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Chapter 4

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4

PORT DEVELOPMENTS

World container port throughput increased by an estimated 5.9 per cent to 572.8 million 20-foot equivalent units (TEUs) in 2011, its highest level ever. This increase was lower than the 14.5 per cent increase of 2010 that was itself a sharp rebound from the slump of 2009. Chinese mainland ports maintained their share of total world container port throughput at 24.2 per cent.

The UNCTAD Liner Shipping Connectivity Index (LSCI) showed a continuation in 2012 of the trend towards larger ships deployed by a smaller number of companies. Between 2011 and 2012, the number of companies providing services per country went down by 4.5 per cent, while the average size of the largest container ships increased by 11.5 per cent. Only 17.7 per cent of country pairs are served by direct liner shipping connections; for the remaining country pairs at least one trans-shipment port is required.

This chapter covers container port throughput, liner shipping connectivity and some of the major port-development projects underway in developing countries. It also assesses how recent trends in ship enlargement may impact ports.

A. PORT THROUGHPUT

Port throughput is usually measured in tons and by cargo type (for example, liquid or dry cargo). Liquid cargo is usually measured in tons or sometimes, in the case of oil, in barrels. Within the dry cargo sector there is bulk (coal, grain, iron ore, and the like) and break bulk (for example, general cargo, timber and containers). The dry cargo sector represents around two-thirds of world seaborne trade. Approximately 25 per cent of the dry cargo sector relates specifically to the five major bulks (coal, grain, iron ore, phosphates and bauxite/alumina) and approximately 40 per cent is other dry cargo. These other dry cargoes (for example, timber, outsized cargo) are carried in general cargo vessels and by container ships. Around 17 per cent of world seaborne trade relates specifically to container trade. The potential for container trade to continue increasing its share of the dry cargo sector is therefore a real possibility. The goods that are shipped in containers represent a variety of products ranging from scrap waste, raw materials and semi-manufactured goods to finished products ready for consumption. The container is popular because it is practical, versatile, ubiquitous and well understood. The standardization of cargo packaging and handling has other benefits, such as ease of movement between modes and reductions in cargo handling time and costs. The share of container cargo within a country's break-bulk trade could also serve as a barometer of how well a country is integrated into the international trade arena. This chapter therefore pays particular attention to developments in container shipping and container ports.

1. Container ports

Container-port throughput is measured in terms of TEUs. It is one of the few units which enable port activity to be compared globally. The latest figures available for world container-port traffic can be seen in table 4.1. Seventy-five developing countries and economies in transition with an annual national throughput of over 100,000 TEUs are listed. (Annex IV shows port throughput figures for 127 countries). In 2010, the container throughput for developing economies grew by an estimated 15.8 per cent to 376.7 million TEUs. This growth is a turnaround in the sharp decline of the previous year that was largely a direct response to businesses reducing their inventories in light of uncertainties surrounding the global economic crisis. The growth rate for container throughput in developing economies for 2011 is estimated at 6.8 per cent, signifying a return to previous year-on-year growth levels. Developing economies' share of world throughput continues to remain virtually unchanged at approximately 70 per cent. Out of the 75 developing economies and economies in transition listed in table 4.1, only 10 experienced negative growth in port throughput in 2010, signalling that there have not been any sustained affects on container ports as a result of the global economic crisis. Of the top 10 developing countries and countries in transition, nine are located in Asia. Sixteen of the top 20 countries are also in Asia, while two are in Central and South America and two in Africa. The dominance of Asia in container port throughput signifies the importance of the region in producing exports. The 10 countries registering the highest growth were Morocco (68.5 per cent), the Russian Federation (32.6 per cent), Mexico (28.5 per cent), Panama (28.5 per cent), Ukraine (27.7 per cent), Georgia (24.5 per cent), Peru (24.4 per cent), Argentina (24.1 per cent), Brazil (23.5 per cent) and Turkey (22.7 per cent). The country with the largest share of container throughput continues to be China, with eight of its ports amongst the top 20. Chinese ports, excluding Hong Kong (China), experienced a positive growth of 19.4 per cent in 2010 to reach 128.9 million TEUs. Preliminary figures for 2011 show a reduced growth for Chinese port throughput to around 7.3 per cent, at 138.4 million TEUs. Chinese ports, with the exception of Hong Kong (China) and Taiwan, Province of China, accounted for around 25.8 per cent of world container throughput in 2011, down from 27.4 per cent in the previous year. The reduction of Chinese ports' share in world container throughput also corresponds to a reduction in Chinese imports of some raw materials, such as iron ore and thermal coal.[1] In order to boost imports and achieve a more balanced trade with trading partners, China announced in 2012 a series of reductions on import taxes for certain goods.[2] This move could translate into increased manufacture of goods for export, if these are not consumed domestically, and thus help increase container throughput (a more detailed account of international trade demand and supply is given in chapter 1).

Table 4.2 shows the world's 20 leading container ports for the period 2009–2011. The top 20 container ports accounted for approximately 52 per cent of world container port throughput in 2011. Combined, these ports showed a 7.8 per cent increase in throughput in 2011, down from a 15.2 per cent increase in

Table 4.1. Container port throughput for 75 developing countries and economies in transition for years 2009, 2010 and 2011 (TEUs)

