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This chapter looks at different performance indicators relating to the maritime transport sector. The aim is to help policymakers and port and maritime authorities assess and track the performance of their countries' ports and shipping businesses and provide analytical tools to guide their policymaking in the field of maritime transport through a set of key performance indicators that are relevant to the sustainable development of the maritime sector.

The various indicators featured in the chapter are indicative of how the *Review of Maritime Transport* can support ongoing performance-tracking analysis. This year, a particular focus is given to port performance and connectivity, building on a new port liner shipping connectivity index for more than 900 ports, new statistics on port calls and time spent in port, as well as insights gained from the UNCTAD Train for Trade Port Management Programme.

Shipping connectivity and port-waiting time are proxy measures of efficiency, access to markets, infrastructure endowment, supply-side capacity, trade facilitation and other sustainability parameters. The data suggest that geography, trade volumes and port efficiency matter for a country's shipping connectivity. Several small island developing States are among the countries with the lowest shipping connectivity, as they are often confronted with a vicious cycle wherein low trade volumes discourage investments in better maritime transport connectivity, and faced with low connectivity, merchandize trade becomes costly and uncompetitive.

With regard to turnaround times, in 2018, ships spent a median time of 23.5 hours (0.97 days) in port. Typically, dry bulk carriers spent 2.05 days in port, container ships, 0.7 days. A shorter time in port is a positive indicator that could signal the level of port efficiency and trade competitiveness. The 10 lowest-ranking economies are all developing countries or least developed countries, while the economies with the fastest turnaround times are mostly advanced economies with large volumes or small economies that handle low cargo volumes at each port call.

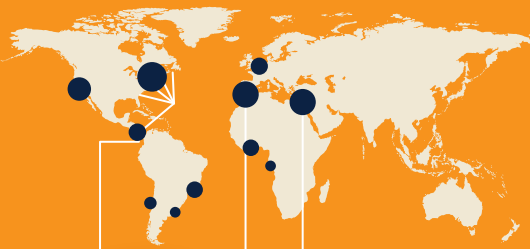
PERFORMANCE INDICATORS

PERFORMANCE INDICATORS

Horizon 2030



LINER SHIPPING CONNECTIVITY



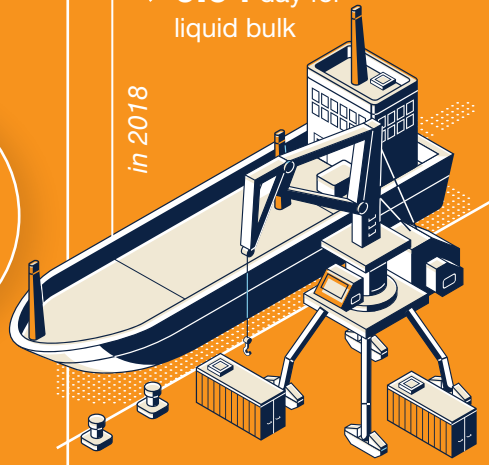
After the Panama Canal expansion in 2017, the liner shipping connectivity index for the East Coast in North American ports increased.

Port Said, Egypt and Tanger Med, Morocco are the leading African ports in the Mediterranean region.

PORT TURNAROUND TIMES

A shorter time in port is a positive indicator of a port's efficiency and trade competitiveness.

- **2.05** days for dry bulk
- **0.70** day for container ships
- **0.94** day for liquid bulk



in 2018

ENVIRONMENTAL INDICATORS

Three vessel indicators can be used to assess the world shipping fleet's impact on the environment.

1
Fitted or due to be fitted with a ballast water treatment system



2
Fitted or due to be fitted with a scrubber to reduce emissions of sulphur

3
Compliant with tier III regulations to reduce nitrogen-oxide emissions

A. MARITIME TRANSPORT PERFORMANCE MEASUREMENT

Maritime transport is a complex area of activity, owing to the inherently international nature of shipping and its multi-stakeholder dimension. These characteristics create an analytical challenge that is compounded by the role of the sector as an input production factor supporting other economic sectors and areas of activity, such as trade, fishing, tourism and energy. Such intricacies also underscore the critical importance of hard facts and data to support sound policymaking across different portfolios to ensure that balanced policy trade-offs are achieved.

Performance indicators are important analytical tools that can facilitate an understanding of the nature and scale of issues facing the shipping industry and ports, and help assess the potential impact of alternative policy options. Indicators are also necessary for self-evaluation and benchmarking, two factors that are integral to policymaking, as they help assess progress towards set goals and targets. Bearing in mind the strategic and practical usefulness of performance indicators, indicators with multidimensional metrics spanning a range of factors, such as efficiency, cost-effectiveness, productivity, profitability, connectivity, access, social inclusiveness and environmental sustainability, are increasingly considered necessary for maritime business and its users, as well as for Governments and policymakers. Data at the country level are becoming ever more important to help establish the nature and scale of maritime transport activity and underlying trends, as well as to interpret the results and implications for policymakers, especially in developing countries. Maritime transport indicators that support performance monitoring, measurement, reporting and evaluation are attracting more and more attention and interest.

Other factors such as the implementation of the 2030 Agenda for Sustainable Development and the Sustainable Development Goals have also reinforced the momentum of performance indicators that would help track and assess the performance of shipping and ports, as well as determine progress towards achieving objectives and targets. UNCTAD contributes to Sustainable Development Goal reporting on various indicators, including on transport (UNCTAD, 2019a). Further, the *Review of Maritime Transport* has a role to play with regard to maritime transport performance indicators, monitoring, reporting and benchmarking.

This chapter capitalizes on existing data from various issues of the *Review of Maritime Transport* to support performance-based approaches to maritime transport. Drawing upon over five decades of maritime transport work – monitoring trends and compiling and analysing data – the chapter offers a one-stop shop to country-level maritime transport indicators, while emphasizing the perspective of developing countries and the sustainability dimension. Some indicators are

augmented by new data and information received from partners that are exploiting digital innovations and technologies.

This year, chapter 3 provides an assessment of selected performance indicators for maritime transport, notably shipping connectivity, port turnaround times, port performance and environmental indicators for the shipping fleet. In the coming years, the Review will cover additional indicators, including the environmental and social dimensions of shipping and ports, and expand the corresponding statistical coverage on its maritime statistics portal.

In this respect, UNCTAD has developed various tools and programmes to assist member States in their effort to improve their transport performance towards achieving their goals and objectives in sustainable transport, including maritime transport. Among these programmes is the UNCTAD Framework for Sustainable Freight Transport, which aims to provide useful guidance and practical tools to support stakeholders in mainstreaming sustainability considerations into their freight transport-related policies, plans, operations and investment decisions (UNCTAD, 2019b). Articulated around 6 steps, 1 set of cross-cutting enabling factors and 27 detailed substeps, the Framework for Sustainable Freight Transport provides a modular step-by-step process that details how to plan, design, develop and implement tailored sustainable freight transport strategies (see www.sft-framework.org/; accessed 16 September 2019).

In addition, the Framework offers guidance and practical tools to help relevant stakeholders and decision-makers, from both the public and the private sectors, take adequate response measures that promote sustainable freight transport systems. The main tools include the *Self-assessment Questionnaire*, a filterable and extensive list of some 250 key performance indicators and a catalogue containing over 300 sustainable freight transport measures. The key performance indicators identified in the Framework enable users to analyse the current situation and monitor developments. These can be filtered by mode of transport, scope and dimensions of sustainability. Of the total set of 250 indicators provided by the tool, 152 can be applied to maritime transport.

Combining the bottom-up approach of the Framework for Sustainable Freight Transport with a top-down approach of global and comparable performance indicators, such as those discussed in this chapter, will help policymakers make informed decisions in support of their port and shipping businesses. UNCTAD will continue to engage with relevant data providers, research institutions and academia to make use of the latest available information and statistics, providing unbiased analysis and advice to the extent possible. Future issues of the Review will cover a variety of different indicators, including environmental and social dimensions of shipping and ports, given their critical importance in meeting the Sustainable Development Goals.

B. LINER SHIPPING CONNECTIVITY

The position of a country or port in the global container shipping network – that is to say, its connectivity – is an important determinant of accessibility to global trade, trade costs and competitiveness. To provide an indicator for this connectivity, UNCTAD in 2004 developed the liner shipping connectivity index (UNCTAD, 2017a), which aims to capture a country's level of integration into the

existing global liner shipping network by measuring liner shipping connectivity. In 2019, UNCTAD expanded the coverage of the index and introduced a new port liner shipping connectivity index for more than 900 ports. (See box 3.1.)

The liner shipping connectivity index can be considered a proxy for the accessibility to global trade. The higher the level, the easier it is for a country to access the global maritime freight transport system, including in terms of

Box 3.1 Liner shipping connectivity index: A proxy for maritime transport connectivity

The liner shipping connectivity index indicates a country's integration level into global liner shipping networks. The index is set at 100 for the maximum value of country connectivity in 2006, which was represented by China. The index was updated and improved in 2019, with further country coverage, incorporating an additional component (the number of country pairs with a direct connection), and newly generated for 2006 onwards, setting the new index at 100 for the country with the highest average in 2006. The new time series replaces the previous liner shipping connectivity index of UNCTAD, which had been generated from 2004 onwards. Readers interested in the earlier time series, covering 2004 until 2018, may contact rmt@unctad.org. The current version of the index is generated from the following six components: number of scheduled ship calls per week in the country concerned, deployed annual capacity in TEUs (total deployed capacity offered in the country), number of regular liner shipping services to and from the country, number of liner shipping companies that provide services to and from the country, average size in TEUs of the ships deployed by the scheduled service with the largest average vessel size and number of other countries that are connected to the country through direct liner shipping services (a direct service is defined as a regular service between two countries; it may include other stops in between, but the transport of a container does not require trans-shipment).

The index is generated for all countries that are serviced by regular containerized liner shipping services. For each component, the country's value is divided by the maximum value of the component in 2006, and the average of the six components for the country is calculated. The country average is then again divided by the maximum value of the average in 2006 and multiplied by 100. The result is a maximum index of 100 in the year 2006. This means that the index for China in 2006 is 100, and all other indices are in relation to this value.

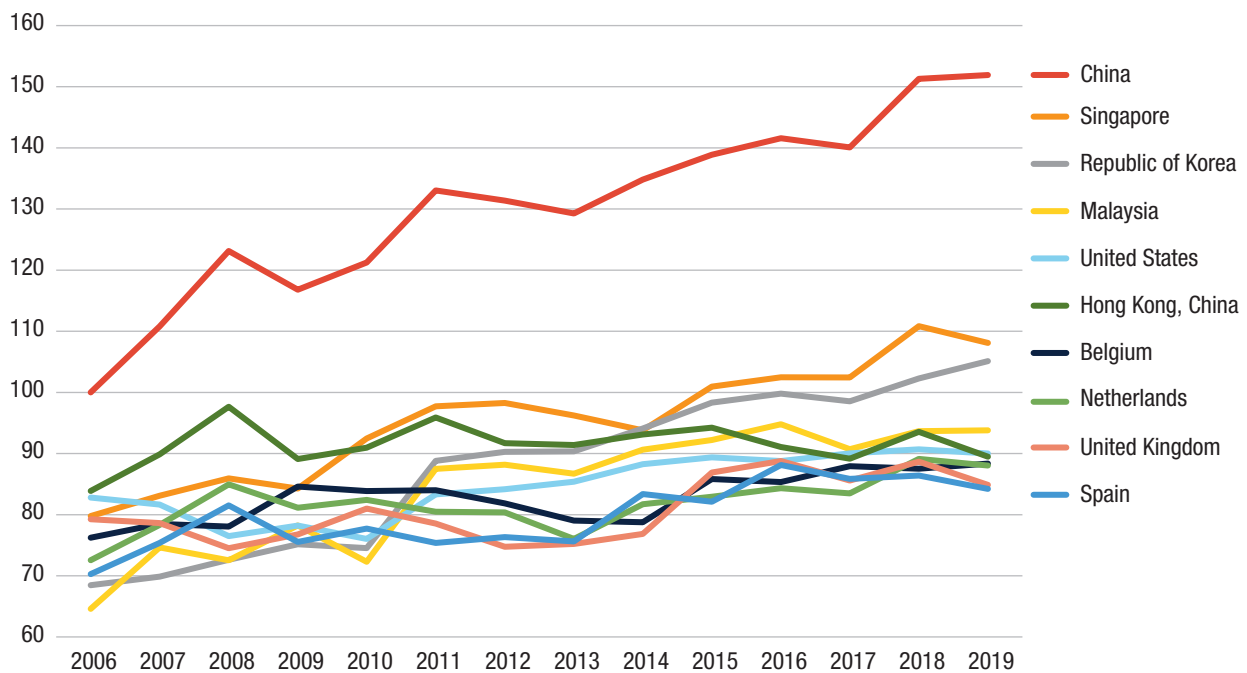
In collaboration with MDS Transmodal, UNCTAD in 2019 updated and improved the liner shipping connectivity index. For example country coverage was expanded to include several small island developing States, and a component covering the number of countries that can be reached without the need for trans-shipment was added. The other five components – number of companies that provide services, number of services, number of ships that call per month, total annualized deployed container-carrying capacity and ship sizes – remain unchanged.

