B. WORLD CONTAINER PORTS AND LINER SHIPPING MARKET DEVELOPMENTS

1. Container ship upsizing

The deployment of mega-ships affects port terminals across the ship–port interface, and with regard to yard and terminal operations, as well as gate and hinterland operations.

As maritime access may be limited by draft restrictions, larger container ships normally call at fewer ports. The physical features of such ships and handling requirements add pressure to berth and crane operations. To quickly service the larger-sized ships, terminal operators use cranes over longer working hours and more shifts. For example, it was reported that in the ports of Los Angeles and Long Beach, terminals are regularly deploying six cranes per ship, given that calls by 8,000 TEU-capacity ships are becoming the norm. With ship sizes further increasing to 14,000 TEUs, the use of seven or eight cranes can be expected (JOC.com, 2014). Additionally, larger port calls may require ships to spend more time at berth, which in turn reduces crane availability. More time is also required to lash and unlash container berths (Port Economics, 2017).

Larger ship calls are often associated with lower service frequency and periods of peak volumes at port terminals. Peak volumes handled by larger vessels lead to overutilization of port capacity on some days and underutilization on others (Drewry Maritime Research, 2016b). As a result, a reduction in berth utilization measured in TEUs per metre of berth has been observed.

Less frequent calls, but greater cargo volumes being handled per call resulting from the deployment of larger vessels create surges and pressure on yard operations, given the ensuing peaks. The global average measured in TEUs handled per hectare is estimated to have increased by 2.5 per cent in 2015. As more equipment is required to move containers to and from stacking areas, additional equipment and labour are necessary. Pressure is also imposed on the restacking of containers through increased requirements for gantry cranes of yards and stacking density. For specialized cargo such as refrigerated goods, larger port call volumes exert pressure on the usage of reefer slots.

Sharp increases in cargo volume also create greater demands on gate access, with more trucks arriving and leaving with larger numbers of containers. This creates more local congestion as more trucks are waiting to enter the port. Overall, large container ships provide economies of scale at sea, but these economies do not necessarily extend to ports. One study finds that a 1 per cent growth in ship size and its auxiliary industry operations increases time in port by nearly 2.9 per cent and creates diseconomies of scale at ports, indicating that economies of scale that are gained at sea are lost at ports (Guan et al., 2017). The challenge with larger ships is how to avoid lost time at berths, as ships take up more space and remain in port longer (JOC Group, 2014). Another challenge, especially for smaller ports in developing regions, is how to decide on the design of terminals, type of cargo-handling equipment to invest in, extent of automation and digitalization of equipment, type of technology to adopt, and port and staffing-level management (Lloyd's Loading List, 2017c).

While there will be winners and losers in this new operating landscape, the extent of the associated gains and losses are yet to be fully understood.

2. Liner shipping alliances and market concentration

As ships and alliances become larger, the number of ports and terminals that can accommodate their ship calls becomes limited. As the scale expansion in shipping is rarely matched with an equivalent expansion in ports, some ports and terminals – especially secondary ports with relatively lower volumes and weaker bargaining power – are likely to lose their direct connections.

Direct mainline services are becoming more frequent, as mega-alliances have created more direct port pairs. The implications for trans-shipment ports, where the level of competition forces terminals to increase productivity and reduce prices, can be significant (Drewry Maritime Research, 2017a). Trans-shipment ports are more vulnerable to market share volatility, as lines can easily switch to competing ports. In contrast, ports that handle a mix of gateway cargo and trans-shipment are more resilient to such a practice (Notteboom et al., 2014).

In the current context of larger and more powerful alliances, decisions made by mega-alliances are of strategic importance for ports (Drewry Maritime Research, 2017c). Ports will be increasingly required to increase productivity and could be expected to harmonize and streamline customs procedures, reduce cabotage restrictions and provide suitable infrastructure (Lloyd's Loading List, 2017c). To accommodate an alliance, a trans-shipment port in South-East Asia, for example, may require a capacity of 7–9 million TEUs. This creates a barrier to entry, given the associated investment requirements. It is no longer possible for an operator to enter the market with 600–800 metres of berth.

