4 PORTS

This issue of the Review of Maritime Transport *sets out to describe the work of UNCTAD in helping developing countries improve port performance in order to lower transport costs and achieve better integration into global trade. The Review explores new datasets in port statistics and presents an overview of what these reveal about the port industry in 2015.*

The overall port industry, including the container sector, experienced significant declines in growth, with growth rates for the largest ports only just remaining positive. The 20 leading ports by volume experienced an 85 per cent decline in growth, from 6.3 per cent in 2014 to 0.9 per cent in 2015. Of the seven largest ports to have recorded declines in throughput, Singapore was the only one not located in China. Nonetheless, with 14 of the top 20 ports located in China, some ports posted impressive growth, and one (Suzhou) even grew by double digits. The top 20 container ports, which usually account for about half of the world's container port throughput and provide a straightforward overview of the industry in any year, showed a 95 per cent decline in growth, from 5.6 per cent in 2014 to 0.5 per cent in 2015.

A. OPPORTUNITIES FOR DEVELOPING COUNTRIES TO IMPROVE PORT PERFORMANCE

The organization of the maritime transport sector significantly affects trade volumes, transport costs and economic competitiveness, making it crucial for ports to adapt to the growing complexities of modern port management. In that context, the methodology developed by the TrainForTrade Port Management Programme,[1] which links performance indicators to strategic objectives, can be a valuable asset to port communities of developing countries.

Thirty-four countries currently participate in the Port Management Programme, nine of which are involved in the port performance initiative: Angola, Benin, the Dominican Republic, Ghana, Indonesia, Namibia, Peru, the Philippines and the United Republic of Tanzania. These represent 21 port entities, which are divided into four language networks: English, French, Portuguese and Spanish.

The indicators are included as part of a port performance scorecard containing 23 benchmarks. The participating ports are in charge of gathering these data, based on a set of recommendations generated from capacity-building workshops (Philippines, 2015; Indonesia, 2016) to maintain comparability across ports.

Port surveys provide valuable information about the type of ports in a network: historical context, legislative background, functional model and insights into port service management. The Port Performance Scorecard contains four strategic dimensions: finance, operations, human resources and market. Financial data are drawn from balance sheets, cash flow statements and profit-and-loss accounts, and are recorded by cargo mode, type of port dues and service charge category. Human resources data are based on labour-related financial measures and proxies for labour productivity. Other valuable indicators for port stakeholders include measures of vessel capacity, berth size, market share by cargo mode and dwell time.

The data suggest that ports belonging to the Programme share many characteristics and that they perform relatively well, according to their size and service profile. The Programme highlights the following key performance measures. The average container dwell time is seven days, the average operating margin is 38 per cent, the ratio of vessel dues to cargo dues is on average 1:2 and the average waiting time for a vessel to berth is 17 hours. In addition, port authority employees earn a yearly average of $23,863, and average training expenditure is less than 1 per cent of total payroll costs. No port authorities are privatized, and State contributions to long-term public interest assets, such as breakwaters, are common.

In addition to capacity-building, the UNCTAD port network provides a good opportunity to conduct research on port performance to identify best practices from which others may learn. UNCTAD research in port performance dates back to as early as the 1970s and is outlined in a number of publications (UNCTAD, 1976, 1979, 1983, 1987a and 1987b).

In 2012, UNCTAD held an expert meeting on assessing port performance that brought together leading scholars in the field (see http://unctad.org/en/pages/MeetingDetails.aspx?meetingid=175). In 2016, UNCTAD published a separate study detailing the ongoing global efforts in assessing port performance (UNCTAD, 2016). This chapter also highlights other types of work undertaken by UNCTAD on port statistics and shows how these complement each other in improving port efficiency and driving down the cost of international trade.