Applying the same methodology as for the country-level liner shipping connectivity index, UNCTAD generated a new port liner shipping connectivity index for more than 900 container ports annually, from 2006 to 2019. This new index at the port level responds to frequent requests received by UNCTAD from port authorities and shippers. Each one of the six components of the port index covers a key aspect of a connectivity:

- A large number of scheduled ship calls allows for high service frequency for imports and exports. In Shanghai, for example, 298 container ship port calls are scheduled per month, that is to say, about 10 per day. The average port in the world receives 12 ships per month, and the median port, 5. This means that a typical port can expect one container ship call about every six days.
- A high deployed total capacity allows shippers to trade large volumes of imports and exports. For example, the value for Shanghai is 68 million TEUs; the global average per port is 1.6 million TEUs.
- A high number of regular services to and from the port is associated with shipping options to reach different overseas markets. For example, 265 services are offered to and from Shanghai; the global average for all ports is 10 services.
- A high number of liner shipping companies that provide services is an indicator of the level of competition in the market. For example, 68 carriers provide services to and from Shanghai; the global average for all ports is six. The global median is three companies; in other words, half of the world's container ports are serviced by three or fewer companies.
- Large ship sizes are associated with economies of scale on the sea leg and with potentially lower transport costs. For example, in 2019, 10 ports accommodated ships services with an average size of 20,182 TEUs: Antwerp, Belgium; Dalian, China; Hamburg, Germany; Ningbo, China; Piraeus, Greece; Qingdao, China; Rotterdam, the Netherlands; Shanghai, China; Singapore, Singapore; and Xingang, China. In the UNCTAD database of 960 ports for 2019, the average size of the ships on the services with the largest vessels is 3,836 TEUs.
- A high number of destination ports that can be reached without the need for trans-shipment is an indicator of fast and reliable direct connections to foreign markets. Counting on a direct regular shipping connection has empirically been shown to help reduce trade costs and increase trade volumes (Hoffmann et al., 2019; Wilmsmeier and Hoffmann, 2008). For example, Shanghai has direct connections with 295 partner ports, which means that an exporter from Shanghai can sell to clients in 295 overseas port destinations without the need for trans-shipment. The average port has 28 direct connections, while the median port has 14.

Source: UNCTAD, Division on Technology and Logistics, based on information from MDS Transmodal.

Figure 3.1 Liner shipping connectivity index, top 10 economies, 2006–2019



Source: UNCTAD, based on data from MDS Transmodal. For the complete data set for all countries, see <https://unctadstat.unctad.org/wds/TableViewer/tableView.aspx?ReportId=92>.

capacity, transport options and frequency, and thus effectively participate to international trade. Therefore, the index can be considered both as a measure of connectivity to maritime shipping and as a measure of competitiveness and trade facilitation.

1. A growing connectivity divide

In 2019, 5 of the 10 most connected economies are in Asia, 4 are in Europe and 1 is in North America (figure 3.1). Since 2006, the most connected country – China – improved its liner shipping connectivity index by 51 per cent; the average index went up by 24 per cent, while the lowest index in 2019 was below the lowest index in 2006. The least connected countries saw little improvement during the period; they include small island developing States, meaning that trade in shipped goods remains problematic in those countries, with economic knock-on effects. Put differently, there is a growing connectivity divide – an increasing difference between the most and least connected countries. The divide can be explained by the enhanced competitiveness of the most connected countries, namely through improved hard and soft port and trade-facilitation infrastructure, while the least connected countries have not found the resources for such investments and thus have not been able to attract additional regular container shipping services. For a more detailed analysis of trends in the country

liner shipping connectivity index and its components, see UNCTAD, 2017a.

2. Ports connect to compete

The port-level liner shipping connectivity index is generated for all container ports of the world that receive regular container shipping services. (For the complete data set of more than 900 ports, from 2006 to 2019, see <http://stats.unctad.org/maritime>). Trends in selected maritime regions relating to the port-level index are discussed below.

On the West Coast of North America, the three most connected ports in 2019 are in the United States, followed by Manzanillo, Mexico and Vancouver, Canada. Mexican ports have seen particularly high growth rates during the last decade, as they serve as entry points for Mexican imports and exports and as trans-shipment hubs for Central American trade with Asia. Over the last three years, West Coast ports in North America have lost steam compared with ports on the East Coast, which gained

There is a growing connectivity divide – an increasing difference between the most and least connected countries.

competitiveness owing to the expanded Panama Canal. All sea routes from China to the East Coast of North America have become cheaper, compared with railway services that connect Chicago or New York with Los Angeles or Long Beach.

On the East Coast of North America, the 10 most connected ports are located in the United States. Halifax, Canada is ranked eleventh in the region, and Veracruz, Mexico, fourteenth. The liner shipping connectivity index in most North American East Coast ports was stagnant until 2016, and only after the Panama Canal expansion in 2017 did the index for the East Coast in North American ports increase, especially in New York/New Jersey, Savannah and Charleston, United States, which are now the top three ports on the East Coast of North America.

In Central America and the Caribbean, the most connected ports in 2019 are Cartagena, Colombia; Manzanillo, Mexico; and Balboa, Panama. Cartagena's connectivity has strengthened since 2017, following the expansion of the Panama Canal. Five of the top 10 ports of the region are in Panama, including Rodman port (ranked ninth), which only began operations as a container port in 2018. Colón, on the Caribbean side of Panama (ranked seventh), also witnessed improvement, as its index more than doubled in 2017.

that have started receiving regular container shipping services in the last decade only (Coronel and Lirquén). As Chilean ports share the fleet assignment to Chile, their individual indices are lower than those of Callao or Guayaquil, where there is less inter-port competition at the national level. Port Callao has almost doubled its liner shipping connectivity index since 2006, following port reforms and private sector investments, as well as a growing domestic market and some trans-shipment traffic.

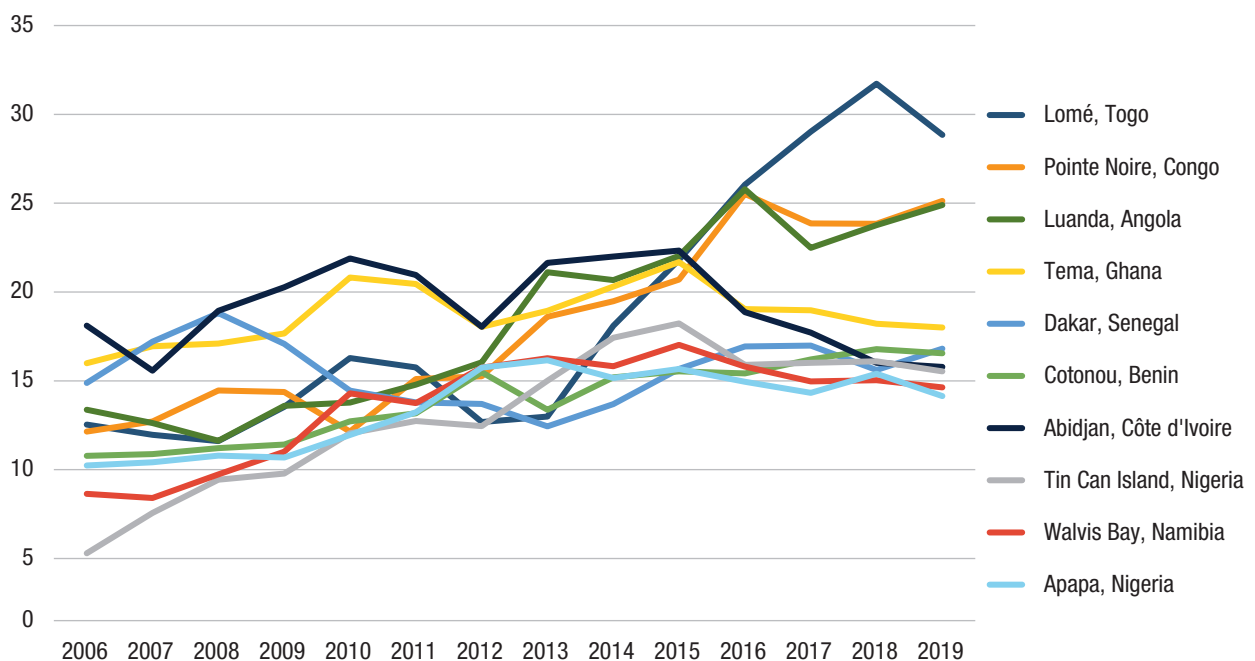
On the East Coast of South America, 8 of the 10 most connected ports are in Brazil, led by Santos. Buenos Aires, Argentina and Montevideo, Uruguay are ranked second and third, respectively. Montevideo has a much smaller national market than ports in Argentina and Brazil, but it manages to attract large portions of trans-shipment traffic, as well as transit cargo destined for the Plurinational State of Bolivia and Paraguay. The cabotage restrictions in the region also increase the prospects of Montevideo becoming a trans-shipment hub, in competition with ports in Argentina and Brazil. Shipping a container between two Argentinean ports, for example, is normally done on vessels flying under the flag of Argentina, while from Montevideo, it is possible to provide such services to secondary ports in Argentina with internationally flagged ships (UNCTAD, 2017b).

In Northern Europe, the ports of Antwerp, Belgium and Rotterdam, the Netherlands closely compete for first position, with Antwerp leading in recent years, followed by Hamburg, Germany in third position. Two ports in the Baltic Sea (Aarhus, Denmark and Gdansk, Poland) have joined the league of the top 10. In the United Kingdom, the new London Gateway port has within a few years

Tanger Med recorded the world's highest absolute increase in its index during the first decade of its operations since 2007.

On the West Coast of South America, Callao, Peru; Guayaquil, Ecuador; and San Antonio, Chile are the most connected ports in the region in 2019. Chilean ports represent 7 of the top 10 most connected ports in the region, including ports

Figure 3.2 Liner shipping connectivity index for the top 10 ports in Western Africa, 2006–2019



Source: UNCTAD secretariat calculations, based on data from MDS Transmodal. Underlying data for these and all other ports are available at <http://stats.unctad.org/maritime>.

climbed to second position in the country, overtaking Southampton, Tilbury and others.

In the Mediterranean, Piraeus, Greece emerged as the most connected port in 2019, followed by Valencia, Algeciras and Barcelona, Spain. In Piraeus, COSCO holds a 51 per cent controlling share and increasingly uses the port for its own trans-shipment services. Port Said, Egypt and Tanger Med, Morocco are the leading African ports in the Mediterranean region; Tanger Med recorded the world's highest absolute increase in its index during the first decade of its operations since 2007. Both Port Said and Tanger Med provide extensive trans-shipment services, benefiting from their geographical position and private sector investments from major global port operators.

In Western Africa, Lomé, Togo has emerged as the leading hub port. It is followed by Pointe Noire, Congo and Luanda, Angola (figure 3.2). Spurred by modernization reforms and benefitting from the congestion at the port of Lagos, Nigeria, Lomé port has been rapidly expanding in recent years. Another factor influencing the good performance of leading ports in the region is that they managed to attract direct services from China, boosting their indices, given the additional services and the larger vessels deployed on these routes (Wolde Woldearegay et al., 2016). Abidjan, Côte d'Ivoire, which was still ranked number one in the region in 2016, slipped to seventh position in 2019. Lagos dropped from the ranking of the 10 most connected ports of the region in 2006 to sixteenth position in 2019, while two other Nigerian ports (Tin Can Island and Apapa) joined the ranking. Within the African continent, Western Africa has relatively low connectivity, as its geographical position does not link it to any major North–South or East–West shipping routes.