Mega-alliances and continued consolidation trends in liner shipping might lead to concentration of market power in the hands of a few major players. Alliances will focus on faster transit times and reliability by raising network efficiency and reducing port calls. Shippers can be expected to pay higher prices for shipping services, which in turn can undermine their competitiveness in the global marketplace. Shippers may also required to redefine their supply chains because of changes or reductions in port calls (MDS Transmodal, 2017).

The precise impact of mega alliances and growing ship sizes has yet to be fully understood and will require further monitoring. Clearly, trans-shipment services are key to liner shipping operations – trans-shipment boxes account for one in four TEUs handled at world ports today. While the trans-shipment of cargo is essential to optimize utilization of ultra-large container ships because it helps generate required cargo volumes, the level of trans-shipment incidence – estimated at 26 per cent of total port volume traffic in 2016 – may stabilize and possibly decline (Drewry Maritime Research, 2017c).

3. World container ports performance

Productivity gains and improved efficiency and operational performance are becoming even more important, given recent developments affecting the liner shipping market. Adapting to the new paradigm means that ports will need to upgrade their performance, including in terms of turnaround time (time in port of ships), dwell time (time in port of cargo), gate operations, hinterland connections and intermodal connectivity.

Various metrics have been used over the years to determine the performance of ports. These include indicators that assess the utilization rates and productivity of cranes, berths, yards, gates and gangs: TEUs per year per crane, vessel per year per berth, TEUs per year per hectare and moves per crane-hour. For instance, average performance levels in a large port can reach 110,000 TEUs per year per crane, 25–40 crane moves per hour, a dwell time of 5–7 days for imported boxes and 3–5 days for exported boxes (OECD, 2013).

While recognizing the inherent limitations of such a measure, ship time in port or turnaround time could, nevertheless, provide a proxy for overall port performance, as it measures the average time that ships spend in a port before departing to another destination. Using information on vessel movement data collected by Marine Traffic, tables 4.4–4.8 illustrate some examples of time in port, measured in days. The average time in port corresponds to the difference between the time a ship enters a port's limits, and the time it leaves those limits. Regardless of whether a ship's visit is related to cargo operations or other operations, such as bunkering, repair, maintenance, storage and idling, time in port includes the time prior to berthing, time spent at berth (dwell and working times) and time spent undocking and transiting beyond port limits. While the average time does not measure the precise efficiency of time in port since it does not distinguish between waiting time, berth time, and working and idle time, the data provide an estimation of overall time in port.

Bearing in mind these considerations, the average time in port worldwide is estimated at 1.37 days or 33 hours. Container ships boast the best performance – less than 24 hours spent within port limits. In contrast, tankers and bulk carriers seem to have longer port stays. Countries where ports seem to take less time to service calling ships include Japan (all ship types), the Republic of Korea and Singapore. Many factors may explain why ships are spending less time in ports. Therefore, more analysis of the observed ship movement data is required to improve understanding of these factors.

Another study using data collected by monitoring vessel movements between 1996 and 2011 indicates an overall reduction in port turnaround time (figure 4.3). Between 2006 and 2011, Asia improved to levels matching those in Europe and North America and exceeded the world average. The best performing ports in terms of time efficiency or port turnaround time were Singapore (0.5 days), Hong Kong (China) (0.72 days), and Shanghai (0.79 days) (Ducruet et al., 2014).

Emphasizing regional differences, berth productivity per ship call reveals that Asian container terminals attain a higher performance than their counterparts in Europe and the United States. Some observers attribute the differences to ports and gates being open 24 hours a day, a high level of automation and large trans-shipment volumes in Asia (JOC Group, 2014). While differences in vessel size and call volumes affect and amplify differences in port productivity (World Bank, 2016a), operational models and costs per move also play a role.