B. PORT STATISTICS

Scholars and bright minds have helped coin the adage, "if you can't measure it, you can't manage it"; therefore, you cannot improve it. Galileo (1564–1642) is attributed to saying, "Count what is countable: Measure what is measurable. What is not measurable, make measurable" (Kozak, 2004). Ports were often the sole gateway into and out of a country, which has made it easy for Governments to record trade data and levy taxes. Port statistics have traditionally been within the realm of terminal operators, local port authorities or national associations. To a large extent, these entities decided what data were collected and, more importantly, how and when the data were disseminated. In some cases, the figures would take months – even years – before they became widely available for scrutiny. Nowadays, the share of national income derived from the taxation of imports (tariffs) has dwindled in most countries, as it has become easier to raise taxes elsewhere. For instance, the share of import duties in tax revenue is estimated at 18 per cent (and in some cases more than 50 per cent) of the total revenue of many low-income countries (Kowalski, 2005). For example, in India, the average tariff rate was reduced from 55 per cent in the early 1990s to a little over 25 per cent by the end of the decade (United Nations Department of Economic and Social Affairs, 2002). While tariffs in the United States accounted for 30 per cent of government revenue in 1912, it now stands at 1 per cent (Progressive Economy, 2013) .

Today, most ports are characterized by a mixed ownership between private terminal operators and public port authorities. Ports are still prolific generators of statistics, providing details about labour employed, equipment usage, cargo throughput and vessel port calls. However, most of that data are for internal use and not for public scrutiny. Even data collected by public institutions are not always made publicly available. Further, available data for some ports are not always homogeneous or easily comparable with that of other ports.

Global or regional port statistics are difficult to ascertain because there is no global organization responsible for collecting these data; even the leading global terminal operators tend to operate in one market segment – container ports – and this industry is still relatively fragmented. The private sector also tends to publish terminal performance as marketing tools, not as a part of unbiased research. Thus data are selective, and their coverage is patchy. There is no global publication that is issued by a group of port authorities, and the International Association of Ports and Harbours, the only international group of port authorities, does not have either the necessary remit or the resources to conduct annual surveys on port statistics.

Further, it is not an advantage for ports to be compared globally, since competition for cargo is usually a regional issue. For years, port authorities have maintained that every port is different and therefore cannot and should not be compared. This is true to some extent, but academics have found ways to overcome limitations through various techniques. Data envelopment analysis, for example, takes into account the different inputs and outputs of ports, while cluster analysis combines similar items for comparison. The main advantage of a global comparison lies in identifying best practices for learning purposes. Port directors may ask themselves why their port should be compared with distant ports, with high volume throughput and greater economies of scale, when their main competitor is a familiar port in a neighbouring country.

While this may be true, this attitude will not drive ever-more needed innovation and change. On the one hand, having details on global ports could make it easier for ports to find suitable partner ports for a meaningful comparison. On the other hand, if a direct comparison between ports on different continents is not considered beneficial, there should be no fear of revealing data, since it would not result in the loss of business to a competitor. In reality, the main reason behind the reluctance of ports to be more transparent seems most likely the fear of being labelled “underperforming”.

Researchers working in this area and wishing to compare global port performance have a difficult task in obtaining the inputs and outputs to be computed. Essentially, ports have to agree to be studied for the data to be collected and analysed, and whether to publish the findings. Even when there is an agreement to be studied, the relevant report is not always available to the public. Studies by regional associations, for example, the 2015 study of the Standing Committee for Economic and Commercial Cooperation of the Organization of Islamic Cooperation titled *Evaluating the Ownership, Governance Structures and Performances of Ports in the OIC Member Countries*, are not always widely publicized.

In 2015, UNCTAD, in association with the Port Management Association for West and Central Africa, organized a regional workshop in Ghana on identifying key performance indicators for ports from 11 countries. Port representatives expressed a desire to be transparent yet were concerned about being compared unfairly. For instance, any partial metric – that is, one that is not complete, such as a time element within a larger operation – that includes travel times from the point of waiting for a berth to completion of operations would give vastly different efficiency ratings for sea ports and fluvial ports, the latter having farther to travel to reach a berth. In addition, loading bulk cargo tends to be quicker than discharging, and differs by product type; therefore, care should be taken in assessing port performance. Also, not all indicators fit all ports, and a matrix of measurements is needed to reflect ports with different characteristics engaged in different market segments. This need led to the development of the aforementioned UNCTAD balance scorecard methodology.