In Southern Africa, 4 of the top 10 ports of the region are in South Africa, namely Durban, Cape Town, Coega and Port Elizabeth. The other ports among the top 10 are in Mozambique (Maputo, Beira and Nacala) and Madagascar (Toamasina and Mahajanga), all of which have significantly lower indices than the top four South African ports. In Southern Africa, port connectivity is closely associated with a country's own trading volumes as well as trade from neighbouring landlocked countries, while trans-shipment services are not a major factor (Hoffmann et al., 2019; Humphreys et al., 2019).

In Eastern Africa, the most connected ports are Port Louis, Mauritius and Pointe de Galets, Reunion. Both ports provide trans-shipment services to other Eastern and Southern African ports. The liner shipping connectivity index of Mombasa, Kenya and Dar es Salaam, United Republic of Tanzania have been relatively stagnant, except for a temporary peak in Mombasa in 2018. Both ports are important gateways to Eastern African countries' overseas trade, including the landlocked countries of Burundi, Rwanda and Uganda, yet they are highly congested, limiting their potential for improved connectivity. Policy measures that

could help improve port connectivity in Eastern Africa include expanding and further modernizing existing ports, investing in new ports, encouraging inter-port competition among neighbouring countries, improving intermodal connections and trade, and facilitating transit (Humphreys et al., 2019; UNCTAD, 2017a).

In the Red Sea, the leading ports are Jeddah and King Abdullah, Saudi Arabia and Djibouti, Djibouti. All three ports mostly provide trans-shipment services, competing with ports in Asia and Eastern Africa for this business. The other ports of the region in Eritrea, the Sudan and Yemen cater mostly for national trade; they have recorded lessening connectivity in the past few years caused by lower trade volumes stemming from economic and political developments in the region.

In the Persian Gulf, the port of Jebel Ali, United Arab Emirates, has the highest index. Dammam, Saudi Arabia; Khalifa, United Arab Emirates; and Salalah, Oman are competitors in the trans-shipment cargo sector, albeit with lower levels of connectivity. The other ports in the region, in Bahrain, the Islamic Republic of Iran, Iraq and Qatar have experienced volatile connectivity. Bandar Abbas, Islamic Republic of Iran experienced a slump in connectivity in 2014 and 2015, following embargoes that discouraged container lines from providing direct calls to ports in that country. Bandar Abbas recovered from 2016 to 2018, but in 2019 again experienced a strong decline, recording its lowest index since 2006.

In South Asia, Colombo, Sri Lanka is the most connected port. The port provides services for goods imported to and exported from Sri Lanka, as well as trans-shipment services for other South Asian countries. The remaining top 10 ports of South Asia are in India (seven ports) and Pakistan (two ports). Chittagong, Bangladesh is ranked fourteenth in South Asia, and Male, Maldives is ranked eighteenth. The port of Mundra, India has seen the largest increase in its index but is still lagging behind Colombo. Colombo benefits from cabotage restrictions in India, as these discourage carriers from trans-shipping in Indian ports, for which they are required to use Indian-flagged ships (UNCTAD, 2017b).

In South-East Asia, Singapore reports the highest index, followed by Port Klang and Tanjung Pelepas, Malaysia. These three ports are important hub ports, largely serving the same trans-shipment markets. The index of Hai Phong, Viet Nam almost doubled between 2018 and 2019, as its new terminal became the first deep-water port in northern Viet Nam. The remaining ports in the region in Indonesia, the Philippines, Thailand and Viet Nam largely cater for their countries' own imports

In Southern Africa, the top four ports of the region are in South Africa – Durban, Cape Town, Coega and Port Elizabeth.

and exports and their indices have for the most part declined.

In mainland China, Shanghai and Ningbo have strengthened their lead since 2006, and today Shanghai is the most connected port in the world. Shanghai has overtaken Hong Kong, China, which was number one in 2006. Ningbo has doubled its liner shipping connectivity index since 2006. Together, mainland China ports accounted for 28.5 per cent of world container port traffic in 2018 (see chapter 1). Most of their traffic is composed of Chinese exports, combined with containerized imports and some domestic trans-shipment traffic.

In East Asia, the top four ports, not including mainland China, are Busan, Republic of Korea, which is ranked third in the world; followed by Hong Kong, China; Kaohsiung, Taiwan Province of China; and Yokohama, Japan. Overall, the East Asian ports outside mainland China recorded less growth in their indices than ports in mainland China. Kobe and Nagoya, Japan have seen a decline in their connectivity, reflecting slower growth in the Japanese economy and the fact that ports in Japan are not as competitive as trans-shipment centres.

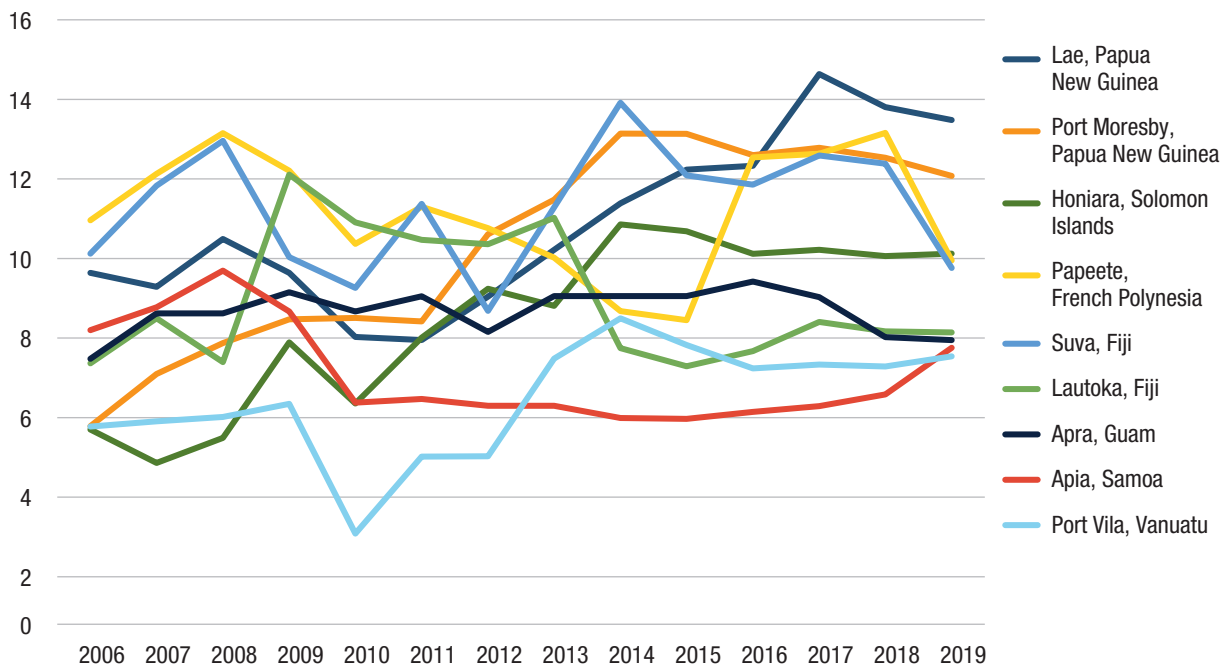
Ports in Australia and New Zealand cater mostly for their own countries' imports and exports, and some trans-shipment services for the Pacific Island economies. In 2017 and 2019, the port of Tauranga, New Zealand accommodated mainline services with ships of capacities of over 9,000 TEUs. In Australia, Melbourne, Brisbane and Sydney have similar indices, as they are served

largely by the same lines deploying the same ships along the country's east coast.

The Pacific Island economies are among those with the lowest container shipping connectivity (figure 3.3). Port Vila, Vanuatu receives about one container ship every three days, and there are only four companies that provide regular shipping services to the island. On Kiribati, only one operator offers regular liner shipping services, with one ship arriving about every 10 days, connecting Kiribati to only four other ports. Some of the Pacific Island economies also have among the fewest port calls (see next section about port calls and time in port). While most other regions have enjoyed improved connectivity, there has not been any systematic improvement in the Pacific small island developing States. They must deal with recurring low trade volumes that discourage shipping companies and ports from investing in better maritime transport connectivity, and they suffer from low shipping connectivity. As a result, trade in goods becomes costly and uncompetitive (UNCTAD, 2014, 2017a).

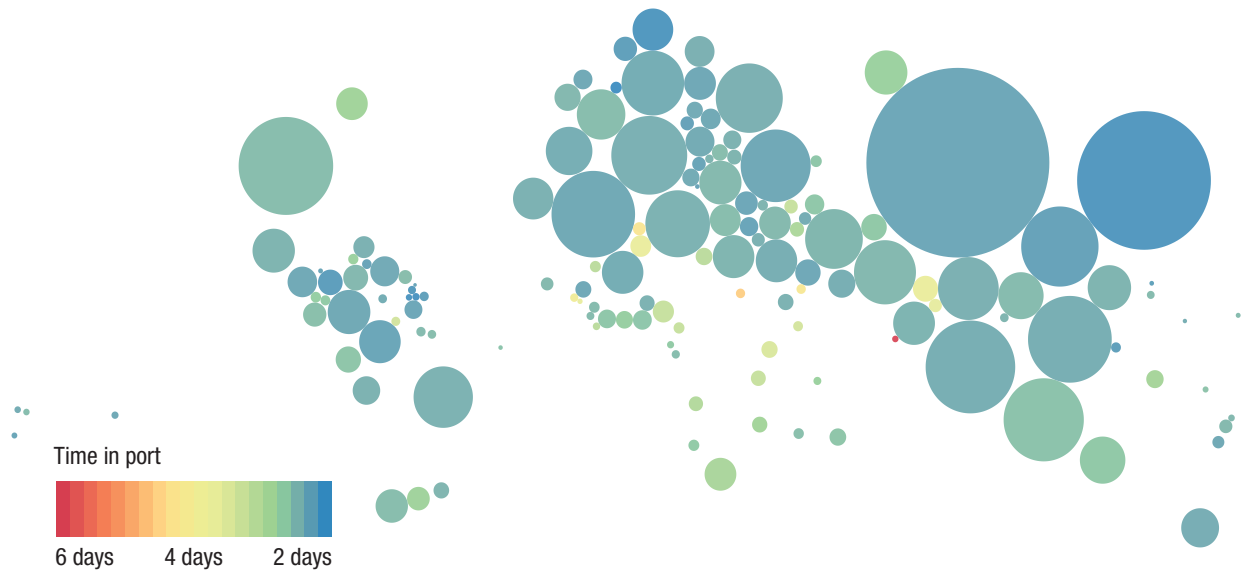
Governments and port authorities can foster port liner shipping connectivity through the following policy areas: digitalization; linkage of domestic, regional and global networks; ensuring competition; port modernization; trade and transport facilitation; sustainability; and monitoring performance (Benamara et al., 2019). The *Review of Maritime Transport* and complementary online statistical information and country profiles are aimed at supporting member States in this endeavour by providing regularly updated statistics and performance indicators.

Figure 3.3 Liner shipping connectivity index for top 10 ports in the Pacific Islands, 2006–2019



Source: UNCTAD secretariat calculations, based on data from MDS Transmodal. Underlying data for these and all other ports are available at <http://stats.unctad.org/maritime>.

Figure 3.4 Container ship port calls and time in port, all countries, 2019



Source: UNCTAD secretariat calculations, based on data from Marine Traffic (www.marinetraffic.com).

Note: Ships of 1,000 gross tons and above.

C. PORT TURNAROUND TIMES

Port performance is a key indicator of trade efficiency that determines connectivity and trade costs (Micco et al., 2003; UNCTAD, 2017a). Every hour of ship time saved in a port helps ports, carriers and shippers save money on port infrastructure investments, capital expenditures on ships and inventory holding costs of merchandise goods.