Country	2009	2010	Preliminary figures for 2011[a]	Percentage change 2010–2009	Percentage change 2011–2010
China	107 963 180	128 929 895	138 391 031	19.42	7.34
Singapore	26 592 800	29 178 500	30 722 470	9.72	5.29
China, Hong Kong SAR	21 040 096	23 699 242	24 404 000	12.64	2.97
Republic of Korea	15 699 161	18 537 801	20 809 210	18.08	12.25
Malaysia	15 859 938	18 244 650	19 808 658	15.04	8.57
United Arab Emirates	14 425 039	15 174 023	16 752 724	5.19	10.40
China, Taiwan Province of	11 352 097	12 501 107	13 463 919	10.12	7.70
India	8 011 810	9 752 908	9 951 310	21.73	2.03
Indonesia	7 243 557	8 371 058	8 884 888	15.57	6.14
Brazil	6 574 617	8 121 324	8 597 733	23.53	5.87
Thailand	5 897 935	6 648 532	7 170 500	12.73	7.85
Egypt	6 250 443	6 709 053	6 556 189	7.34	-2.28
Panama	4 597 112	5 906 056	6 534 265	28.47	10.64
Viet Nam	4 936 598	5 983 583	*6 282 762*	21.21	*5.00*
Turkey	4 521 713	5 547 447	5 998 820	22.68	8.14
Saudi Arabia	4 430 676	5 313 141	5 694 538	19.92	7.18
Philippines	4 306 941	4 946 882	5 230 909	14.86	5.74
Sri Lanka	3 464 297	4 000 000	*4 200 000*	15.46	*5.00*
Oman	3 768 045	3 893 198	4 089 760	3.32	5.05
South Africa	3 726 313	3 806 427	3 924 059	2.15	3.09
Mexico	2 874 290	3 693 949	3 878 646	28.52	5.00
Russian Federation	2 360 625	3 129 973	3 692 719	32.59	17.98
Chile	2 795 989	3 171 950	3 387 348	13.45	6.79
Iran (Islamic Republic of)	2 206 476	2 592 522	*2 722 148*	17.50	*5.00*
Colombia	2 056 747	2 443 786	*2 565 975*	18.82	*5.00*
Pakistan	2 058 056	2 149 000	*2 256 450*	4.42	*5.00*
Morocco	1 222 000	2 058 430	*2 161 352*	68.45	*5.00*
Argentina	1 626 351	2 018 424	*2 119 345*	24.11	*5.00*
Jamaica	1 689 670	1 891 770	*1 986 359*	11.96	*5.00*
Peru	1 232 849	1 533 809	*1 610 499*	24.41	*5.00*
Dominican Republic	1 263 456	1 382 601	*1 451 731*	9.43	*5.00*
Bangladesh	1 182 121	1 356 099	*1 423 904*	14.72	*5.00*
Ecuador	1 000 895	1 221 849	*1 282 941*	22.08	*5.00*
Venezuela (Bolivarian Republic of)	1 238 717	1 216 208	*1 277 018*	-1.82	*5.00*
Bahamas	1 297 000	1 125 000	*1 181 250*	-13.26	*5.00*
Costa Rica	875 687	1 013 483	*1 064 157*	15.74	*5.00*
Guatemala	906 326	1 012 360	*1 062 978*	11.70	*5.00*
Lebanon	994 601	949 155	1 034 249	-4.57	8.97
Kuwait	854 044	888 206	*932 616*	4.00	*5.00*
Kenya	618 816	696 000	*730 800*	12.47	*5.00*
Uruguay	588 410	671 952	*705 550*	14.20	*5.00*
Ukraine	516 698	659 541	692 069	27.65	4.93
Syrian Arab Republic	685 299	649 005	*681 455*	-5.30	*5.00*
Honduras	571 720	619 867	*650 860*	8.42	*5.00*
Jordan	674 525	619 000	*649 950*	-8.23	*5.00*
Côte d'Ivoire	677 029	607 730	*638 117*	-10.24	*5.00*
Djibouti	519 500	600 000	*630 000*	15.50	*5.00*
Trinidad and Tobago	567 183	573 217	*601 878*	1.06	*5.00*

Table 4.1. Container port throughput for 75 developing countries and economies in transition for years 2009, 2010 and 2011 (TEUs) (continued)

Country	2009	2010	Preliminary figures for 2011[a]	Percentage change 2010–2009	Percentage change 2011–2010
Ghana	493 958	513 716	*539 402*	*4.00*	*5.00*
Tunisia	418 880	466 375	*489 693*	11.34	*5.00*
Sudan	431 232	439 100	*461 055*	1.82	*5.00*
United Republic of Tanzania	370 401	426 847	*448 189*	15.24	*5.00*
Mauritius	406 862	444 778	439 695	9.32	-1.14
Yemen	382 445	370 382	*388 901*	-3.15	*5.00*
Senegal	331 076	349 231	*366 693*	5.48	*5.00*
Qatar	410 000	346 000	*363 300*	-15.61	*5.00*
Congo	285 690	297 118	*311 973*	*4.00*	*5.00*
Bahrain	279 799	289 956	*304 454*	3.63	*5.00*
Benin	267 000	277 680	*291 564*	*4.00*	*5.00*
Papua New Guinea	262 209	268 649	283 839	2.46	5.65
Algeria	247 986	265 628	*278 910*	7.11	*5.00*
Cameroon	240 300	249 912	*262 408*	*4.00*	*5.00*
Cuba	283 910	228 346	246 773	-19.57	8.07
Georgia	181 613	226 115	*237 421*	24.50	*5.00*
Cambodia	207 577	224 206	*235 416*	8.01	*5.00*
Mozambique	214 701	223 289	*234 453*	*4.00*	*5.00*
Guam	157 096	183 214	*192 375*	16.63	*5.00*
Myanmar	160 200	166 608	*174 938*	*4.00*	*5.00*
Libya	155 596	161 820	*169 911*	*4.00*	*5.00*
El Salvador	126 369	145 774	*153 063*	15.36	*5.00*
Madagascar	132 278	141 093	*148 148*	6.66	*5.00*
Croatia	130 740	137 048	*143 900*	4.82	*5.00*
Gabon	130 758	135 988	*142 788*	*4.00*	*5.00*
Aruba	125 000	130 000	*136 500*	*4.00*	*5.00*
Namibia	265 663	256 319	107 606	-3.52	-58.02
Subtotal	**322 916 789**	**373 174 905**	**398 093 478**	**15.56**	**6.68**
Other reported[b]	**2 314 458**	**3 514 451**	**4 247 444**	**51.85**	**20.86**
Total reported	**325 231 247**	**376 689 356**	**402 340 923**	**15.82**	**6.81**
World total	**472 273 661**	**540 693 119**	**572 834 421**	**14.49**	**5.94**

Sources: UNCTAD secretariat, derived from information contained in Containerisation International Online (May 2012), from various Dynamar B.V. publications and from information obtained by the UNCTAD secretariat directly from terminal and port authorities.

[a] In this list, Singapore includes the port of Jurong.

[b] The term other reported refers to countries for which fewer than 100,000 TEUs per year were reported. Notes: Many figures, especially for 2011, are estimates (these figures are highlighted in italics). Port throughput figures tend not to be disclosed by ports until a considerable time after the end of the calendar year. Country totals may conceal the fact that minor ports may not be included; therefore, in some cases, the actual figures may be higher than those given.