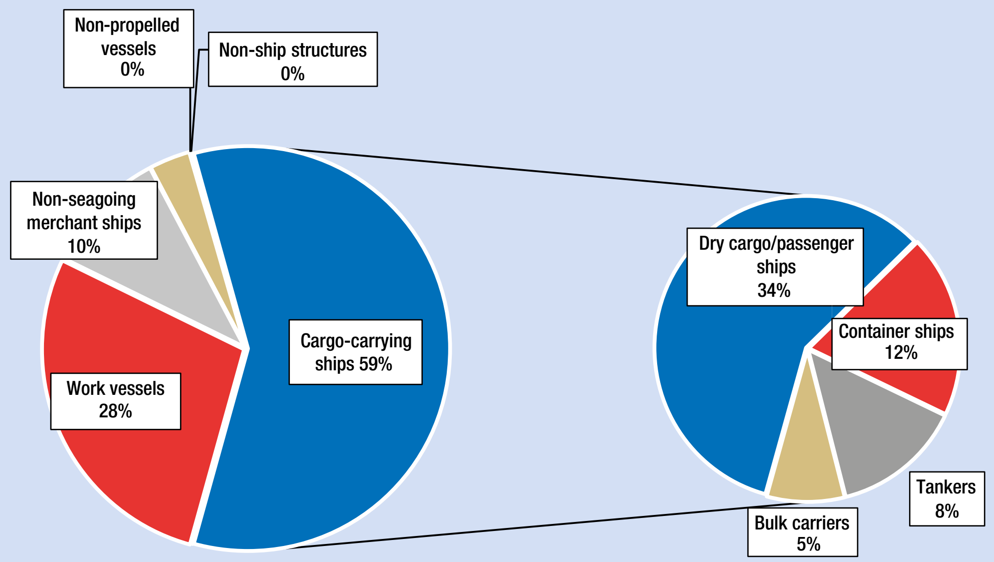
One of the main reasons businesses tend to congregate around ports is to reduce their exposure to losses in the labour force, component suppliers or service providers. Being close to labour and other business suppliers often outweighs the cheaper costs of land and labour at inland locations. Poor transport links impede reliability, predictability and certainty. On a national scale, other factors such as the rule of law separate from government, secure property rights and the ability to repatriate capital, are also important for businesses wishing to establish a long-term view. However, transparent and readily available trade and transport data could help alleviate investors' concerns. Initially the publication of data helps to quantify risk, then manage it and later reduce it to provide certainty and build business confidence. Without data, businesses could underestimate the risks involved and thereby increase their chance of failure; alternatively, financial backers could significantly exaggerate their potential exposure and overcharge, thus making a business unprofitable. Either choice could lead to business failure, and while data are not a panacea, they can help avoid these pitfalls if used properly. A clear indication that a Government intends to create transparency in one area could spread to other aspects of government. The publication of trade and transport data should be a priority for policymakers wishing to promote international trade. The data should be publicly available and free to access. For this to be effective on a global scale, the data should emanate from a partnership involving a data provider, a host organization that collates and publishes the data – UNCTAD for example – and an academic institution responsible for providing one interpretation (or the first interpretation). As the data would be freely available, analysis by other interested parties would also be possible.

Observational data, the recording of specific actions that have been observed as having occurred, are the result of counting specific occurrences of individual actions without any analysis, for example, the number and type of vehicles, trains or vessels arriving and departing from a particular point. Individually, these data indicate very little, but when aggregated and analysed, may reveal patterns not previously visible. This chapter presents some observational data from two different sources to show what they reveal about the port sector. As with any data analysis, there are caveats. Owing to the large quantity of data required, the analysis must be automated in order to reduce analysts' labour time and costs, and automation may lead to errors. This research focuses on the descriptive data, rather than the analytics of that data, in an attempt to understand the dataset and establish proof of concept or possible limitations.

Information on ship arrivals and departures from ports may not reveal much in itself, but when analysed along with weather data or the number of patients treated for severe asthma in local hospitals, may indicate a pattern through which minor readjustments in operational matters could achieve major benefits for society. Governments and local authorities should not be dissuaded from providing data on the assumption that such data may bring about litigation, as the benefits in the long term will lead to a better life for as many people as possible. Exactly what big data on international trade will reveal is not yet known. Perhaps this will lead to cargo and vessels being matched more easily, thus leading to high fleet utilization rates and lower transport costs. Perhaps ports will be able to plan better for a ship's arrival, avoiding the need to buy expensive and underutilized equipment. Perhaps environmentalists will be able to anticipate periods of increased animal migration with peaks in vessel arrivals to lessen any negative factors. In reality, the opening of big data is likely to create new jobs and opportunities not previously imagined.