Benefiting from a new data set provided by Marine Traffic, which draws on automatic identification system data produced by the world's commercial fleet, UNCTAD has undertaken a novel analysis on the time ships spend in port during port calls.⁷ A number of significant variations can be observed between countries and vessel types.

1. Reducing the time in port to accommodate more ship calls

A shorter time in port is a positive indicator of a port's efficiency and trade competitiveness. In 2018, the median time of ship spent in port during one port call

⁷ UNCTAD secretariat calculations are based on data provided by Marine Traffic (www.marinetraffic.com). Aggregated figures are derived from the fusion of automatic identification system data with port-mapping intelligence by Marine Traffic, covering ships of 1,000 gross tons and above. Passenger ships are not included in this analysis. Only arrivals have been taken into account to measure the number of port calls. Cases involving less than 10 arrivals or 5 vessels on a country level per commercial market as segmented are not included. The data will be updated every six months on the UNCTAD maritime statistics portal (<http://stats.unctad.org/maritime>).

was 23.5 hours (0.97 days).⁸ In general, dry bulk carriers spent 2.05 days during a port call, almost three times the median time of a container ship.

Table 3.1 lists the top 25 economies in terms of port calls and the median time of different ship types spent in their ports in 2018. Tables 3.2 to 3.5 present in more detail the data for different vessel types. Figure 3.4 illustrates the global distribution of port calls by container ships and the median time spent in ports. The predominance of Asia in port calls reflects the dominant role of Asian countries in containerized trade.

In 2018, tankers and other liquid bulk vessels spent a median of 0.94 days in port, ranging between 0.11 days (about 2.5 hours) in Peru and more than four days in Kenya (table 3.2). The best performing

⁸ The present analysis reflects the median time. The average time vessels spend in port is longer for practically all countries and markets, due to statistical outliers – ships that spend weeks or months in a port, for example for repairs. The statistical distribution of time spent in ports has a “long tail”. The global average time ships spent in port in 2018 was 42 hours, compared with a median time of 23.5 hours. To avoid any distortion by outliers of the results of the analysis, UNCTAD statistics report on the median time – not the average time – as the latter may be influenced by a few exceptional cases of ships being detained or staying longer than planned for other reasons. A longer time spent in port does not necessarily mean that the port is less efficient. Shipowners may choose to have their ships stay longer to purchase goods or bunkers or to undertake repairs. At the same time, a short stay may not only be due to fast and efficient operations, but simply result from being a small port with few port calls (i.e. no congestion). At such ports only a small number of containers are loaded or unloaded.

Economy	Number of port calls	Number of days					
		Liquid bulk carriers	Dry bulk carriers	Container ships	Break bulk carriers	Liquefied natural gas carriers	Liquefied petroleum gas carriers
China	205 448	1.10	2.00	0.62	1.17	1.21	1.00
Japan	180 400	0.31	0.90	0.35	1.12	0.99	0.32
Netherlands	100 343	0.49	0.84	0.78	0.40	1.30	0.94
United States	72 485	1.64	1.84	1.00	1.79	1.28	2.03
Russian Federation	68 211	1.04	2.50	1.40	1.56	1.10	1.34
Republic of Korea	65 762	0.79	2.34	0.60	1.29	1.03	0.72
Indonesia	62 059	1.28	3.55	1.09	1.26	1.38	1.13
Singapore	60 712	0.60	0.12	0.77	0.65	2.22	1.12
Spain	59 326	0.84	2.27	0.66	1.14	1.05	0.96
United Kingdom	58 203	1.06	2.73	0.73	1.46	1.43	1.08
Germany	50 264	0.36	2.48	0.79	0.50	..	0.75
Norway	49 339	0.61	0.87	0.33	0.34	0.32	0.75
Turkey	47 488	1.11	4.00	0.63	1.52	1.31	1.36
Italy	39 265	1.29	3.55	0.82	1.93	..	1.44
India	38 999	1.42	2.49	0.93	0.82	1.15	1.27
Malaysia	32 982	1.16	3.42	0.76	1.15	1.09	0.91
Belgium	31 811	1.30	3.88	1.02	1.43	1.18	1.40
Taiwan Province of China	30 729	1.05	2.14	0.46	1.26	0.99	0.98
Australia	29 783	1.34	1.65	1.20	1.79	1.22	0.90
Greece	28 535	0.54	0.35	0.95	1.07	0.99	0.88
Brazil	27 546	1.74	2.67	0.81	2.45	2.94	1.66
Canada	27 225	1.12	0.32	1.49	0.28
Thailand	26 206	0.68	3.07	0.79	1.59	1.23	0.57
Sweden	25 461	0.68	0.51	0.63	1.04	0.61	0.82
France	24 677	1.06	3.14	0.75	1.50	1.20	1.07
World total	1 884 818	0.94	2.05	0.70	1.11	1.11	1.02

Source: UNCTAD secretariat calculations, based on data from Marine Traffic (www.marinetraffic.com).

Notes: Ships of 1,000 gross tons and above, not including passenger ships. The total number of port calls is computed for roll-on roll-off vessels; the time spent in ports by such vessels is not. Ports with fewer than five port calls of this vessel type in 2018 are not included. For the complete table of all countries, see <http://stats.unctad.org/maritime>.

economies include two groups. One group represents countries with a high number of port calls. These include Japan, which, with 44,382 port calls, has the highest number of all countries in this segment, followed by the Netherlands (41,843 port calls) and Germany (14,394 port calls). The other group represents economies that have very few port calls, and small and relatively old ships, for example Switzerland. In both cases, highly efficient and mechanized liquid bulk operations in the ports ensure that tanker owners can expect their ships to spend less than half a day in port. Developing countries and the least developed countries, where a tanker is likely to spend two to four days loading or unloading its cargo, make up the lower half of the table. The possible reasons and potential policy

solutions are discussed below, as they mostly apply to all vessel types equally.

Dry bulk carriers are the vessels with the highest median time (2.05 days) spent in port (table 3.3). While loading iron ore or coal can be done relatively quickly with conveyer-belt systems, unloading is usually a more time-consuming operation. Also, the value per ton of dry bulk cargo tends to be lower than for most other commodities, hence the inventory holding cost of staying longer in port is less for iron ore carriers than for container ships. The time spent in port ranges between 0.12 days per port call in Singapore and more than 11 days in the Sudan. In this market segment, too, the economies with the longest port turnaround times are developing countries or the least developed countries.

Table 3.2 Ten highest- and lowest-ranking economies: Median time spent in port by liquid bulk carriers, 2018

Economy	Ranking, from fastest to slowest	Median time in port (days)	Average size of vessels (gross tons)	Size of largest vessel (gross tons)	Average age of vessels (years)	Total number of port calls in 2018
Peru	1	0.11	24 356	83 850	14	2 521
Switzerland	2	0.23	1 869	5 000	25	394
Japan	3	0.31	7 913	166 093	12	44 382
Gibraltar	4	0.35	5 060	59 315	14	1 252
Germany	5	0.36	4 428	160 278	18	14 394
Cyprus	6	0.39	9 010	62 385	18	909
Faroe Islands	7	0.45	4 587	13 239	12	125
Iceland	8	0.48	8 896	30 641	14	242
Netherlands	9	0.49	9 440	170 004	15	41 843
Panama	10	0.49	13 730	165 125	21	2 713
Madagascar	142	2.49	13 467	42 826	6	131
Reunion	143	2.54	26 535	30 965	8	33
Senegal	144	2.79	25 289	85 362	11	265
Yemen	145	2.87	12 437	63 076	19	284
Congo	146	2.93	20 770	29 658	11	36
Somali	147	2.94	5 259	26 218	23	56
Iraq	148	3.13	71 414	172 146	13	1 380
Nigeria	149	3.15	20 250	157 831	16	1 507
United Republic of Tanzania	150	3.84	20 385	64 705	18	236
Kenya	151	4.03	36 933	64 705	11	198
World		0.94	15 543	234 006	13	494 120

Source: UNCTAD secretariat calculations, based on data from Marine Traffic (www.marinetraffic.com).

Note: Ships of 1,000 gross tons and above. Ports with fewer than five port calls of this vessel type in 2018 are not included. For the complete table of all countries, see <http://stats.unctad.org/maritime>.

Table 3.3 Ten highest- and lowest-ranking economies: Median time spent in port by dry bulk carriers, 2018

Economy	Ranking, from fastest to slowest	Median time in port (days)	Average size of vessels (gross tons)	Size of largest vessel (gross tons)	Average age of vessels (years)	Total number of port calls in 2018
Singapore	1	0.12	24 275	155 051	8	2 731
Canada	2	0.32	27 302	108 237	23	13 562
Greece	3	0.35	5 792	63 864	25	2 928
Sweden	4	0.51	6 838	51 147	28	1 443
Cabo Verde	5	0.53	27 721	107 666	12	158
Netherlands	6	0.84	36 464	134 692	10	4 355
Denmark	7	0.87	9 528	65 950	29	783
Norway	8	0.87	16 467	108 237	18	2 282
Japan	9	0.90	17 830	203 403	14	28 835
Barbados	10	0.94	9 790	25 769	18	17
Tunisia	123	6.45	19 814	36 426	12	303
Cameroon	124	6.74	25 953	36 467	11	250
Algeria	125	6.85	24 224	70 933	10	645
Iraq	126	8.22	29 970	44 625	9	132
Angola	127	8.56	24 753	41 091	10	53
Benin	128	9.02	27 263	36 353	11	110
Myanmar	129	9.07	25 037	36 339	11	65
Cuba	130	9.68	18 004	31 617	15	272
Libya	131	9.90	19 634	94 542	21	165
Sudan	132	11.25	27 085	45 026	12	112
World		2.05	31 940	203 483	13	259 551

Source: UNCTAD secretariat calculations, based on data from Marine Traffic (www.marinetraffic.com).

Note: Ships of 1,000 gross tons and above. Ports with fewer than five port calls in 2018 of this vessel type are not included. For the complete table of all countries, see <http://stats.unctad.org/maritime>.

Table 3.4 Ten highest- and lowest-ranking economies: Median time spent in port by container ships, 2018

Economy	Ranking, from fastest to slowest	Median time in port (days)	Average size of vessels (gross tons)	Size of largest vessel (gross tons)	Average age of vessels (years)	Total number of port calls in 2018
Faroe Islands	1	0.23	11 635	17 368	14	276
Saint Vincent and the Grenadines	2	0.28	13 325	18 358	11	114
Grenada	3	0.30	13 899	16 162	10	86
Gibraltar	4	0.31	11 187	35 878	14	40
Norway	5	0.33	8 377	21 586	15	3 536
Japan	6	0.35	17 334	217 617	12	38 238
Saint Lucia	7	0.40	12 620	16 162	11	137
Taiwan Province of China	8	0.46	29 444	217 617	14	15 616
Honduras	9	0.46	17 887	32 901	14	1 297
Denmark	10	0.49	21 242	214 286	13	1 171
Myanmar	147	2.77	14 676	25 165	19	355
Guinea-Bissau	148	2.86	13 278	25 294	17	59
Algeria	149	2.96	12 145	28 397	16	926
Bangladesh	150	2.97	18 306	94 511	12	1 338
Gambia	151	3.39	18 174	32 903	17	144
Guyana	152	3.53	22 575	27 279	8	65
Yemen	153	3.62	20 603	34 610	16	187
Tunisia	154	3.80	9 356	18 327	18	344
Sudan	155	4.31	26 581	73 899	16	182
Maldives	156	6.48	17 075	39 753	15	87
World		0.70	38 520	217 673	13	454 016

Source: UNCTAD secretariat calculations, based on data from Marine Traffic (www.marinetraffic.com).

Note: Ships of 1,000 gross tons and above. Ports with fewer than five port calls in 2018 of this vessel type are not included. For the complete table of all countries, see <http://stats.unctad.org/maritime>.