Table 4.4. Average time in port: All vessels, 2016

Vessel type	Days in port	Total arrivals	Total vessels	Total dead-weight tonnage (thousands of tons)
Container ships	0.87	445 990	288 148	18 288 135
Tankers	1.36	309 994	205 034	8 504 418
Gas carriers	1.05	59 183	32 404	765 328
Bulk carriers	2.72	213 497	169 851	12 150 088
Dry cargo and passenger ships	1.10	2 065 505	474 982	6 372 305
Grand total	**1.37**	**3 094 169**	**1 170 419**	**46 080 274**

Source: Marine Traffic, 2017.
Note: Average time in port is equivalent to the average of median per world ports.

Table 4.5. Average time in port: Container vessels, 2016

Country	Days in port	Total arrivals
China	0.83	60 795
Japan	0.29	38 415
Republic of Korea	0.49	23 545
United States	0.97	19 844
Taiwan Province of China	0.40	16 895
Singapore	0.80	16 159
Malaysia	0.93	15 678
Germany	0.46	14 784
Spain	0.51	14 018
Netherlands	1.14	12 264
World total	**0.87**	**445 990**

Source: Marine Traffic, 2017.
Note: Average time in port is equivalent to the average of median per port per country.

Table 4.6. Average time in port: Tanker vessels, 2016

Country	Days in port	Total arrivals
Japan	0.45	54 015
Singapore	0.98	19 047
China	3.12	18 702
Netherlands	0.95	18 077
United States	1.54	17 526
Republic of Korea	0.92	11 894
Russian Federation	1.40	10 560
United Kingdom	0.94	9 950
Germany	0.58	8 509
France	0.96	8 205
World total	**1.36**	**309 994**

Source: Marine Traffic, 2017.
Note: Average time in port is equivalent to the average of median per port per country.

Table 4.7. Average time in port: Bulk carriers, 2016

Country	Days in port	Total arrivals
China	2.60	41 908
Japan	1.08	32 239
United States	1.88	14 104
Australia	2.12	12 840
Canada	1.50	11 278
India	2.83	8 885
Brazil	2.70	7 814
Indonesia	3.48	7 338
Republic of Korea	2.89	5 987
Russian Federation	3.40	4 579
World total	**2.72**	**213 497**

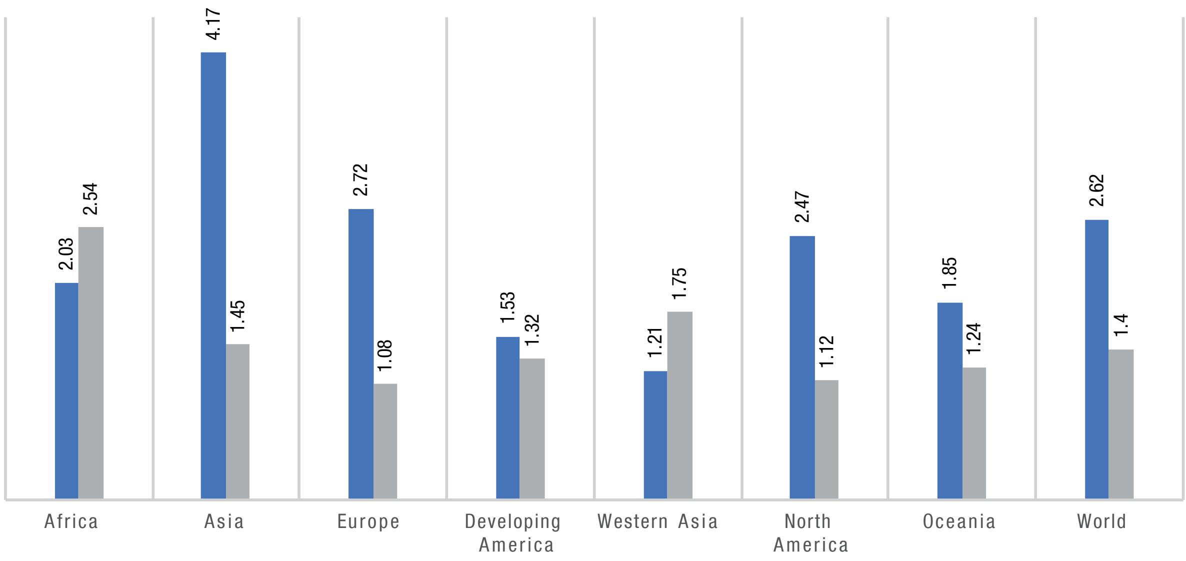
Source: Marine Traffic, 2017.
Note: Average time in port is equivalent to the average of median per port per country.