2010. The list includes 15 ports from developing economies, all of which are in Asia; the remaining five ports are from developed countries, three of which are located in Europe and two in North America. In 2011, 15 of the ports maintained the same ranking as in the previous year, with all of the top 13 maintaining exactly the same position. One North American port (New York and New Jersey) fell out of the top 20 and was replaced by one Asian port (Dalian). Shanghai maintained its top position, widening the gap between itself and the second in position, Singapore, from 600,000 to 1.7 million TEUs. The entry into the top 20 container ports of Dalian comes on the back of a 22 per cent growth in throughput, the highest in the top 20. The ports of Antwerp and Hamburg swapped places, with the latter taking the lead on the back of a 14.2 per cent increase against the former's 2.3 per cent growth. Long Beach moved down two places from eighteenth to twentieth position as container throughput contracted by 3.2 per cent, the only port in the top 20 to experience a negative growth. Xiamen moved up one place from nineteenth to eighteenth

Table 4.2. Top 20 container terminals and their throughput for 2009, 2010 and 2011 (In TEUs and percentage change)

Port Name	2009	2010	Preliminary figures for 2011	Percentage change 2010–2009	Percentage change 2011–2010
Shanghai	25 002 000	29 069 000	31 700 000	16.27	9.05
Singapore	25 866 400	28 431 100	29 937 700	9.92	5.30
Hong Kong	21 040 096	23 699 242	24 404 000	12.64	2.97
Shenzhen	18 250 100	22 509 700	22 569 800	23.34	0.27
Busan	11 954 861	14 194 334	16 184 706	18.73	14.02
Ningbo	10 502 800	13 144 000	14 686 200	25.15	11.73
Guangzhou	11 190 000	12 550 000	14 400 000	12.15	14.74
Qingdao	10 260 000	12 012 000	13 020 000	17.08	8.39
Dubai	11 124 082	11 600 000	13 000 000	4.28	12.07
Rotterdam	9 743 290	11 145 804	11 900 000	14.39	6.77
Tianjin	8 700 000	10 080 000	11 500 000	15.86	14.09
Kaohsiung	8 581 273	9 181 211	9 636 289	6.99	4.96
Port Klang	7 309 779	8 871 745	9 377 434	21.37	5.70
Hamburg	7 007 704	7 900 000	9 021 800	12.73	14.20
Antwerp	7 309 639	8 468 475	8 664 243	15.85	2.31
Los Angeles	6 748 994	7 831 902	7 940 511	16.05	1.39
Tanjung Pelepas	6 016 452	6 530 000	7 500 000	8.54	14.85
Xiamen	4 680 355	5 820 000	6 460 700	24.35	11.01
Dalian	4 552 000	5 242 000	6 400 000	15.16	22.09
Long Beach	5 067 597	6 263 399	6 061 085	23.60	-3.23
Total top 20	220 907 422	254 543 912	274 364 468	15.23	7.79

Source: UNCTAD secretariat and *Containerisation International Online* (May 2012).
Note: In this list Singapore does not include the port of Jurong.

position with a growth of 11 per cent. The overall picture that emerges is that most of the demand and growth for container ports is still firmly in Asia. This signals greater intraregional trade in Asia and the importance of the region as a centre of international trade.

2. Liner shipping connectivity

Components of liner shipping connectivity

As regards the deployment of container ships by liner shipping companies, the year 2012 saw a continuation of trends already observed in previous years, that is, an increase in ship sizes and carrying capacity, and a decrease in the level of competition. Between mid-2004 and May 2012, the average number of companies deploying container ships on services from and to coastal countries' seaports decreased from 22 to 17, a decline of 23 per cent. During the same period, the size of the largest vessels deployed continuously increased, from an average vessel maximum of 2,812 TEUs in 2004 to 5,452 TEUs in 2012, an increase of 94 per cent (see figure 4.1). As vessel sizes have increased faster than the available volume of cargo, there is less space for liner shipping companies in each market, and the average number of companies is consequently decreasing.

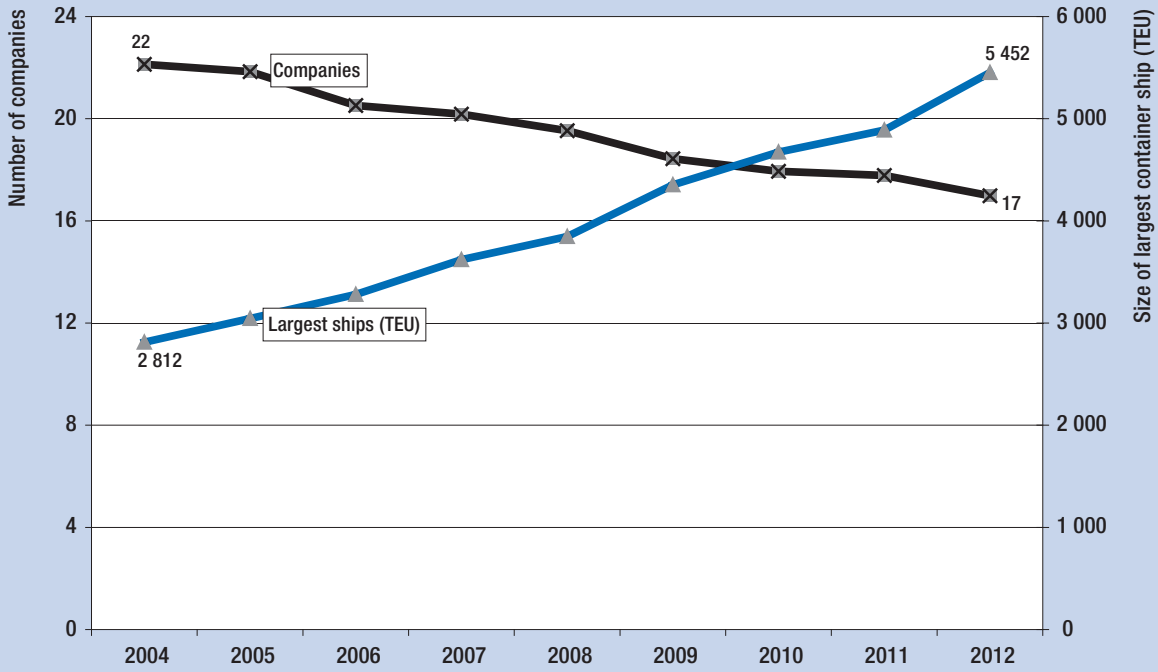
Figure 4.2 illustrates another aspect of this trend. The country average of the total TEU carrying capacity increased by 82 per cent between 2004 and 2012, while the number of ships has remained almost constant. Using larger ships, the growing seaborne containerized trade can be transported without the need to increase vessel numbers.

Developing-country connections

Globally, the best-connected country continues to be China. In May 2012, there were 1,765 container ships deployed on liner shipping services to and from Chinese ports, with a total carrying capacity of 8.96 million TEUs; 75 companies operated ships on these services, the largest vessel having a capacity of 15,550 TEUs.[3]