Table 3.5 Ten highest- and lowest-ranking economies: Median time spent in port by break bulk vessels, 2018

Economy	Ranking, from fastest to slowest	Median time in port (days)	Average size of vessels (gross tons)	Size of largest vessel (gross tons)	Average age of vessels (years)	Total number of port calls in 2018
Guernsey	1	0.12	1 800	2 597	21	208
French Polynesia	2	0.16	3 066	18 100	38	637
Gibraltar	3	0.20	3 828	21 483	13	498
Saint Kitts and Nevis	4	0.24	3 717	14 413	30	195
Canada	5	0.28	10 014	37 499	9	3 281
Saint Vincent and the Grenadines	6	0.31	8 742	16 137	21	189
Bahamas	7	0.32	4 070	39 771	24	548
Norway	8	0.34	2 802	51 065	22	32 692
Antigua and Barbuda	9	0.38	6 164	20 973	18	171
Paraguay	10	0.38	2 877	5 162	32	619
Gambia	165	3.43	7 211	19 883	20	46
Moldova	166	3.44	3 424	5 985	31	95
Maldives	167	4.51	6 065	22 998	25	70
Myanmar	168	4.63	10 107	23 132	16	72
Somalia	169	4.88	7 085	21 992	25	179
Syrian Arab Republic	170	4.98	5 797	32 333	31	135
Korea, Democratic People's Republic of	171	5.44	3 380	6 558	25	18
Yemen	172	5.62	5 966	23 856	26	186
Seychelles	173	5.72	5 242	20 886	26	168
Tuvalu	174	13.99	4 067	6 082	29	72
World		1.11	5 438	91 784	19	430 344

Source: UNCTAD secretariat calculations, based on data from Marine Traffic (www.marinetraffic.com).

Note: Ships of 1,000 gross tons and above. Ports with fewer than five port calls in 2018 of this vessel type are not included. For the complete table of all countries, see <http://stats.unctad.org/maritime>.

Of all vessel types, container ships spend the least median time in port (0.7 days). The data range between less 0.23 days on the Faroe Islands to 6.5 days on Maldives (table 3.4). Among the reasons for such results on Maldives is that container ships usually have to anchor in the port area and unload the container using their own gear onto barges, which then take the containers to the pier. With 87 container ship port calls in 2018, this means that in practice one or two ships are being serviced at a time. The 10 lowest-ranking economies in this segment, too, are developing countries or least developed countries, while the countries with the fastest turnaround times are mostly advanced economies with large volumes (Japan and Norway, for example) or small economies, where the short time spent by ships in port is the result of low frequencies – no waiting times or congestion – and low volumes loaded or unloaded at each port call.

Although break bulk general cargo ships do not account for a large share of seaborne trade (chapter 2, table 2.1), they represent a large share of the world fleet in terms of number of vessels and port calls. They carry all types of combined and general cargo and are important for smaller ports that lack sufficient volumes to attract more specialized vessels. The widest range of times spent in port has been observed for break bulk general cargo ships, between 0.12 days on Guernsey and two weeks on Tuvalu (table 3.5). The traffic in Guernsey includes frequent regular traffic with France and the United Kingdom, which does not require any customs or immigration formalities and thus allows the ships to start operations immediately after arriving in their dedicated terminals. Similarly, in Norway, with 32,692 port calls for this vessel type, ships provide frequent domestic services, with fast and efficient operations and no customs or immigration formalities. On Tuvalu, the median time a general cargo ship spent in port in 2018 was two weeks. Just 72 port calls were recorded during the year. Again, all economies in the lower half of the table are developing countries and least developed countries, including several small island developing States.

Carriers of liquefied natural gas and liquefied petroleum gas call in a few countries only, as this type of cargo requires highly specialized port facilities. In 2018, only 43 countries received liquefied natural gas carriers, and only 84 countries received liquefied petroleum gas carriers. For both vessel types, the median time spent in port is slightly more than one day, ranging from less than five hours in Peru to more than three days in Côte d'Ivoire, Ghana and Jordan. Countries with short turnaround port times include some with high numbers of port calls (Japan, the Republic of Korea, Norway and Thailand). Those economies in the lower half of table 3.4 concerning carriers of liquefied natural gas and liquefied petroleum gas are mostly developing countries and least developed countries with a low number of port calls for these vessel types (data on

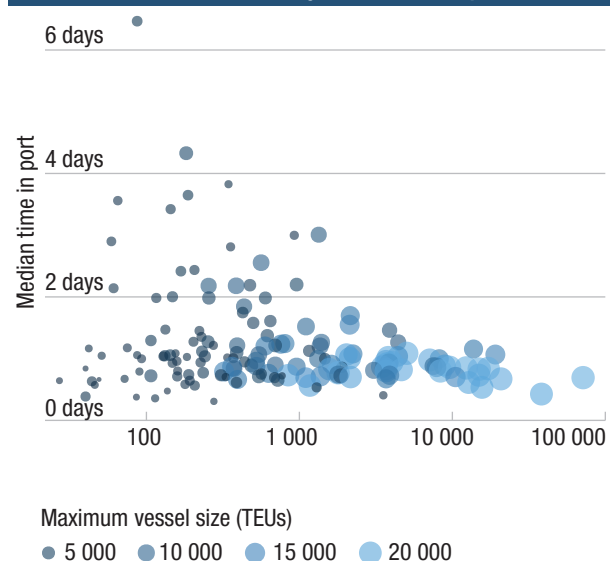
additional vessel types and countries are available at <http://stats.unctad.org/maritime>.

2. Ships spend less time in more efficient ports

Countries with more port calls usually have shorter turnaround times as well. Ports with shorter turnaround times are more attractive to shippers and the carriers; therefore, the number of port calls will tend to be higher compared with competing ports that have longer turnaround times. The causality goes both ways: If the turnaround time is shorter, a port with the same number of berths can accommodate more port calls. At the same time, countries that trade more and have more port calls will also generate more income to invest in efficient port operations. For container ships, for example, figure 3.5 depicts the correlation between the number of port calls, the size of the largest container ships that call in a country's ports and the median time container ships spend in the port.

If ships are larger, other things being equal, turnaround time should be longer, as there will be more cargo to be loaded and unloaded. At the same time, ports that can accommodate larger ships will usually also be more modern and efficient. UNCTAD analysis shows that there is a negative correlation between the size of the largest ship that calls at a country's port and the median time ships spend in port, while there is a slight positive correlation for most market segments between the average size of vessels and the time spent in port. In other words, being able to accommodate very large container ships is an indicator that a port is fast and efficient, while ports that receive large ships will on

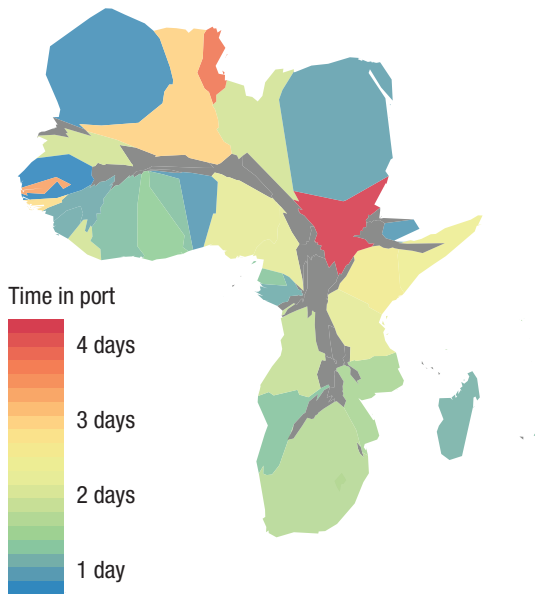
Figure 3.5 Time in port and number of port calls by container ships, 2018



Source: UNCTAD secretariat calculations, based on data from Marine Traffic (www.marinetraffic.com).

Note: Ships of 1,000 gross tons and above.

Figure 3.6 Africa: Container ship port calls and time in port, 2018



Source: UNCTAD secretariat calculations, based on data from Marine Traffic (www.marinetraffic.com).

Note: Ships of 1,000 gross tons and above.

average also take slightly longer to load and unload the higher cargo volumes.

In Africa, the countries with the most port calls are located at the geographical corners of the continent (figure 3.6). Egypt, Djibouti and Morocco benefit from their geographical position and attract container ships for trans-shipment services (see also previous section on liner shipping connectivity). South Africa provides hub port services, and its ports serve as gateways to containerized trade in South Africa and its neighbours. All four countries are also among those receiving the largest container ships in Africa.

In order to minimize the time a ship spends in port – for a given volume of cargo to be loaded or unloaded – port and maritime authorities and policymakers may consider the following three recommendations (Benamara et al., 2019). First, ships should only arrive when they need to arrive, as arriving too early implies additional costs in port as well as additional expenditures and more pollution, including air emissions. To arrive on time rather than in time is the aim of port-call-optimization initiatives (Lind et al., 2018, 2019; UNCTAD, 2019c). Second, once a ship arrives at the pier, operations should start immediately, without having to wait for authorities to clear paperwork or carry out other procedures. Implementing the IMO Convention on Facilitation of International Maritime Traffic and the Agreement on Trade Facilitation of the World Trade Organization can help in this regard (UNCTAD, 2016). Finally, port operations should be borne into account. Fast and reliable loading and unloading operations require investment in infrastructure and superstructures, as well as technological and human capacities. It is

important to consider the total logistics costs when pondering such investments, including the daily costs of waiting times of ships and trucks, and the potential loss of trade competitiveness resulting from long port turnaround times (UNCTAD, 1998; World Bank, 2007).

D. SHIPPING FLEET: ENVIRONMENTAL INDICATORS

The environmental impact of shipping includes pollution caused by the invasion of non-native species following the discharge of untreated ballast water from ships. This is considered one of the greatest threats to the world's oceans and one of the major threats to biodiversity (see chapter 4). The International Convention for the Control and Management of Ships' Ballast Water and Sediments (2004) entered into force in September 2017. The Convention aims to prevent the risk of the introduction and proliferation of non-native species following the discharge of untreated ballast water from ships. One way to reduce this risk is to install ballast water treatment systems.

Air pollution from ships is another concern that has a major impact on health and the environment. Vessels emit large quantities of pollutants into the air, principally in the form of sulphur oxide, nitrogen oxide and particulate matter, which have been steadily growing and affect human health. Ships also generate 3 per cent of the world's total greenhouse gas emissions such as carbon dioxide, contributing to global warming and extreme weather effects. As noted in chapter 2, from 1 January 2020, IMO will enforce a new 0.5 per cent global sulphur cap on fuel content, a reduction in the present 3.5 per cent limit. The global fuel sulphur cap is part of IMO's response to heightening environmental concerns, contributed in part by harmful emissions from ships.

This section will look at three indicators applicable to vessels and which are of relevance in assessing the environmental impact of some of the world's shipping fleet:

- The vessel is fitted or is due to be fitted with a ballast water treatment system.
- The vessel is fitted or is due to be fitted with a scrubber to reduce sulphur emissions.
- The vessel is compliant with tier III regulations to reduce emissions of nitrogen oxide. (See table 3.6 and chapter 4 for further information).

In total, of the 95,402 ships in the UNCTAD maritime database, 7.66 per cent have installed or ordered a ballast water treatment system, 1.58 per cent have installed or ordered a system to reduce sulphur-oxide emissions, and 0.53 per cent have installed or ordered a system to reduce nitrogen-oxide emissions as of 1 January 2019.

There are significant differences between the fleets by flag of registration and country of ownership. The underlying causes of these differences are mainly

the different vessel types and the trading routes. Tables 3.6, 3.7 and 3.8 are designed to encourage discussion rather than to draw conclusions. Some vessel types have less need for having certain systems installed than others, and some trading routes and ports do not require ballast water treatment.

The shipping industry is in a transformational phase, including in terms of environmental development. Providing some indicative data for policymakers, including flag States and ownership origin, to see where their countries' fleets stand, can be a useful initial indicator that could help stakeholders address some of the issues and apply purposeful transport policy or incentive schemes. Whether or not ships trade internationally and are bound by international conventions, policymakers in maritime authorities and port States have a role to play: setting strategies and encouraging, for example, the installation of modern systems to reduce the environmental impact of shipping or introducing regulations or tax or incentive schemes. Knowing how a country's national fleet compares with others as regards the installation of such systems is a first objective performance indicator.