Table 4.8. Average time in port: Gas carriers, 2016

Country	Days in port	Total arrivals
Japan		22 279
Thailand	0.88	6 318
China	1.16	4 904
Republic of Korea	0.95	2 827
Indonesia	1.41	2 146
United Kingdom	0.99	1 932
Qatar	1.20	1 400
Singapore	1.10	1 219
Belgium	1.26	1 159
Netherlands	0.88	1 156
World total	**1.05**	**59 183**

Source: Marine Traffic, 2017.
Note: Average time in port is equivalent to the average of median per port per country.

Figure 4.3. Container port turnaround time, 1996 and 2011 (Number of days)

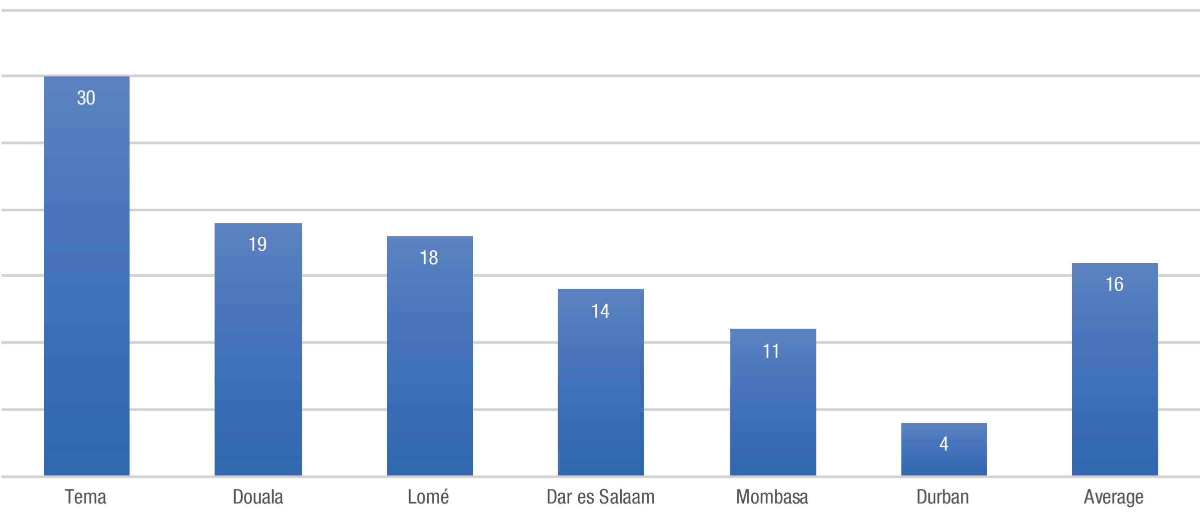


Source: Ducruet et al., 2014.

A measure complementing berth productivity and ship time in port is cargo dwell time. Efficient cargo handling operations as measured by crane productivity contribute significantly to cargo being able to rapidly leave the port. Reaffirming some of the observed trends, most effective operations seem to be concentrated in Asia, followed by those in Northern Europe. According to Drewry Maritime Research, the average crane productivity in 2009 was 136,531 TEUs per crane per year in Western Asia, 124,581 TEUs in Eastern Asia and 119,276 TEUs in South-East Asia; the lowest scores were reached in Eastern Europe (56,063 TEUs) and North America (71,741 TEUs) (OECD, 2013). Crane productivity is typically an average of 20 moves per crane per hour in Western Africa, 25 to 30 in South Africa and 35 to 40 in Asia.