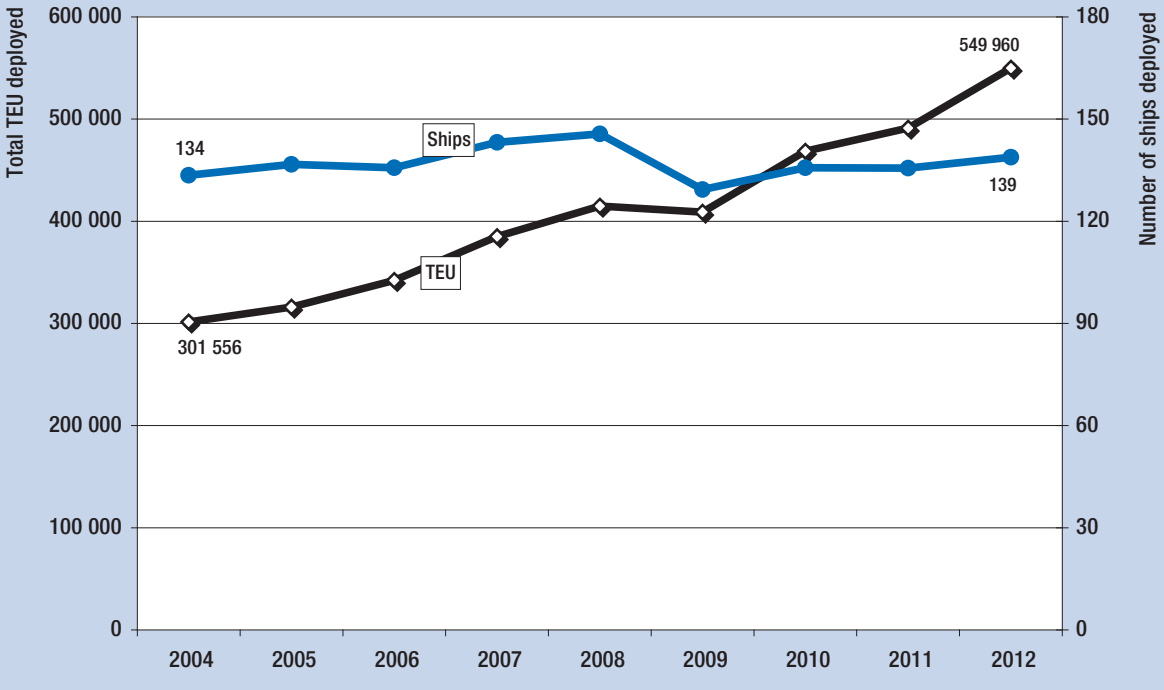
The best-connected country in Latin America is Panama, with 23 companies deploying 342 ships with a total carrying capacity of 1.28 million TEUs, followed by Brazil, with 937,000 TEUs. The position

Figure 4.1. Trends in container-ship fleet deployment: number of companies and size of the largest ships deployed (Averages per country, midyear estimates)



Source: Calculations by the UNCTAD secretariat, on the basis of data supplied by *Lloyd's List Intelligence*.

Figure 4.2. Trends in container-ship fleet deployment: number of ships and their total TEU carrying capacity (Averages per country, midyear estimates)



Source: Calculations by the UNCTAD secretariat on the basis of data supplied by *Lloyd's List Intelligence*.

of Panama as a hub in Latin America is made evident by the large number of ships deployed on routes from Panama to China (147 container ships), to the United States (182 ships) and to Colombia (127 ships).

In Africa, the geographical positions of Egypt, Morocco and South Africa at the nodes of the global liner shipping networks contribute to these countries' highest connectivity for this continent. There are more companies that provide services between South Africa and Singapore (15 companies), China (14) and Malaysia (13) than for intra-African connections. For example, there are only eight companies that connect South Africa with Benin and Nigeria.

In South Asia, ports in Sri Lanka cater for larger container ships than ports in India, and the total TEU capacity deployed from and to Sri Lanka (1.14 million TEUs) is higher than the TEU deployed from and to Indian ports (1.06 million TEUs). Singapore and Malaysia are the best-connected countries in South-East Asia, with 5.28 million and 4.21 million TEUs capacity deployed, respectively.

Comparing different regions, the densest network of liner shipping services is within Asia. There are 794 container ships deployed on regular services between China and the Republic of Korea, 718 between China and Singapore, and 600 between China and Malaysia. This compares to just 440 ships deployed between China and the United States, and 111 ships between the United States and Germany.

Characteristics of the global network

An analysis of the structure of the global liner shipping network shows that only 17.7 per cent of country pairs are served by direct liner shipping connections.[4] For the remaining country pairs, at least one trans-shipment is required.

Interestingly, at least in theory (potentially competing shipping companies and ports would need to cooperate) 62.2 per cent of pairs of countries could be connected with only one trans-shipment (for example, Chile to Suriname via Jamaica). Only for 19.9 per cent of country pairs is a second trans-shipment needed; for example, to move a container from Cambodia to Namibia is possible via Singapore and South Africa. A third trans-shipment is required for only 0.2 per cent of country pairs; an example of the latter would be containerized trade between Tuvalu and the Democratic Republic of the Congo via New Zealand, Belgium and the Republic of the Congo. While it is difficult to envisage demand for a containerized trade transaction between these two countries, thanks to the global liner shipping network and trans-shipment ports, it would be possible.

B. RECENT PORT DEVELOPMENTS

Port developments continue throughout the world at an uneven pace spurred on by national needs to import and export and a chance to seize a share of growing world seaborne trade through trans-shipment opportunities. The following sections are a brief overview of some of these developments organized alphabetically. The list is not exhaustive and the ports mentioned are merely meant to give regional perspective as well as illustrate the variety and type of developments. Other developments mentioned in previous issues of the *Review of Maritime Transport* continue at their pace. Virtually every port or government has a development plan or is presently engaged in infrastructure improvements.

In Cameroon, work continues on the development of the Kribi port complex. The port will enable subregional integration through the Kribi–Bangui (the Central African Republic)–Kasangani (the Democratic Republic of the Congo) transport and development corridor.[5] The port, which is being built as the main export point for oil pumped from Chad via pipeline, will also handle containerised cargo and cargo for Cameroon's mining sector, such as bauxite, iron, nickel and cobalt.

In China, port developments continue at a seemingly relentless pace. The port of Xiamen is planning to invest some RMB 14 billion ($2.2 billion) on upgrading its facilities over the next few years. This is in addition to the $705 million spent to open the new container terminal – Xiamen Ocean Gate Container Terminal – in 2011.[6] For Ningbo-Zhoushan port, plans were announced to build two iron-ore berths of 300,000–400,000 deadweight ton (dwt) capacity, one 100,000 dwt berth and two 50,000 dwt berths. The project, which will cost an estimated of RMB 4.91 billion ($774 million) will give the port a combined handling capacity of 52 million tons of iron ore per year.[7] This suggests that the recent declines in the import of iron ore by Chinese ports is not envisaged to persist into the long term.

In Costa Rica, the Government approved a 33-year concession agreement with APM Terminals (APMT) to construct and operate the Caribbean port at Moin. Located 10 hours sailing time from the Panama Canal,

the construction is set to be completed by the end of 2016 and cost $992 million. When complete the port will have an along-side depth of 16 metres and be able to serve the current maximum container vessels.[8] It will be able to attract new clients by accommodating some of the passing traffic transiting the Panama Canal.