1. Larger and newer ships tend to be equipped with more modern installations

Larger and newer ships that trade internationally are more likely to have ballast water treatment systems installed than smaller and older ships that may be deployed mostly in national waters. Accordingly, the ship types that have the largest share of ballast water treatment systems installed are liquefied gas carriers (28.76 per cent), dry bulk carriers (23.32 per cent) and

container ships (18.88 per cent) (table 3.6). Oil and chemical tankers have a higher average age (see also chapter 2, table 2.2.), which may partly explain why this vessel type has a smaller share of installed ballast water treatment systems. Ferries, general cargo ships and offshore supply vessels are more likely to be deployed in coastal or inter-island transport and may not need to treat their ballast water.

2. Differences by flag and country of ownership

Among the top 50 flag States by number of ships, the registries with the best performance for ballast water treatment systems are the Isle of Man (33.33 per cent), Hong Kong, China (30.47 per cent) and the Marshall Islands (28.66 per cent) (table 3.7). For ships that do not trade internationally, there tends to be less need for investing in such systems, as water ballast is not an issue. It is therefore not surprising that the national fleets of China, Indonesia, Japan and the United States have far lower environmental indices, as many of these ships are deployed in domestic shipping services. As regards scrubbers, the largest shares are those of Greece (9.25 per cent of its registered ships), followed by the Marshall Islands (8.64 per cent) and Malta (7.64 per cent). The fact that a vessel does not have a scrubber installed does not necessarily imply that the vessel does not comply with the sulphur cap, as it may also switch to alternative fuels. For systems to reduce nitrogen-oxide emissions, the two Norwegian international ship registers, the Danish International Ship Register and the Isle of Man have the most ships equipped with such systems. These leading flags of registration cater largely for ships that trade internationally.

Vessel type	Percentage of vessels fitted with ballast water treatment systems	Percentage of vessels fitted with scrubbers	Percentage of vessels compliant with tier III regulations to reduce nitrogen-oxide emissions
Bulk carriers	23.32	4.03	0.05
Chemical tankers	10.72	1.15	0.86
Container ships	18.88	5.05	0.19
Ferries and passenger ships	1.36	2.13	0.57
General cargo ships	2.16	0.65	0.21
Liquefied natural gas carriers	28.76	1.45	1.45
Offshore supply vessels	2.37	0.03	0.96
Oil tankers	11.99	3.71	0.46
Other/not available	2.82	0.30	0.19
Total	7.66	1.58	0.53

Source: UNCTAD secretariat calculations, based on data from Clarksons Research.

Notes: Propelled seagoing merchant vessels of 100 gross tons and above, beginning-of-year figures. Estimates include ships fitted with scrubbers, those pending scrubber installation and ships on order.

Ranking by number of ships	Flag State	Percentage of vessels fitted with ballast water treatment systems	Percentage of vessels fitted with scrubbers	Percentage of vessels compliant with tier III regulations to reduce nitrogen-oxide emissions
1	Indonesia	0.23	0.01	0.00
2	Panama	13.96	1.83	0.37
3	Japan	2.30	0.04	0.02
4	China	2.79	0.27	0.17
5	United States	2.60	0.30	0.65
6	Marshall Islands	28.66	8.64	0.56
7	Liberia	19.51	4.44	0.34
8	Singapore	21.11	1.28	0.17
9	Russian Federation	2.20	0.00	0.15
10	Hong Kong, China	30.47	2.30	0.26
11	Malta	21.55	7.64	1.01
12	Korea, Republic of	5.48	0.16	0.05
13	Viet Nam	0.16	0.00	0.00
14	Malaysia	1.43	0.00	0.29
15	India	0.81	0.69	0.06
16	Philippines	2.53	0.00	0.00
17	Bahamas	22.07	4.26	2.34
18	Italy	2.95	2.28	0.07
19	Greece	12.23	9.25	0.46
20	Turkey	1.13	0.97	0.24
21	Netherlands	11.48	4.26	1.23
22	Cyprus	15.98	2.79	0.87
23	United Kingdom	11.05	3.78	0.87
24	Norway	6.35	0.52	8.95
25	Brazil	2.10	0.00	0.35
26	Thailand	2.05	0.24	0.00
27	Saint Vincent and the Grenadines	0.74	0.00	0.25
28	Antigua and Barbuda	1.91	0.76	0.13
29	Belize	0.38	0.00	0.00
30	Islamic Republic of Iran	0.13	0.00	0.00
31	Canada	2.84	2.09	0.60
32	Nigeria	0.30	0.00	0.00
33	Mexico	1.57	0.00	0.00
34	United Arab Emirates	0.00	0.00	0.00
35	Germany	3.44	3.28	1.64
36	Norwegian International Ship Register	25.62	4.11	11.66
37	Australia	0.52	0.17	0.86
38	Danish International Ship Register	12.77	5.14	3.90
39	Honduras	0.00	0.00	0.00
40	Sierra Leone	0.00	0.00	0.00
41	Spain	0.62	0.00	0.21
42	Madeira	15.09	2.59	0.65
43	France	2.50	2.05	0.00
44	Ukraine	0.00	0.00	0.00
45	Togo	0.00	0.00	0.00
46	Egypt	0.26	0.00	0.00
47	Isle of Man	33.33	2.82	3.85
48	Taiwan Province of China	7.14	3.70	0.00
49	Saudi Arabia	2.95	1.07	0.00
50	Bangladesh	0.54	0.00	0.00
Subtotal top 50 registries		8.50	1.71	0.53
<i>Rest of world and unknown flag</i>		<i>2.17</i>	<i>0.76</i>	<i>0.49</i>
World total		7.66	1.58	0.53

Source: UNCTAD secretariat calculations, based on data from Clarksons Research.

Notes: Propelled seagoing merchant vessels of 100 gross tons and above, beginning-of-year figures.

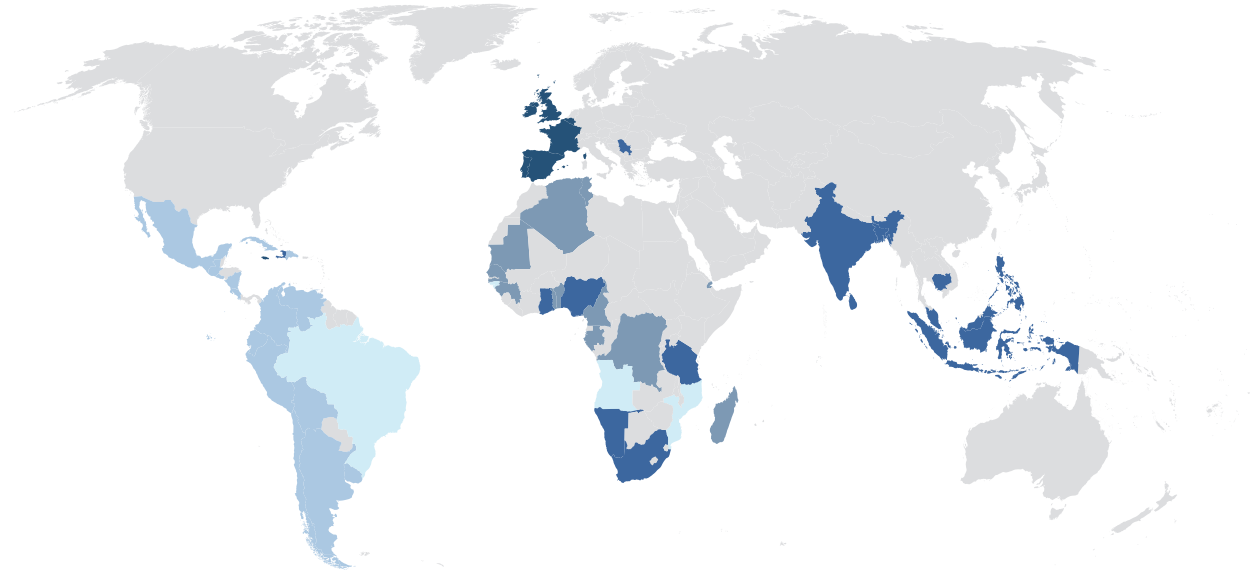
Table 3.8 Environmental indicators by ownership origin and top 50 economies by number of ships, 2019

Ranking by number of ships	Ownership origin	Percentage of vessels fitted with ballast water treatment systems	Percentage of vessels fitted with scrubbers	Percentage of vessels compliant with tier III regulations to reduce nitrogen-oxide emissions
1	Indonesia	0.25	0.02	0.00
2	Japan	13.13	0.14	0.16
3	China	8.05	0.43	0.13
4	Greece	17.07	7.94	0.29
5	United States	6.98	3.64	0.76
6	Singapore	12.00	1.53	0.09
7	Germany	9.91	1.97	0.68
8	Russian Federation	2.78	0.00	0.22
9	Republic of Korea	12.46	1.13	0.04
10	Norway	16.53	2.36	7.79
11	Turkey	3.95	1.35	0.35
12	Hong Kong, China	18.47	0.76	0.14
13	United Arab Emirates	3.52	0.20	0.30
14	Viet Nam	0.21	0.00	0.00
15	United Kingdom	15.40	2.01	0.85
16	Netherlands	8.25	2.04	0.55
17	India	2.17	0.67	0.44
18	Malaysia	1.43	0.00	0.34
19	Philippines	0.36	0.00	0.00
20	Italy	4.63	1.48	0.07
21	Taiwan Province of China	21.41	6.01	0.00
22	Denmark	17.20	4.50	1.85
23	Brazil	2.05	0.11	0.11
24	Thailand	2.73	0.23	0.11
25	Canada	5.76	1.28	0.26
26	France	8.39	1.31	0.00
27	Islamic Republic of Iran	1.72	0.00	0.00
28	Nigeria	1.29	0.00	0.29
29	Ukraine	1.05	0.00	0.15
30	Australia	3.33	0.48	0.79
31	Saudi Arabia	3.54	0.00	0.00
32	Spain	1.71	1.02	0.17
33	Mexico	0.69	0.00	0.00
34	Sweden	8.80	4.58	5.99
35	Egypt	1.45	0.00	1.08
36	Bermuda	40.99	5.88	0.92
37	Switzerland	17.76	18.20	1.54
38	Monaco	30.77	30.09	0.45
39	Belgium	19.31	1.24	1.73
40	Panama	0.53	0.00	0.00
41	Bangladesh	0.57	0.00	0.00
42	Cyprus	8.12	0.00	0.58
43	Croatia	2.41	0.00	0.30
44	Azerbaijan	1.01	0.00	0.00
45	Finland	4.75	10.51	5.42
46	Chile	1.10	0.00	0.00
47	Poland	20.46	0.00	0.00
48	Bolivarian Republic of Venezuela	0.00	0.00	0.00
49	Lebanon	0.00	0.00	0.00
50	Democratic People's Republic of Korea	0.00	0.00	0.00
Subtotal top 50 shipowning economies		8.30	1.74	0.57
<i>Rest of world and unknown ownership origin</i>		<i>1.95</i>	<i>0.21</i>	<i>0.15</i>
World total		7.66	1.58	0.53

Source: UNCTAD secretariat calculations, based on data provided by Clarksons Research.

Notes: Propelled seagoing merchant vessels of 100 gross tons and above, beginning-of-year figures.

Figure 3.7 Port Management Programme coverage



SPANISH(15)	ENGLISH (16)	FRENCH (16)	PORTUGUESE (7)	PARTNERS (6)
Argentina	Bangladesh	Algeria	Angola	Belgium
Plurinational State of Bolivia	Cambodia	Benin	Brazil	France
Chile	Ghana	Cameroon	Cabo Verde	Ireland
Colombia	India	Comoros	Timor-Leste	Portugal
Costa Rica	Indonesia	Congo	Guinea-Bissau	Spain
Cuba	Jamaica	Côte d'Ivoire	Mozambique	United Kingdom
Dominican Republic	Kenya	Djibouti	Sao Tome and Principe	
Ecuador	Malaysia	Gabon		
El Salvador	Maldives	Guinea		
Guatemala	Namibia	Haiti		
Mexico	Nigeria	Madagascar		
Nicaragua	Philippines	Mauritania		
Peru	Serbia	Senegal		
Uruguay	South Africa	Seychelles		
Bolivarian Republic of Venezuela	Sri Lanka	Togo		
	United Republic of Tanzania	Tunisia		

Source: UNCTAD secretariat calculations, based on data from port entities members of the Port Management Programme network.