UNCTAD receives automatic identification system (AIS) observational data from MarineTraffic, a London-based private-sector maritime data provider (see http://www.marinetraffic.com, 2007–2016). AIS data are explained in box 4.1 and how the data work, in box 4.2. Box 4.3 looks at the validity of the data. MarineTraffic supplied UNCTAD with details on AIS data for 2.8 million vessel calls made at 661 ports in 151 countries in 2015 (figure 4.1). The dataset of 2.8 million vessels calls is not a complete picture of all vessel movements. As reported in chapter 2, the world merchant fleet consists of 90,917 vessels, but the AIS data in this sample pertain to 36,665 vessels (40 per cent). There are thousands of ports worldwide; some estimates put the figure at over 10,000, but monitoring all would be burdensome. UNCTAD experts have narrowed down the number of observations to 1.66 million signals, which they believe represents much of the estimated 80 per cent of the world's merchandisable trade carried by seagoing vessels. The four types of cargo-carrying vessels are dry cargo or passenger ships, container ships, tankers and bulk carriers. Their definitions should be interpreted with care, as a dry cargo ship or passenger ship may be either a passenger ferry that services commuters across a narrow strait or a large ocean-going vessel that carries merchant trade.

Figure 4.1 Sample of automatic identification system data signals by type of vessel, 2015



Source: UNCTAD secretariat calculations, based on raw observational data provided by MarineTraffic.

Note: The large pie chart relates to the 2.8 million signals received and the small one, to the 1.66 million signals pertaining to cargo-carrying vessels as defined by UNCTAD.

Box 1. What are automatic identification systems?

Since 2002, SOLAS requires that internationally bound ships with gross tonnage of 300 or more, and all passenger ships regardless of size, be fitted with AIS. AIS data are automatically and electronically broadcast by vessels through very high frequency radio at regular intervals. AIS data include items such as the following: IMO identification number, maritime mobile service identity, call sign, ship name, ship dimensions, position, course, speed and draft. The data are transmitted continuously at irregular intervals, providing a comprehensive and detailed dataset of the passage of a vessel. The AIS data transmission rate is usually about three minutes for anchored or moored vessels, and up to two seconds for fast-moving or manoeuvring vessels. Typically, the data range is limited by the very high frequency signal strength and topological features such as islands, mountain ranges and the earth's curvature. The horizontal range is thus around 75 km, whereas the vertical range can be up to 400 km, making satellite-mounted AIS receivers capable of providing extra coverage at sea. In 2010, the International Space Station was successfully fitted with an AIS receiver, and global coverage has increased. Nonetheless, the industry is still in its infancy as commercial products derived from the data are being explored.

AIS data are transmitted and received by other suitably equipped vessels and by the vessel traffic service located in and around ports and sea lanes, which is a part of a nation's maritime collision avoidance system. There are essentially two types of AIS transmitters and receivers on vessels: Class A is fully integrated into the ship's main systems for merchant vessels over 300 gross tons, and Class B is a more affordable less integrated version for smaller craft. In June 2016, one AIS data provider reported on the 69,726 vessels in range. Of these, 84 per cent were fitted with Class A transponders and 16 per cent, with Class B transponders (VT Explorer, 2006–2013). Much like radio signals, AIS data are picked up by multiple listening stations on land and in space; as a result, there is no restriction as to who may tune in and record what is broadcasted. Duplicate recordings of data are common where overlapping base stations in adjacent countries may pick up the same signal. Duplicated AIS data signals also provide valuable confirmation of a vessel's position from multiple sources.

Maritime safety authorities tend to save AIS data for incident investigation, traffic analysis or further research (Xiao et al., 2015). The data tend to be stored regionally by many national maritime authorities, not centrally by an international organization in one global hub. The volume of data can be very large. In the United States, the Nationwide Automatic Information System receives 92 million such messages per day from approximately 12,700 vessels (United States Coast Guard, 2016). It is therefore conceivable that the world fleet of merchant vessels of around 90,000 vessels could transmit several hundred billion signals yearly.