In France, the ports of Le Havre, Rouen and Paris, which share access to the River Seine, joined together to form a new entity named HAROPA. The new entity aims to win back some of the trade lost in 2011 due to strikes by port workers in response to nation-wide port reforms. This concept enables synergies in pricing and marketing and if successful could be a concept which may be adopted by other ports in other regions.

In Georgia, transfer of the operations of the Black Sea port of Poti from Ras Al Khaimah Investment Authority (RAKIA), a sovereign wealth fund of the United Arab Emirates, to APMT resulted in the retrenchment of 386 employees, almost one quarter of its labour force. Management of the port had been acquired by RAKIA in 2008, but the company had failed to stimulate local trade through the port.[9] This example illustrates the importance of import/export traffic to a port's success.

In Germany, the port of Wilhelmshaven partially opened for business in 2012. The port has experienced various challenges including, on the operational side, the provision of tug services and, on the infrastructure side, cracks in the quay and weak rail track foundations. The port, which has a depth of 18 metres, is able to serve the world's largest container ships, such as Maersk's Triple E-class vessels. To attract new business the port's management is reportedly offering a 70 per cent rebate on its standard tariff of €0.32 per ton on all ships until December 2013, after which the rebate reduces to 50 per cent until 2018. In addition, the fees payable are only applicable for the first 145,000 tons. This means that, for example, Maersk's E-class vessel the 170,794 gross tonnage (GT) M/V *Emma Maersk* (15,500 TEUs), would pay just €14,000 per call instead of €46,400.[10] Such pricing strategies could also be offered by other ports in order to stimulate demand.

In India, the State of Gujarat has finalized plans for the development of new ports at Dahej, Nargol, Vansi Borsi and Kutchhigarh, which are to be undertaken using public–private partnership (PPP). Plans to develop ports at Dholera and Khambhat have been put on hold in view of the Kalpasar project, which aims to build a dam over the Gulf of Khambhat to establish a huge fresh-water reservoir. These port developments serve to illustrate that the Government of India is committed to undertaking improvements to its transport infrastructure. However, the task is huge and for only 82 of the estimated 276 port projects identified by the government in the past five years has construction commenced, while only 25 have seen completion.[11]

In Indonesia, Perlindo II, the state-owned port operator and port authority, was given permission by the Government to start the construction of Kalibaru port. Phase one of the new port construction will see container-handling capacity of 1.5 million TEUs come online in early 2014, followed by further construction of two more terminals, bringing the total capacity of the port to 4 million TEUs.[12] This development is important for a country which is seeing an average gross domestic product (GDP) growth rate of 6 per cent per year since 2008 and a growing per capita income of $3,000.[13]

In the Democratic People's Republic of Korea, plans were announced to develop the port of Rason in the north-east of the country. Details of the plans are vague but refer to refurbishing three piers, developing an airport, a power station and the construction a 34-mile cross-border railroad linking the port to the Chinese north-eastern city of Tumen.[14] The agreement involves a 45–50 year concession and the $3 billion investment is coming from China.[15] The area around Rason will be a Special Economic Zone. Elsewhere in the country, similar plans are afoot to develop Wihwa Islands located in the north-west and across the Yalu River from the Chinese city of Dandong. Increasing trade between the Democratic People's Republic of Korea and its neighbours allows for greater opportunities and backward linkages into the national economy, which may help raise the country's GDP and living standards.

In Liberia, negotiations with a Dutch dredging company are near completion that will enable better utilization of a previous concession agreement signed between the Government and APMT to develop the port of Monrovia. In 2010, APMT signed a 25-year concession agreement to operate the port and invest $125 million in rebuilding the damaged marginal wharf and improve the port infrastructure.[16] This will help improve market access for both importers and exports and may lead to lower transport costs.

In Morocco, the newly operational container port Tanger Med II is continuing to expand its container capacity with third and fourth terminals, scheduled to be operational in 2015/16. The new terminals

will increase the port's capacity to 5 million TEUs per annum. In 2012, Renault opened a new vehicle assembly plant near the port that is expected to boost traffic. This marks a good opportunity for the port, which experienced a labour strike in 2011 over stevedore pay and conditions that then contributed to a reduction in cargo volumes at the port during the later part of 2011 and into 2012. A year-on-year comparison shows that throughput during the first quarter of 2012 was 30 per cent lower than in 2011.[17]

In Nigeria, the Nigerian Ports Authority (NPA) announced plans to develop two new deepwater ports at Lekki, in Lagos State, and Ibaka, near the city of Uyo in Akwa Ibom. The Ibaka port development project is expected to create thousands of jobs.[18] The Lekki port, which will consist of liquid, dry bulk and container terminals, is estimated to have a final capacity of 2.5 million TEUs. The port of Lagos will also benefit from a $124.4 million redevelopment project at the so-called Bull Nose area of Lagos port. The work includes the construction and operation of an oil and gas facility on a 20-year concession basis.[19]

In South Africa, Transnet Port Terminals (TPT) announced plans to spend R 33 billion ($4.2 billion) over seven years on capital expenditure to encourage economic growth and improve efficiencies. The areas marked for investment include container port development at Durban and Ngqura, iron ore bulk facilities at Saldanha, and the creation of additional manganese capacity by relocating cargo from Port Elizabeth to a newly created two-berth manganese facility at the Port of Ngqura. The port of Richards Bay will also receive mobile equipment, quayside equipment and weighbridges, and will be re-engineered to create additional capacity for bulk products.[20] The Port of Ngqura, located just outside Port Elizabeth, officially opened in 2012 after 12 years in construction. The R 10 billion ($1.3 billion) facility upon completion will include four container berths, a liquefied natural gas (LNG) facility and a bulk and break bulk berth. The port has been partially open since the end of 2009 and currently handles around 0.5 million TEUs.[21] Together, these developments help to mark the ascendance of South Africa as one of the world's emerging economies, as described in various press articles under the acronym BRICS (Brazil, Russian Federation, India, China and South Africa).

In Ukraine, the Government gave approval for a new port to be built at Lake Donuzlav in the Crimea. The location is in an area free of ice all year round, has a natural depth of 25 metres and is directly accessible to the Black Sea. The new facilities will focus upon providing ferry, general cargo and container services. The agreement, said to be worth $1.2 billion, was reached between the Ukraine Government and China National Technical Import and Export Corporation (CNTIC).[22] The port will facilitate direct access for trade between Ukraine and Asia.

In the United Kingdom, the Olympic Games and the associated preparation have increased congestion around London resulting in the revival of barge traffic along the River Thames. Two barges normally used for transporting non-containerized cargo on the Thames were deployed from Tilbury to Northumberland wharf – a few kilometres from the Olympic village – to carry 48 40-foot equivalent units (FEUs). If successful, the service could be extended further west along the Thames to Fulham, Battersea or Wandsworth.[23] Elsewhere in the country, barge traffic is also making a comeback, for example between the cities of Liverpool and Manchester.[24] Together, these developments may mark the start of a shift to a more sustainable freight transport.