Among the top 50 economies of ownership, the fleets with the largest share of ballast water treatment systems are those owned by companies in Bermuda (40.99 per cent), Monaco (30.77 per cent) and Taiwan Province of China (21.41 per cent) (table 3.8). With regard to scrubbers, the fleets owned in Monaco (30.09 per cent), Switzerland (18.20 per cent) and Finland (10.51 per cent) have the largest share of ships equipped with such systems. As regards systems to reduce nitrogen-oxide emissions, Norway (7.79 per cent), Sweden (5.99 per cent) and Finland (5.42 per cent) record the best indicators. None of the ships controlled by owners from the Democratic People's Republic of Korea, Lebanon and the Bolivarian Republic of Venezuela are reported to have installed any ballast water treatment systems or systems to reduce emissions of sulphur oxide or nitrogen oxide.

E. TRAIN FOR TRADE PORT MANAGEMENT PROGRAMME: LESSONS LEARNED

Since 2013, the Train for Trade Port Management Programme has been implementing knowledge networks covering Africa, Asia, Europe, Latin America and the Caribbean, and capacity-building activities covering 60 countries since 1996 (figure 3.7).⁹ As a way to monitor and measure the performance of its member ports over time, the Programme has developed a port performance scorecard. The main objective is to provide members of the Programme with a useful tool that would benchmark performance and carry out port and regional comparisons.

⁹ A pool of over 3,635 port managers has been certified under the Modern Port Management lead course of UNCTAD in four language networks: English, French, Portuguese and Spanish.

Section	Indicator	Mean (2014–2018)	Number of values (2014–2018)
Finance	1 EBITDA/revenue (operating margin)	35.80%	90
	2 Vessel dues/revenue	16.40%	91
	3 Cargo dues/revenue	37.00%	86
	4 Rents/revenue	9.40%	83
	5 Labour/revenue	22.20%	80
	6 Fees and the like/revenue	12.40%	83
Human resources	7 Tons per employee	52 034	92
	8 Revenue per employee	\$233 564	90
	9 EBITDA per employee	\$117 776	79
	10 Labour cost per employee	\$36 633	73
	11 Training cost/wages	1.40%	75
Gender	12 Female participation rate (global)	16.80%	76
	12.1 Female participation rate (management)	34.30%	75
	12.2 Female participation rate (operations)	12.10%	60
	12.3 Female participation rate (cargo handling)	5.10%	44
	12.4 Female participation rate (other employees)	30.60%	18
	12.5 Female participation rate (management + operations)	21.90%	96
Vessel operations	13 Average waiting time (hours)	15	83
	14 Average gross tonnage per vessel	17 315	98
	15.1 Oil tanker arrival average	10.90%	51
	15.2 Bulk carrier arrival average	10.70%	51
	15.3 Container ship arrival average	32.70%	53
	15.4 Cruise ship arrival average	1.60%	54
	15.5 General cargo ship arrival average	22.40%	52
	15.6 Other ships arrival average	20.20%	51
Cargo operations	16 Average tonnage per arrival (all)	6 918	105
	17 Tons per working hour, dry or solid bulk	416	61
	18 Boxes per ship hour at berth	24	23
	19 TEU dwell time (days)	6	54
	20 Tons per hour, liquid bulk	436	28
	21 Tons per hectare (all)	140 220	84
	22 Tons per berth metre (all)	4 077	93
	23 Total passengers on ferries	1 058 762	36
	24 Total passengers on cruise ships	78 914	37
Environment	25 Investment in environmental projects/total CAPEX	1.30%	20
	26 Environmental expenditures/revenue	0.40%	31

Source: UNCTAD secretariat calculations, based on data from port entities members of the Port Management Programme network.

Abbreviations: CAPEX, capital expenditure; EBITDA, earnings before interest, taxes, depreciation and amortization.

Based on the balanced scorecard concept, 26 indicators were identified, collected and classified into six main categories since 2010: finance, human resources, gender, vessel operations, cargo operations and environment. The global average is calculated based on a five-year rolling back average.¹⁰ Results covering the period 2014–2018 are summarized in table 3.9, with

¹⁰ In 2018, the port performance scorecard introduced new features based on recommendations adopted by the representatives of the four port networks in Geneva, Switzerland, during Port Management Week in April 2018. A regional benchmark was created and is accessible on the pps.unctad.org platform to allow direct comparisons between ports in the same geographical range and similar environment and constraints. The regions are simplified for this purpose under the following categories: Africa, Asia, Europe and Latin America.

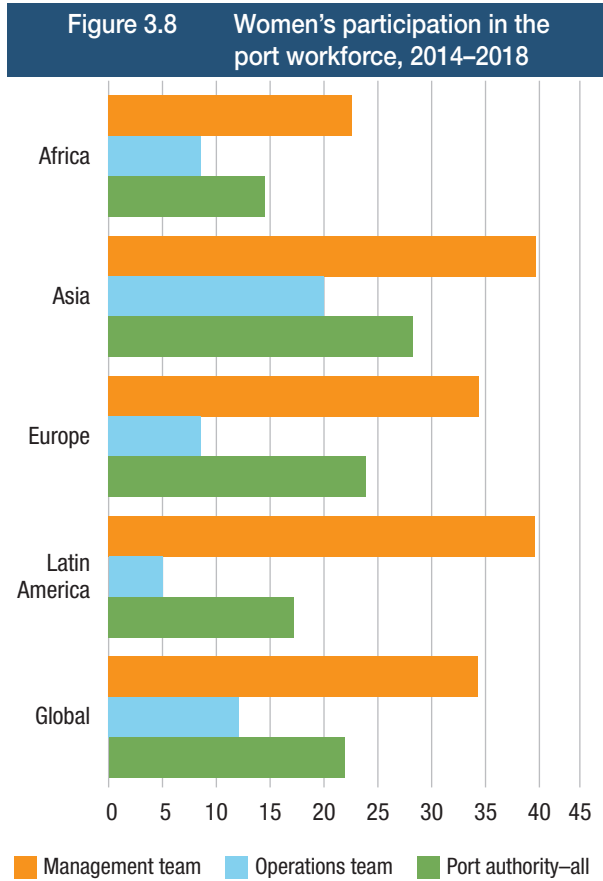
reported values ranging from 20 to 183.¹¹ This section will highlight some of the key outcomes.

Some of the port entities in the network are directly engaged in activities that are not covered by management, operations and cargo-handling groups. For example, some ports own and run hospitals and education facilities and manage estates where substantial non-port property, such as hotels, is a substantial and separate business operation.

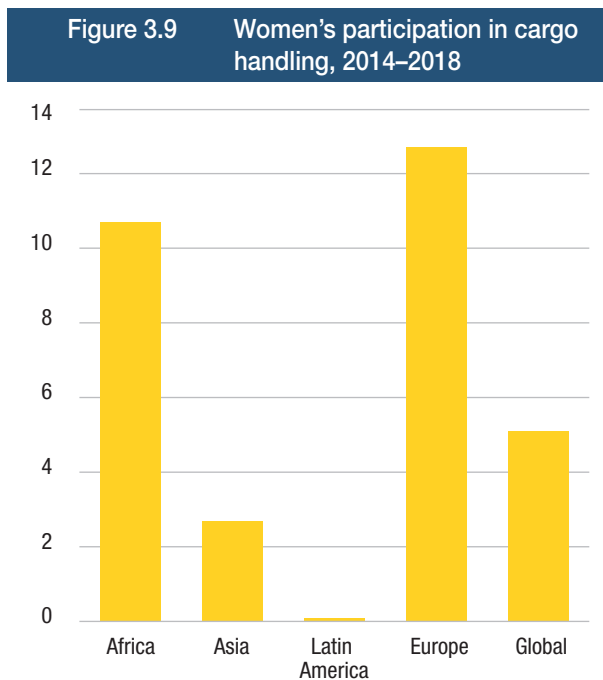
¹¹ The lowest number of values (datapoints) reported from 2014 to 2018 is 20 for the indicator “investment in environmental projects/total CAPEX [capital expenditure]”, followed by the indicator “boxes per ship hour at berth” (23 datapoints). The maximum datapoint is 105 for the indicator “average tonnage per arrival (all)”, closely followed by the indicator “average gross tonnage per vessel”, with 98 datapoints.

1. Gender participation

One of the six categories of indicators from the port performance scorecard covers gender in relation to Sustainable Development Goal 5. It measures the level of women's participation in the port workforce. Port workers



Source: UNCTAD secretariat calculations, based on data from port entities members of the Port Management Programme network.



Source: UNCTAD secretariat calculations, based on data from port entities members of the Port Management Programme network.

are traditionally regarded as a male-dominated group in most societies. In general, changes in working practices, technology and society have opened up the possibility for higher levels of women's participation in the port workforce.

Figure 3.8 examines the average rates of women's participation in the port workforce by region. General results show that overall participation is low, although participation at the management level is encouraging. The low level of women's participation in port operations suggests that their participation in activities such as engineering and service provision on the quays is also low.

Data on cargo-handling operations show a recurrent low level of women's participation in that area (figure 3.9). However, digitalization and the automation of activities in the shipping industry could lead to higher participation of women in this segment. It can also be argued that an increase in participation levels requires direct action by employers and society at large.

2. Finance, cost and revenues

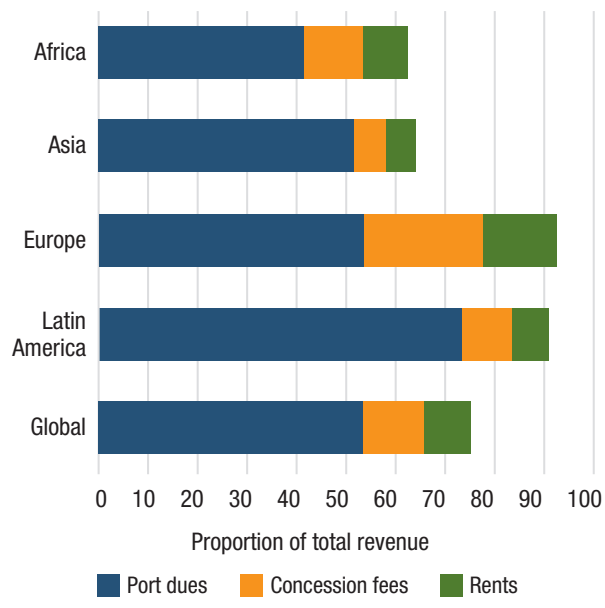
Traditional revenue profiles in ports relied heavily on the dues charged to ship and cargo owners, usually through agents. This revenue stream is required to build and maintain port infrastructure for vessels and cargo-handling operations. Other revenue streams would consist of rent on storage sites and the provision of services such as tugs and pilots. Figure 3.10 shows that the port dues category is still the largest block of revenue. However, with privatization, a trend which began in the 1980s, has come a new and major source and category of revenue – concession fees.¹² The level of concessions is higher in the larger ports with significant container operations.

Another important indicator is earnings before interest, taxes, depreciation and amortization, which is the conventional accounting measure of annual financial performance (figure 3.11). It excludes items that vary across the regions and time such as depreciation, interest on debt and tax and allows for comparison. The value for Asia is an outlier, which may in part be explained by the State-supported capital funding structures for a number of ports in the sample.

A valuable port indicator is the cost of labour as a proportion of total revenue (figure 3.12). It is a high-level metric with a number of constituent parts. For example, as the level of automation or outsourcing increases, the average may be expected to fall. A shift to advanced technologies can also result in high skills recruitment and an increase in average wages. Port performance scorecard data show that the global average of labour

¹² The port performance scorecard questionnaire defines this datapoint widely to capture the extent to which services, especially cargo handling, is now managed by the private sector. As this can be arranged in leases, operating contracts, joint venture agreements and concession agreements, the objective is to chart an expected rise in these levels. The variety of approaches is important to note and must be recognized in interpreting the data.