Figure 4.4 provides examples of cargo dwell times in sub-Saharan Africa, which are unusually long, compared with performances in other regions such as Asia and Europe, where cargo dwell times in large ports are usually under one week. Not including Durban and Mombasa, the average cargo dwell time in most ports in sub-Saharan Africa is estimated at 20 days (Raballand et al., 2012). Recent data indicate that import container dwell times in Mombasa have improved, falling from

Figure 4.4. Average cargo dwell time in sub-Saharan Africa, 2011
(Number of days)



Source: Raballand et al., 2012.
Note: Average does not include Durban.

12 days in 2008 to 4.8 days in 2015. Delay after release declined from 72 hours in 2010 to 43 hours in 2015. For comparison, existing benchmarks for container dwell time and delay after release are 48 hours and 24 hours, respectively (Dooms and Farrell, 2017).

Enhancing port efficiency and reducing port dwell time is necessary to cut costs and enhance trade competitiveness. Some estimates indicate that increasing the port efficiency score of a given country – on a scale from 0 (most inefficient) to 1 (most efficient) by 0.1 unit – would reduce the maritime transport cost of its exports by 2.3 per cent. This, in turn, would lead to a 1.8 per cent increase in the country's exports (Herrera Dappe and Suárez-Alemán, 2016).

It is estimated that more than 50 per cent of total land transport time from port to hinterland cities in landlocked countries in sub-Saharan Africa is spent in ports (Arvis et al., 2010). On average, delays caused by poor handling and operational factors are found to generally account for no more than 2 days out of at least 15 days of dwell time. Delays are mainly due to transaction and storage time associated with controlling agencies' performance and, more importantly, strategies of importers and customs brokers, which tend to use port facilities as storage. To improve port performance and competitiveness, it is therefore necessary to have a better understanding of the various components of cargo delays in ports and address the underlying causes (Raballand et al., 2012). The Northern Corridor Performance Dashboard, which draws upon the Corridor's Transport Observatory – a performance monitoring tool with an online platform that tracks over 31 performance indicators for the Mombasa Port Community – provides useful information concerning factors that increase port cargo dwell times and delays (Northern Corridor Transit Transport Coordination Authority et al., 2017).

Relevant initiatives seeking to advance the work on port performance measurement include the Portopia project, which brings together an international consortium of academic, research and industrial partners with experience in port performance management. The aim is to support the European Port industry with performance data, in particular, to inform policy formulation and monitor implementation (Portopia, 2017). Another example is the work carried out under joint working group 174 on sustainability reporting for ports of the International Association of Ports and Harbours and the World Association for Waterborne Transport Infrastructure. One of the key objectives of this working group is to develop guidance relating to sustainability reporting for ports.

Apart from operational upgrades, equipment procurement, infrastructure development, efficient communications among port stakeholders, improved business practices, faster processes, streamlined and coordinated activities and reduced administrative and procedural inefficiencies are key to enhancing port performance in general and container port management in particular. In this respect, port community systems can help improve transactional efficiency, reduce costs and enhance reliability, while customs reforms and automation can support faster cargo clearance and reduce dwell time (box 4.1). Building the security of these systems and enhancing their resilience to security breaches and threats will be essential, given the growing exposure and vulnerability of port and shipping systems to security attacks.

Box 4.1. Port community systems, developments in information technology and collaborative arrangements

The UNCTAD Train for Trade Port Management Programme, and in particular, its Modern Port Management Programme, provides an opportunity for ports worldwide to share their experiences by carrying out case studies on the challenges faced by local ports, exploring solutions and formulating recommendations for the way forward. Useful insight, lessons learned and good practice in port operation and management are being generated in over 80 completed case studies and others are under way. An overview of selected case studies focusing on port community systems, developments in information technology, stakeholder collaboration and public–private partnerships, as well as their potential to enhance port performance, is given below.