In the United States, the port of Long Beach is set to invest around $4 billion over the next decade to upgrade its facilities. The project includes, amongst others, $1.2 billion for the upgrading of existing terminals to handle containers and provide rail access, $950 million to replace a bridge providing access to the port, and $650 million for the construction of a new container terminal.[25] The port of New York/New Jersey revealed plans to develop a terminal of 1.7 million TEUs capacity at Bayonne, New Jersey. The new terminal is expected to open in 2014 at a cost of more than $300 million. The location provides an advantage over close neighbours and competitors located west of the height-restricted Bayonne Bridge.[26] These developments coincide with the enlargement of the Panama Canal and provide the opportunity to attract some of the increased traffic that its opening is envisaged to create.

C. PORT DEVELOPMENT OUTLOOK

Port development is closely related to the actual, historical or anticipated volumes of trade that pass through the port, that is, the derived demand of the port's users. Some port development projects are built ahead of demand, typically green field projects, or when congestion at existing ports becomes a problem for one or more parties. Many traditional ports built close to rivers or natural harbours have become

constrained over time as cities have grown around them. Port development projects are increasingly subject to lengthy discussions as different interest groups (workers, residents, user groups, business owners, and the like) vie to advocate their concerns and express their needs. These landside users' issues are in stark contrast with those of the seaside users. Landside users are constrained by the physical hinterland and procedural requirements of local or national governments and special-interest groups, whereas the seaside users are often able to make changes which may affect local communities but are not subject to the same procedures. One of these areas concerns the port's maritime customers, the shipowners. Ships are mobile and generally do not operate where they were constructed. Local communities centred around their creation points tend to see their advantages (for example, direct and indirect local employment) and not their operational disadvantages (pollution through emissions of gases, noise and light, among others). Ship construction is a large employer with strong roots in the local community and usually closely associated with other industrial plants, such as smelting. Ports, on the other hand, have lost a lot of their employee-based relations with the local community through retrenchment of labour brought about by mechanisation, streamlined business practices and a concentration on trans-shipment traffic – which seemingly has few direct benefits for the local economy. In addition, port communities are very sensitive to change, because ports rarely move and their facilities usually last for several decades.

In recent times, shipowners have sought to benefit from economies of scale by building ships that are longer, wider and deeper than previous vessels. To service these customers, ports need to undertake a number of upgrades to their infrastructure (quays, turning basins, sea defences, and the like), superstructure (for example, cranes, storage facilities, offices, and the like) and operations (dredging, human resources, software, and the like). Port authorities or governments need to make informed choices about where to invest, the potential return on investment and the cost of each opportunity. Adaptation measures to possible negative impacts of climatic changes, such as sea-level rise and extreme weather events also need to be considered. Infrastructure investments need to be financially sustainable so that countries maintain competiveness in international markets.

The impact of increased ship size upon ports can be substantial. For example, the ports of Rotterdam and Shanghai have, over time, become constrained by the cities which have grown around them. The only route for expansion is to build further into the sea as this satisfies the need for land and for the depth required to accommodate larger ships. Both Rotterdam's new Maasvlakte container terminal and Shanghai's Yangshan container terminals are located at the most extreme outreaches of the ports with the greatest depths, sufficient to cater for the newest generation of container vessels. In addition, some ports (for example, gateway and transit ports)[27] need hinterland connections to facilitate the movement of cargo.

Container terminals

Container trade has grown significantly in the last few decades to represent approximately 17 per cent of world seaborne trade by volume and 52 per cent by value. Containerized trade has grown not just at the expense of the share of general break bulk cargo carried via other means, but also through increased global trade. Many ports have adapted to this changing pattern of trade by undertaking infrastructure development programmes to increase their market share of containerized cargo. Increased port throughput volumes may increase the port's revenue collected through port dues or cargo handling fees. Local government may also see an increase in tax collection through higher trade volumes. However, increased cargo volumes driven by increased competition (between ports, exporters and importers, transport operators, and the like), could greatly improve the chances of return cargoes becoming available. This could lead to improved connectivity and lower transport costs per unit, to the benefit of the end user. The end results for increased trade are well documented and include higher levels of peace, security, health and living standards.[28] While this outcome may seem far removed from ship size, improvements which help lower transport costs could spill over into other areas.

Since the launch of the first post-Panamax vessel, the 6,400 TEU M/V *Regina Maersk,* back in 1996, there has been a trend for ever larger ships. The M/V *Regina Maersk* itself was around 50 per cent larger than its predecessors, but today is dwarfed by the latest class of container ships. In 2006, the M/V *Emma Maersk* was launched with a reported capacity of 15,500 TEUs. Since the start of the recession around 100 ships of more than 10,000 TEUs have

been launched, with around one and a half times that number set to be delivered over the next few years.[29] In 2011, the shipping line Maersk ordered 20 vessels reportedly of more than 18,000 TEUs and possibly as large as 22,000 TEUs. These ships are known as super-post-Panamax, ultra-large container ships (ULCSs) or Malaccamax vessels (the maximum size of vessels that are able to transit the Straight of Malacca, a main route for cargo moving between the Far East and Western Asia, Africa and Europe).

Such large vessels require ports with deepwater access channels, alongside berth depths of 18 metres, adequate turning circles and specialised cargo handling equipment. While not every port may be able to accommodate the latest ULCS vessels, their existence has an implication for all ports. Only a few of the world's biggest ports on the East–West trade routes will be served by ULCSs. Displaced ships will, however, operate elsewhere and bring changes to other ports. The first-generation post-Panamax-type vessels (for example, M/V *Regina Maersk*), which are too young to be scrapped, are still operating on the main East–West route.[30] With a draft of 14.5 metres these vessels are still too big for the majority of African ports (excluding those located in South Africa, Egypt, Mauritius and Morocco). However, ports located in Djibouti, Namibia, Nigeria and Sudan all receive vessels greater than 4,000 TEUs, this indicating that displaced East–West vessels are seizing opportunities in South–South trading. This implies that ports in these countries also need to undertake, in their turn, more costly infrastructure works and provide each vessel with a greater provision of equipment.