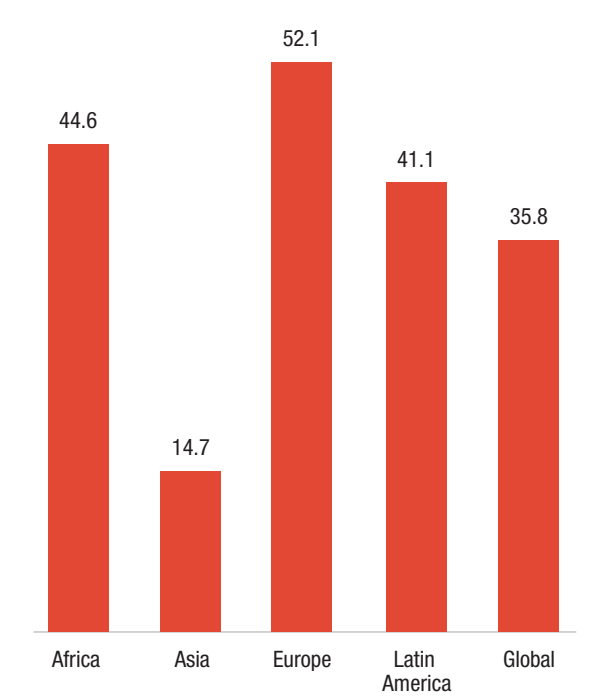
Figure 3.10 Revenue mix of ports by region, 2014–2018



Source: UNCTAD secretariat calculations, based on data from port entities members of the Port Management Programme network.

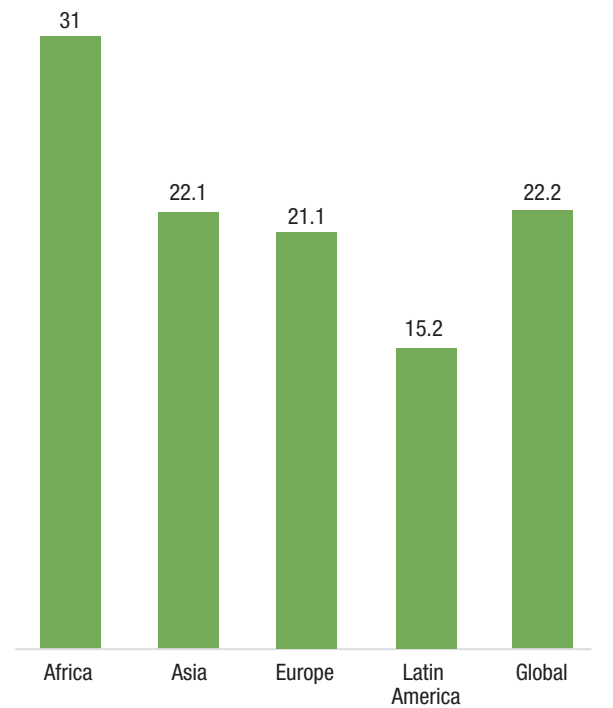
Note: Financial comparisons of port performance are contingent on the use of the same currency and time periods. Accounting data are reported by ports in local currency, then converted by UNCTAD into United States dollars, using currency tables issued by the World Bank to facilitate comparison.

Figure 3.11 Earnings before interest, taxes, depreciation and amortization, 2014–2018



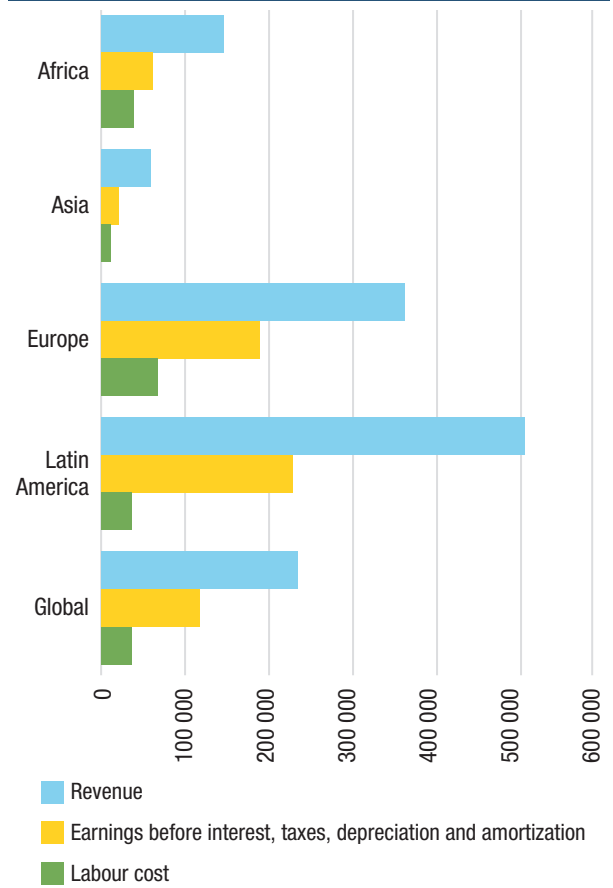
Source: UNCTAD secretariat calculations, based on data from port entities members of the Port Management Programme network.

Figure 3.12 Labour costs as a proportion of revenue, 2014–2018



Source: UNCTAD secretariat calculations, based on data from port entities members of the Port Management Programme network.

Figure 3.13 Employee contributions, 2014–2018



Source: UNCTAD secretariat calculations, based on data from port entities members of the Port Management Programme network.

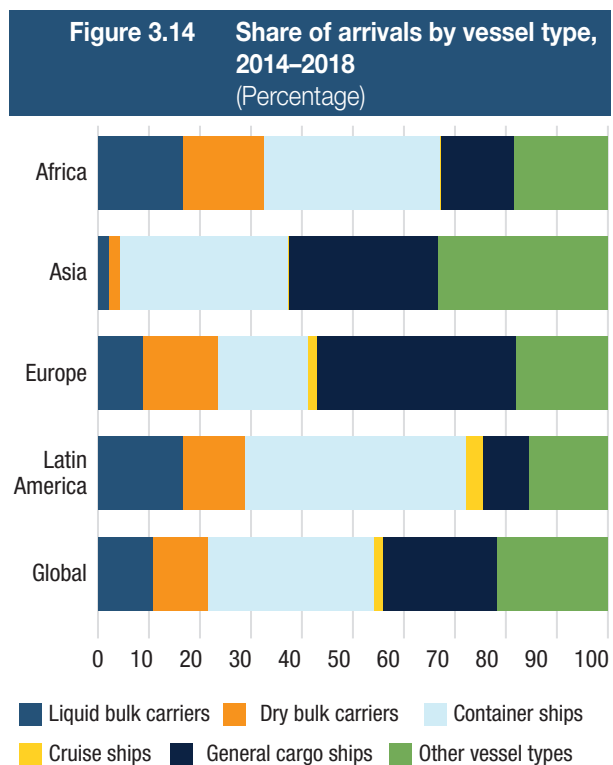
cost as a proportion of total revenue was between 20 per cent and 25 per cent for the period 2014–2018.

The regional average for Asia and Europe falls within this range. The relative outliers are Africa and Latin America. Although there is insufficient detail in the data to be definitive, feedback from ports suggests that Latin America is below the range because of privatization and Africa is above the range because of higher numbers of employees. There are other possible explanations such as wage rates, revenue levels or differences in how ports classify employees. The relative contribution of each employee to the financial performance of a port is depicted in figure 3.13. The regional spread is noteworthy; however, it is unlikely that the explanations can be summed up in a single variable.

3. Port entity operations

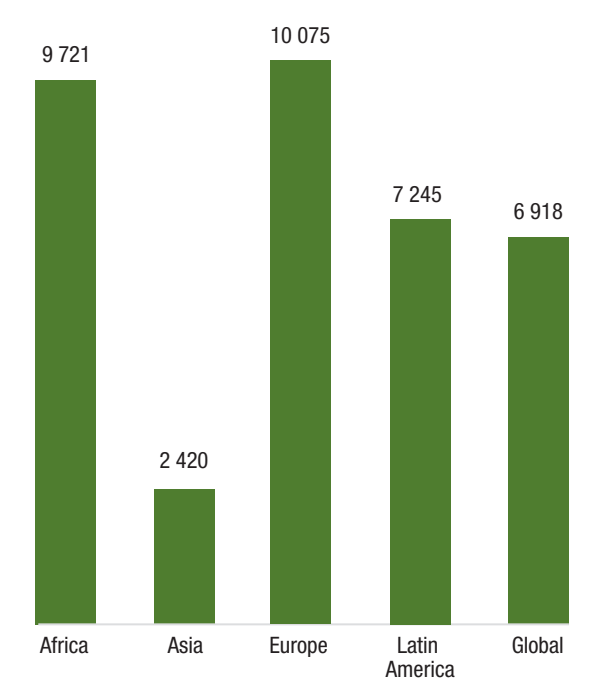
The data on the variable mix of port configurations in terms of cargo and vessels reinforce industry wisdom that states “when you have seen one port, you have seen one port”. Each has its own dynamic driven by geography and the local political economy.

The data in figure 3.14 provide a snapshot of the mix of vessels arriving in the member ports. The categorization of vessels is consistent with the definitions used in the *Review of Maritime Transport* for world fleet profiles. Member ports can compare their unique mix with the averages in their respective region and globally. The data are useful references when examining the revenue and profitability performance of individual ports.



Source: UNCTAD secretariat calculations, based on data from port entities members of the Port Management Programme network.

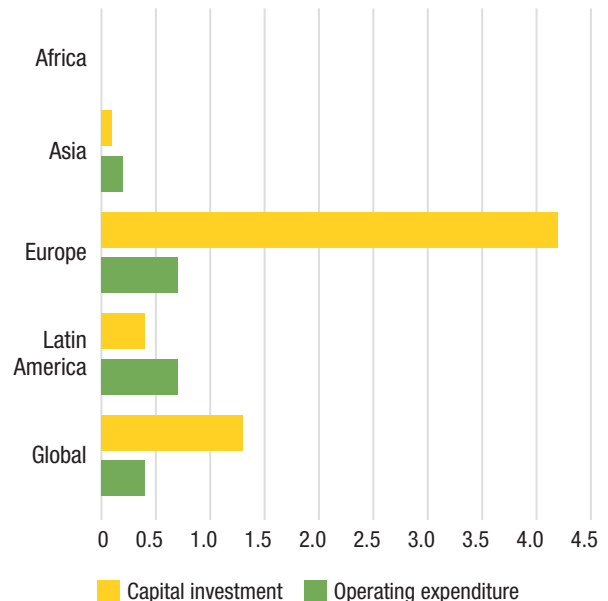
Figure 3.15 Average cargo tons loaded or unloaded per arrival



Source: UNCTAD secretariat calculations, based on data from port entities members of the Port Management Programme network.

Figure 3.15 illustrates the relative size of these vessels in terms of average cargo discharged or loaded per arrival. According to a port performance scorecard survey carried out in April 2019, some 65 per cent of all ports in a survey have annual cargo volumes of fewer than 10 million tons. Feedback from ports suggests that the relative low average for Asia is partly a function of inter-island traffic, including on ferry type vessels.

Figure 3.16 Environmental spending



Source: UNCTAD secretariat calculations, based on data from port entities members of the Port Management Programme network.

The general profile of ports in the aforementioned survey is unchanged and the majority can be classified as small to medium in size, owned by an arm of the State, managed in some corporate form, with a broader recognition that functional models are less likely to be exclusively landlord in nature. The average volume of cargo discharged or loaded per arrival is marginally lower than last reported. This may reflect global and regional trade disruption.

4. Sustainability

One difficulty with data in this category is the variable way ports will account for their environmental spending (figure 3.16). Some will record specific costs, while for many, the environmental portion of a project is embedded in the overall costs. This applies to both capital and operating costs. The data suggest that the larger ports in Europe do indeed record such performance indicators. Feedback on environmental spending suggests that capital expenditures and operational costs are rarely

classified as a single project. Therefore, such costs are included under many budget lines in other projects. This may in part explain the relatively low spending (1.7 per cent of capital expenditures) reported on the scorecard.

The data in this section provided a summary of the performance of Port Management Programme members between 2014 and 2018. Two points, which would require continued monitoring and reporting in the future, are worth highlighting. First, the levels of women's participation in the sector remain low. It is also necessary to bear in mind recent changes in working practices, technology and society that are opening up the possibility for greater participation of women in the sector. The advent of digitalization and the automation of activities in the shipping industry could lead to the increased participation of women in the future. Second, the growing trend towards privatization, which started in the 1980s, has brought a new and important category of revenue, concession fees.

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