A number of private companies and at least one organization are building their own networks of listening stations and storing the received signals in their own databases.

In the fishing sector, for example, data providers and conservationists work together to increase transparency as to where fishing vessels catch their cargo. However, for the most part, AIS datasets on merchant fleets tend to have restricted access rights and cannot be easily analysed by the public. Either the information is restricted to the sole view of the data provider membership or, to individual users for one ship or one port or region at a time. Thus without a prearranged agreement, the data cannot be analysed on a global scale. A partial exception are communities of individual enthusiasts and professionals who record and share AIS broadcasts they have received from devices installed in or connected to their personal computers (see www.AISHub.net, AISHub data-sharing centre, which boasts nearly 500 global base stations). Membership is open to those possessing their own AIS receivers and who agree to share their data. Seemingly, interested parties in landlocked countries far from the sea or, those located in busy areas where others are already providing data, may find it difficult to join communities and share data.

Box 2. How do automatic identification systems work in practice?

AIS data on vessel port calls are automatically generated from vessel movements. MarineTraffic AIS data signals are triggered upon receipt of an arrival notification indicating when a ship crosses the boundary of an invisible predetermined polygon and, conversely, upon receipt of an exit notification indicating when a vessel leaves. While manoeuvring, a vessel's signal may be interpreted as a duplicate port call. Likewise, a port authority may, on the other hand, only include in their official statistics vessels that have been serviced through cargo handling, not those that have sailed close to a port to take a person or package on board.

The recordings of AIS data originating in ports can be considered to be the minimum number of vessel port calls for those ports. Broadcasts from ship AIS signals may not always be transmitted or captured for a variety of reasons, such as power outage linked to transmitters or receivers, technical difficulties with data management (for example, multiple signals generated simultaneously) or simple human errors or omissions. MarineTraffic data relate to 69 different vessel types, from anchor-handling vessels and search-and-rescue vessels, to military vessels and pleasure yachts. While the number of vessel types is difficult to interpret, data from a leading ship classification lists over 300 different vessel categories. Thus the first challenge with the dataset is to filter it down into working vessels (for example, tugs and cable-laying vessels) and cargo-carrying vessels (for example, vessels engaged in trading goods) and then into the aforementioned four broad categories of cargo-carrying vessels.

Table 4.1 Vessel port calls by region and type, 2015

Vessels	Africa	Asia	Caribbean	Europe	North America	Oceania	South America	Grand total
Cargo-carrying ships								
Bulk carriers	9 486	69 150	3 684	17 048	10 553	14 051	13 403	137 375
Container ships	20 418	180 705	16 729	64 900	14 620	7 188	17 669	322 229
Dry cargo/passenger ships	36 915	375 134	13 035	431 849	48 834	40 651	19 780	966 198
Tankers	9 160	127 312	6 599	62 721	10 387	3 306	10 312	229 797
Grand total	75 979	752 301	40 047	576 518	84 394	65 196	61 164	1 655 599

Source: UNCTAD secretariat calculations, based on raw observational data provided by MarineTraffic.

Note: The regions listed have been defined by UNCTAD; for the purpose of this research, the Caribbean region also includes Mesoamerican countries.

Box 3. Validity of automatic identification systems data

To check the validity of the AIS data figures, the data provided by a small multipurpose port were compared with those of the AIS dataset from MarineTraffic. The Mauritius Port Authority was chosen because it handles a mixture of vessel types and has a sound reputation for regular and timely publication of port statistics. The AIS database showed 537 container vessel calls at Port Louis in 2015, compared with 568 posted on the port website, which means that 95 per cent of port calls were registered. For bulk carriers. the figures are 55 AIS signals, compared with 52 port calls registered by the port (106 per cent). General cargo vessels generated 131 AIS signals, compared with103 recorded by the Port Authority (127 per cent). Cruise vessels generated 24 AIS signals, as opposed to 23 recorded by the Port Authority (104 per cent). Yet variations in fishing vessels show 126 AIS signals, compared with 953 recorded by the Port Authority (13 per cent). The significant variation in the figures relating to fishing vessels can be explained by the fact that many of the fishing vessels reported by the Port Authority may have been small (below 300 gross tons) and were not fitted with AIS transponders. In all, 2,090 AIS individual vessel signals were received, compared with 2,947 vessels calls recorded by the Port Authority (71 per cent). If fishing vessels are excluded, the alignment between the two sources would be much greater (98.5 per cent).