The implications of ULCSs of 22,000 TEUs for ports are that larger shore-side gantry cranes, with an outreach of 72 metres and a lift height of 52 metres above quay will be needed. The distance between the front and back legs of the cranes may also need to be increased from 30 to 35 metres.[31] This can be problematic as the legs operate on rails built into the quay, making upgrading subject to spatial and underpinning constraints. Some of the challenges with larger cranes include stiffness, weight, corner loads, wind loads, increased power and operational issues including visibility, handling speeds and performance.[32] Another less common implication for ports concerns that of local residents, who may complain about unsightly cranes interrupting their view.[33]

The cost of purchasing new container gantry cranes capable of servicing ULCSs is around $8 million–$10 million each, and a single vessel could theoretically employ 10 to 12 such cranes. These cranes are sometimes called Jumbo 23s, because their outreach stretches to 23 containers width from the quay. However, while ULCSs may be 23 containers wide, the ports of Jebel Ali in Dubai and Felixstowe in the United Kingdom have container gantry cranes with an outreach of 24 containers, and the new port of Wilhelmshaven in Germany reportedly has cranes with an outreach of 25.[34] Adapting existing cranes could, however, prove a solution to some ports, with costs at between 25 to 60 per cent of the cost of new material. In addition, long waiting lists and a limited number of manufacturers often means that the time required to adapt a crane is sometimes half that of procuring a new one.[35] With two of the market leaders in the manufacture of container gantry cranes located in China, and customers located worldwide, the transportation of these cranes via ship can take several months. More than 72 per cent of gantry cranes capable of handling 22 or more rows of containers from the quay are positioned in terminals where global terminal operators have a shareholding.[36] As of 2011, the order book for container gantry cranes with an outreach of greater than 22 container rows totalled 17, two destined for the Caribbean and Central America, four for North America, four for South-East Asia and seven for the Far East. However, the most popular size of cranes on order is for those with an outreach of 18–20 rows. This may imply that smaller ports are upgrading their facilities as the cascading effect of larger ships entering the market pushes smaller vessels to call at other ports.

Container gantry cranes with an outreach of 22 rows and above are 100 per cent controlled by the global terminal operators in the Caribbean, Central America, South Asia and Southern Europe. In Northern Europe the figure is over 97 per cent, in the Middle East and South-East Asia, the figures are close to 95 per cent. This shows that many governments have met the financial challenge of purchasing port equipment through public–private partnerships. According to Drewry Shipping Consultants, of the 1,011 container gantry cranes of between 20 and 22 rows in operation, three are located in South Asia, 48 in the whole of Africa, 99 in South-East Asia and 542 in the Far East. This reflects clearly the source of containerized exports against other destinations, where containerized cargo relates primarily to import trade.

The world's largest crane manufacture is the Chinese firm ZPMC, which holds approximately 75 per cent

of the market share and is continually updating its designs.[37] However, as good as each crane design may be, there are limitations to how many can be deployed per vessel and increasingly wider vessels do not necessarily permit more cranes to be deployed unless an indented berth concept is adopted.[38] However, modern technology enables different concepts to be tried and tested. For example, the container terminal operator APMT is working on its own crane concept. This company's FastNet container terminal concept allows gantry cranes to work more closely together, thereby increasing significantly the number of cranes deployed per vessel. The FastNet crane concept enables cranes to work adjacent rows, whereas the present container gantry cranes are too wide to allow this. With ULCSs capable of holding 24 FEUs from fore to aft and 23 containers across their beams, employing more container gantry cranes is imperative to improving port efficiency.

One area often overlooked when considering port development is insurance. According to one survey by the TT Club on accidents in ports, 79 per cent of accidents were caused by human error.[39] Maintenance of complex port equipment in an environment where equipment downtime can be costly may also be a factor in increased claims.[40] In an analysis of its claims, the TT Club revealed that 34 per cent of the cost of asset-related claims was directly related to container gantry cranes. The main causes of damage to container gantry cranes cited were:

- Wind damage – with ports being built further out to sea to cater for larger ships, there are fewer natural wind deflectors available;
- Hoist, spreaders and ropes – better preventative maintenance is needed;
- Structural integrity issues – again better maintenance or design could help;
- Operational issues – boom-to-ship collisions, spreaders, ship-cell guides and ropes all caused significant damage, which could be reduced by retrofitting avoidance systems.[41]

Dry bulk terminals

In the dry bulk sector ships are also increasing in size. The dry bulk sector represents almost one quarter of world seaborne trade by volume but, because these vessels often carry cheap raw materials, a mere 6 per cent by value. The dry bulk sector is dominated by the need to transport the five major bulk cargoes (coal, grain, iron ore, bauxite/alumina and phosphates). Two of the biggest mining companies are the Australian BHP Billiton and the Brazilian Vale, which compete on many fronts including shipments of iron ore to China, the world's single biggest importer. In 2011, China imported 634 million tons of iron ore.

Because of the greater distance from Brazil to China compared with that of Australia to China, more of the final price of Brazilian iron ore goes towards transport costs. The vessels plying a trade between Brazil and China, usually Capesize vessels of 150,000 dwt, can perform approximately five round trips a year, including loading and unloading time, whereas on the Australia to China route the same vessel can perform an average of 12 voyages. Australian iron ore can thus command a higher price, grading excluded.

In 2008, at the height of the commodity boom and just prior to the global financial crisis, Vale made an order for 12 very large ore carriers (VLOCs) of 400,000 dwt. Termed Valemax vessels, they are the world's largest dry bulk ships. The Valemax vessels are an attempt by the Brazilian firm to lower its geographical disadvantage over its closest competitor, BHP Billiton, for its largest customer market, China. In terms of iron ore alone, Brazil exported over 326 million tons and Australia 437 million tons in 2011. The total iron ore imports by China from Brazil equalled 140 million tons in 2011, significantly below the 295.7 million tons of BHP Billiton, and enough to theoretically keep 70 Valemax vessels in full employment. Presently, it is reported that Vale have 35 Valemax vessels on order (see chapter 2).

The Valemax vessels have, however, caused some controversy, generated especially by Chinese owners of smaller dry bulk vessels concerned about a lack of cargo to carry. As a consequence, in early 2012 the Chinese Government announced that dry bulk vessels of over 350,000 dwt, and tankers of over 450,000 dwt, would no longer be permitted to call at Chinese ports.[42] This decision was apparently superseded by another decision from the Chinese Government that stated that approval would be given to the port of Ningbo-Zhoushan to build two berths of 300,000 dwt capacity, which could receive Valemax vessels.