Port Autonome de Cotonou. The Port of Cotonou uses various methods to deploy a new enterprise resource planning system and capture the perceptions and usage trends of its main users. Promoted by the Government of Benin, the new system is part of integrated management system of the Port of Cotonou, which carries out the following tasks: vessel traffic management, stevedore operation management, invoicing, apron side and shed management, management of goods and utility, provision of supplies for ships and user resource management. This enterprise resource planning system is part of a port strategy aimed at improving port management and port efficiency, through the use of information and communications technology. User participation in the inception phase and data transfer between systems was low, and a revision and adaptation process was lacking. Furthermore, hands-on training and administrator support for users were limited. Given these factors, it was recommended that additional consultants be engaged to help improve the situation, that stronger buy-in from management and port users be obtained, that work be prioritized and that proper training be provided to improve skills and change prevailing mindsets.

Port of Douala. The case study proposed methods and procedures to increase revenue collection and better manage the port land (1,000 hectares). The port's domain revenue represents 8.4 per cent of sales revenue, while those of the ports of Dakar and Abidjan represent 18 per cent and 13 per cent, respectively. It was recommended that the Cargo computer system application, which includes a domain management component, be implemented. Moreover, a proper scheme for domain utilization and allocation should be established and supervised by a dedicated commission.

Port of Dakar. The important role of specialized installations for improving port efficiency and attracting more traffic in a highly competitive range of ports in the subregion was highlighted in the case study. The Port of Dakar generates 30 per cent of State income, 90 per cent of external trade and 90 per cent of customs revenue, and caters for direct and indirect jobs in Dakar. It was recommended that the support of public–private partnerships be sought to deal with capital-intensive investments and develop transnational synergies between Senegal and landlocked countries that depend economically on the performance of the Port of Dakar. Achieving economies of scale, ensuring effective time management and enhancing land connections and global access are a must for its sustainable development.

Port of Tema. Cargo operators were identified as an integral part of the chain of actors in the port community, and their services constitute the prime criteria in the customer satisfaction index. Cargo handling is the largest cost heading in the total costs of moving goods through a port (40 per cent for bulk, 50 per cent for containers and 60 per cent for general cargo). The case study noted that investment in equipment by private stevedores was inadequate and was not in conformity with the relevant licensing agreement. Ten licensed stevedores operate in competition with the Ghana Ports and Harbour Authority's own section. Data show that private operators are working with 50–65 per cent of required equipment, which is below the 80–90 per cent rate envisaged by the agreement. This has a negative impact, including a 25 per cent delay in working container vessels, due to limited access to equipment and failure in the course of operations. Capital investments required to purchase equipment are too costly for private stevedoring companies. It was recommended that the Authority guarantee the loans.

Maldives Ports Limited. Challenges facing the Maldives Ports include limited space and infrastructure and insufficient room for rearranging the space used. Cargo is handled by ship gear, as the vessels in operation have 9.5 metres of draft and do not exceed 150 metres of length overall. Electronic services are one of the few options that could improve port performance. In addition, capitalizing on data modelling can help determine the best possible scenarios for cargo positioning in the port area. Expected benefits of adopting an electronic service model in Male's commercial harbour include reduced overhead costs, reduced time for completion of procedures, minimized error rates, improved customer services, a better organizational image and increased revenues. Electronic services technology provides a unique opportunity to simplify complex working procedures and improve port service delivery. Moreover, implementation costs are expected to be low, as most of the infrastructure and resources are already available. One challenge remains – the port community must accept the new system and opt for a comprehensive solution that would not simply combine existing single systems. Staff training would be important to combat fear of change and encourage the use of the future system.

Source: UNCTAD secretariat, Train for Trade Programme, June 2017; based on data from UNCTAD, 2014, 2015a and 2015b.