, 1999 was another step towards making the liner shipping industry more market-driven. The new law retained the antitrust exemption for the ocean liner industry and still required service contracts to be filed, but allowed their terms to remain confidential. A subsequent study found that as a result most shippers negotiated one-on-one confidential service contracts with individual carriers, instead of negotiating with rate-setting conferences or groups of carriers. In the two years following the regulation the number of these service contracts and amendments increased by 200%.[27]

European Union regulation of shipping competition

European regulations governing competition are set out in Articles 81 and 82 of the Treaty of Rome (1958). Article 81 makes it illegal for companies to cooperate to 'prevent, restrict or distort' competition by fixing prices, manipulating supply or discriminating between parties. Article 82 makes it illegal for a company to use its dominant position to undermine free competition by price fixing, manipulating supply or other abuses. In 1962, Regulation 17 gave the EU powers to enforce these articles but specifically excluded the transport industries, and it was not until 1986 that the EU Regulation 4056/86 set out 'detailed rules for the application of Articles 81 and 82 of the Treaty to maritime transport'. This regulation excluded tramp shipping because prices were 'freely negotiated on a case by case basis in accordance with supply and demand conditions'. Liner shipping was included, but, like most regulators before them, the EU accepted that conferences were in the interest of consumers, providing stability. As a result, the liner companies were given a 'block exemption' from Article 81, permitting them to fix rates, regulate capacity and collude in ways which would otherwise be illegal under the Treaty of Rome (although some shipping companies were fined for fixing prices outside liner conferences).

In 2004 the EU launched an initiative to review this special treatment received by the tramp shipping and liner industries. After consultation with the liner and tramp shipping industries, the EU concluded that:

> no credible consideration has been put forward in response to the consultation to justify why these services would need to benefit from different enforcement rules than those which the council has decided should apply to all sectors. On that basis the intention would be to bring maritime cabotage and tramp vessels services within the scope of the general enforcement rules.[28]

In September 2006, Regulation 4056/86 was repealed. The tramp shipping exemption lapsed on 18 October 2006, facing companies with the possibility that Articles 81 and 82 of the Treaty of Rome might be enforced against shipping pools, of which a number were operating in the tanker, dry bulk and specialist markets.

For the rapidly growing container industry the Commission's discussion paper published in 2005 argued that

> even if conferences were to provide for pro competitive effects in terms of e.g. price stability, reduced uncertainty about trade conditions, possible more accurate forecasts of supply and demand, reliable and adequate services, this would appear in itself not to be sufficient to conclude that the second condition of Article 81(3) on the treaty is fulfilled, since it has not been established that the net effect on consumers (transport users and end consumers) is at least neutral.[29]

After a lengthy investigation they ruled that price agreement was no longer necessary and that the industry and consumers would benefit from free competition. The repeal of Regulation 4056/86 removed the block exemption with effect from 18 October 2008. From this date all shipping companies operating on routes into and out of Europe cannot operate in conferences that fix price and capacity. This will apply equally to EU and non-EU based carriers. Liner shipping conferences outside of Europe are not affected but are subject to their own anti-trust laws.

EU regulation of tramp shipping pools

For tramp shipping the loss of the exemption from Articles 81 and 82 raised questions about the legality of the pools operated in the tanker and bulk carrier markets. Tramp shipping pools bring together similar vessels under different ownership. They are placed under a single pool manager, though the ships generally continue to be operated and crewed by the owners. The nature of pool agreements in tramp shipping varies widely, but the main principles were discussed in Section 2.9.

Article 81(1) of the Rome Treaty explicitly prohibits price fixing and sharing markets between competitors, unless the pool produces genuine benefits as defined in Article 81(3). In effect, pool members must be able to demonstrate: that their pool produces efficiency gains; that these benefits are passed on to transport users, for example as lower transport costs or new logistic solutions; that there is no less restrictive way of obtaining these efficiencies; and that the pool does not have an unreasonably large market share which inhibits free market competition.

Generally the EU took the view that tramp pool agreements that have very low market shares are unlikely to raise competition problems, provided the agreement does not contain provisions regarding joint price fixing and/or joint marketing or if the participants cannot be considered actual or potential competitors.[30] In September 2007 the EU published draft guidelines setting out the principles that the EU will follow when defining markets and assessing cooperation agreements in the maritime transport services sectors affected by the repeal of Regulation 4056/86.[31]

16.11 SUMMARY

In this chapter we have moved outside the conventional framework of market economics to examine the regulatory system that plays such a vital part in the economics of the shipping industry. We started by identifying three regulatory regimes which operate in the shipping industry: the classification societies, the flag states and the coastal states.

The classification societies are the shipping industry's internal regulatory system. The mainstay of their authority is the classification certificate which is issued when the ship is built and updated by means of regular surveys throughout the life of the ship. Without a class certificate a ship cannot obtain insurance and has little commercial value. But they are also the industry's largest technical resource, and in their role as recognized organizations they play an increasingly important part in the regulation of safety and security.

Flag states make the laws which govern the commercial and civil activities of the merchant ship. Because different countries have different laws, the flag of registration makes a difference. Registers can be subdivided into national registers, which treat shipping companies in the same way as other national industries; open registers (flags of convenience) such as Liberia and Panama, which are set up with the specific objective of earning revenue by offering commercially favourable terms of registration as a service to shipowners; and international registers set up by maritime states to offer their domestic shipowners comparable commercial terms to the open registers. With the increasing globalization of the maritime industry, open registers have become more prominent and half the world merchant fleet is now registered under a foreign flag, which in practice usually means a flag of convenience.

Although each nation makes its own maritime laws, on matters such as safe ship design, collision avoidance, load lines, pollution of the sea and air, tonnage measurement and certificates of competency it would be hopelessly impractical if each country had different laws. Developing a framework of international law which avoids this problem is achieved by means of international conventions. Maritime nations meet to discuss the draft convention, which is finally agreed. Each country then ratifies it and in doing so undertakes to incorporate the terms of the convention into its own national legislation. International conventions drawn up since the mid-1960s cover a wide range of different subjects including the safety of life at sea, load lines, crew training, tonnage measurement, terms and conditions of employment of crew, oil pollution and the conduct of liner conferences. The organizations active in developing these conventions are the International Maritime Organization and International Labour Organization.

Although major conventions such as SOLAS (1974) are ratified by 99% of the eligible countries, others are controversial and some countries choose not to ratify them, or allocate sufficient administrative resources to enforcing them, leaving 'loopholes' in the system.

Shipowners registered in these countries are, in principle, able to operate outside the convention, but they are still subject to a third form of regulation, by the coastal state in whose waters their ship is trading. The Law of the Sea permits coastal states to pass legislation concerning the 'good conduct' of ships in its territorial waters. One important area of legislation is pollution control, notably the US Oil Pollution Act 1990. In addition, since the 1970s there has been a trend towards 'port state control'. The movement started with the Paris MOU under which a group of European states agreed to work together to ensure that ships visiting their ports complied with international conventions on safety and pollution. There are now similar MOUs covering most parts of the world and over 50,000 ships a year are inspected.

Finally, the competitive practices of the shipping industry are also subject to regulation, and the United States and Europe are particularly active in this area. The principal area of concern is the liner conferences which fix prices and capacity levels. During the cargo liner era this was accepted as necessary to provide stable services and pricing, but with the advance of containerization the regulatory authorities are less willing to exempt the liner and tramp shipping industry from anti-trust regulations, and in 2006, for example, the EU made liner conferences and tramp shipping pools subject to its competition laws.