Vale, in an attempt to overcome Chinese port restrictions, is undertaking an innovative solution using floating storage centres based in countries nearby to China. In 2012, Vale took delivery of the world's largest trans-shipment vessel, the M/V *Ore Fabrica* of 284,000 dwt. The vessel will serve as a platform

Table 4.3. The relationship between vessel size and terminal type

	Terminal Type		
	Container terminal	**Dry-bulk terminal**	**Tanker terminal**
Maximum vessel carrying capacity	ULCSs (maximum 18,000–22,000 TEUs; 165,000 dwt)	VLOCs (maximum 400,000 dwt)	Ultra large crude carriers (ULCCs) (maximum 440,000–550,000 dwt)
Maximum vessel dimensions	Length: 400 metres Beam: 59 metres Draught: 14.5 metres	Length: 362 metres Beam: 65 metres Draught: 23 metres	Length: 458 metres Beam: 69 metres Draught: 24.6 metres
Alongside berth depth needed	15 metres	23.5 metres	25 metres
Berth length	1 000 metres. The whole vessel needs to be adjacent to the quay area to allow maximum unloading/loading and further berths needed at the same quay for feeder vessels.	Access to the vessel can be via a pier extended out into deeper water and cargo moved via conveyor.	Access to the vessel can be via a pier extended out into deeper water and cargo moved via pipeline.
Pilotage	Increased assistance likely	Increased assistance likely	Increased assistance likely
Terminal area	Two-way (import/export) cargo movement means increased storage space is needed to discharge and load cargo. Container yard depth should be at least 500 metres. Approximately 25–30 ha is needed for a terminal with an annual throughput of 1 million TEUs.	As cargo tends to move in one way (export to import) the increase storage space needed is minimal and tends to be open air, i.e. requiring only land surface. One million tons of iron ore occupy approximately 12–15 ha.	Although cargo tends to move in one direction, costly storage facilities and land surface are needed. One million barrels of storage occupy an area of 5 ha.
Quayside cargo-handling equipment	8–10 gantry cranes per berth with an outreach of 23 TEUs, $8 million–10 million each.	No significant difference	No significant difference
Onshore cargo-handling equipment	Increased number of vehicles needed to transport containers to stacking yard, automated guidance vehicles, higher reach stackers (possibly up to 7 high), rail-mounted gantry cranes, straddle carriers, etc.	No significant difference	No significant difference
IT equipment	More advanced IT systems needed to monitor increased number of containers.	No significant difference	No significant difference
Customs/security checks	Increased volume of containers and number of individual shippers could significantly increase the number of security checks.	No significant difference	Extra security may be needed to deter terrorist attacks.
Inland congestion	With most containers arriving/leaving ports on trucks, congestion could be severe and affect local residents.	Bulk cargo tends to arrive/leave port via trains/barges. Congestion depends upon other infrastructure.	Congestion within pipelines tends not to be noticeable.
Seaside congestion	A restrictive access channel may cause delays to other vessels.	A restrictive access channel may cause delays to other vessels.	A restrictive access channel may cause delays to other vessels.
Environment	Increased trucks on roads will raise levels of CO_2 pollution. Noise and light pollution may also affect local residents. There may also be ballast water issues for loading ports.	Increased dust affecting the health of local residents is to be expected, as well as possible ballast water issues for loading ports.	In the absence of any spillage, environmental costs will be low. There may also be ballast water issues for loading ports.
Employment	More skilled workers (for example, cranes and IT-systems operators) will be required. Increased potential for employment within supporting industries.	Minimal increase to port workers but a higher potential for employment within supporting industries.	Minimal increase to port workers but a higher potential for employment within supporting industries.

Source: UNCTAD secretariat.

to transfer iron ore from Vale's VLOCs to smaller ships for transport to Asian markets, including China.[43] The locations where these VLOCs will be based include the Philippines, the Republic of Korea and possibly Malaysia.[44] Also in Malaysia, Vale has spent $600 million on the order of port equipment including loaders, ultra-large unloaders, bucket-wheel stackers and reclaimers for its break bulk trans-shipment centre at Teluk Rubiah.[45] With the deployment of both floating and regional trans-shipment centres, large iron ore shipments can be transported from Latin America to Asia at optimum economies of scale and cost savings passed on, allowing Vale to obtain the sought-after market share.

Trans-shipment in dry bulk differs from container trans-shipment, the former being performed at sea and the latter on land. This is possible because, unlike containers, dry bulk cargo is homogenous and can be split and sold en route, whereas containers contain very specific cargos sometimes with multiple owners. Furthermore, the trend of larger vessel sizes in the dry bulk sector does not affect ports in the same way as the increased sizes of container ships, as indicated by the comparison shown in table 4.3. Larger dry bulk or tanker vessels can still be loaded and unloaded with the same equipment needed for smaller vessels. All, however, require deeper alongside berths, but with dry bulk and tanker vessels, extending the reach of conveyor belts or pipelines and power is not technically as challenging.

Tanker terminals

The tanker sector has traditionally benefited from large vessels with the first very large crude carriers (VLCCs) appearing in the 1970s. The tanker sector represents around one third of international seaborne trade by volume and 22 per cent by value. The tanker market is generally concerned with the transportation of crude oil and petroleum products which are mainly used to manufacture other goods. The growth potential of this sector is enormous due to the increases in demand for carbon energy as a result of the growing middle classes in developing countries.

Ports have dealt with the challenges of receiving VLCCs by extending piers with pipelines further out to sea. The port infrastructure needed to service these vessels relates primarily to storage tanks within the port area. However, most oil importing countries would probably benefit from better inland storage facilities closer to the consumer, depending on the geographic characteristics of the country, rather than to rely upon shore-side storage, which better benefits oil-exporting countries. Thus, the role of ports in tanker storage should primarily be a buffer role to help balance inflows and outflows rather than storage per se.

The trend for larger vessels and the concept of floating storage centres to act as trans-shipment hubs could be a competitor to ports which traditionally make their revenue from cargo handling. Floating storage centres already exist in the tanker sector, but their use is mainly by oil refineries to absorb surplus capacity. The largest vessel ever built was the tanker M/V *Seawise Giant* that, along with many other ULCCs, ended her last days as a floating storage platform in the Persian Gulf.[46] Some vessels may be used by oil traders as temporary storage but these vessels do not trans-ship and tend only to be laid up as floating storage until there is an upward movement in the price of oil.

Conclusions

One of the consequences of increasing vessel size to transport cargo more efficiently is that inefficiencies are simply moved to elsewhere in the logistics chain. The quayside (crane handling in particular) continues to be a problem area, together with the landside entrance/exit point where trains or trucks enter or leave the port. Unloading vessels tends to be more time consuming than loading (in container shipping) as boxes often originate from one country specializing in manufacture (for example, China) but are unloaded at many places in lower volumes, making it difficult to achieve the same operational efficiencies. In addition, receiving countries often need to shuffle containers in order to gain access to those underneath. While computer software can make the process easier, space is still needed to perform the movement and thus the areas where work can be performed are reduced. One of the key challenges facing ports working with container shipping is the reduction in frequency of port calls by individual vessels, as highlighted in the LSCI. With larger ships calling at fewer hub ports the frequency of cargo arrival will put many ports to the test. The rate at which cargo flows into a port must match the rate at which it leaves for the port not to occupy large tracks of land or for congestion not to occur. As with most businesses, port operators prefer steady streams of traffic. Cargo surges combined with time constraints and perhaps unfamiliarity of heavy equipment can increase pressure that may translate into a slip in safety standards. With larger vessels and more specialised cargo handling equipment tied up with each vessel, any port downtime could significantly affect the ability of the port to earn enough revenue to make infrastructure investment financially sustainable.

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