Next, the data concerning the port of Tangier, Morocco, were examined. Initially the AIS data did not show any vessels other than roll-on/roll-off passenger ships. This caused some concern, as Tangier is a well-known port of call for container liner companies, as demonstrated by the 3 million TEUs handled at the port in 2015. The error could be traced to an interpretation of the name of the port. The initial AIS data pertained to the old port of Tangier, not the new container port, Tanger Med, or its second phase, Tanger Med II, located 40 km to the east of the old port. Once rectified, the total number of vessel port calls from AIS signals quadrupled to 15,575. Although detailed by port and cargo category, however, the data from the website Agence nationale des ports (http://www.anp.org.ma/) mainly cover volume amounts and percentage increases, as opposed to the number of vessel arrivals. This does not make a direct comparison possible.

Lastly, the large multipurpose Port of Rotterdam was chosen for comparison with the AIS dataset of MarineTraffic. The initial problem was that the Port of Rotterdam is so large that there are six ports within the port (Botlek, Centrum, Delfshaven, Maasvlakte, Pernis and Waalhaven) if the United Nations Code for Trade and Transport Locations (UN/LOCODE) is used as the geographical tag. Dating back to 1981, UN/LOCODE originated within the Working Party on Trade Facilitation of the Economic Commission for Europe and is based on a code structure set up by the Economic Commission for Latin America and the Caribbean and a list of locations originating in the latter, developed in UNCTAD in cooperation with transport organizations and with active contributions from national Governments and commercial bodies. At the time of writing, the data for these subports were not available. However, in the bulk sectors, there was a close alignment between the port's official statistics, which indicated 1,177 dry bulk carriers, and the AIS category bulk carriers, which indicated 1,174 port calls (99.7 per cent).

Further analysis is needed to understand why North America does not feature more prominently in the dataset. This could relate to the greater use of combined ferries and freight traffic vessels, river traffic, a greater use of short sea shipping or simply the number of vessels fitted with AIS transponders. The data for the port of Seattle, Washington (United States) shows 12,674 dry cargo or passenger ships, which is twice the number of recorded calls for the next largest United States port in Galveston, Texas and just one sixth of that reported by the Northwest Seaport Alliance (Seattle and Tacoma ports combined) (The Northwest Seaport Alliance, 2016).

Table 4.1 shows a breakdown of the minimum number of port calls by category of ship per region. Asia and Europe represent the highest number of port calls. In Australia and the developed regions of Europe and North America, the category dry cargo/ passenger ships represents more than 50 per cent of the total.

Figure 4.2 shows the geographical distribution of the scale of 76,000 recorded port calls in Africa. Previously much research, albeit in the container sector, has identified Africa's corner points – Egypt, Morocco, and South Africa – as the busiest parts of the continent for maritime trade. This map of AIS data shows that there is considerable vessel traffic in the Gulf of Guinea. Luanda, Angola, is singled out as the second busiest port in the data sample, after Tangier, Morocco, with almost 4,000 port calls (2,105 dry cargo/passenger ships, 1,236 tankers, 507 container ships and 147 bulk carriers). Other leading ports in the data sample show significant levels of traffic in Durban, South Africa; Lagos, Nigeria; and Port Said, Alexandria and Suez, Egypt.

Figure 4.2 Scale of vessel port calls in Africa, 2015

Source: UNCTAD secretariat calculations, based on raw observational data provided by MarineTraffic.

Figure 4.3 shows the number of AIS data recordings received for African countries. The AIS data represent 73 ports located in 37 countries (this figure includes the island of St. Helena, a British overseas territory). It does not include the 15 African landlocked countries, Cabo Verde or the Democratic Republic of the Congo, where data were not reported. The AIS data may not have systematically recorded every vessel's port call; therefore, these figures should be regarded as a minimum indication, and the accurate number of port calls will therefore be higher. Figure 4.4

Figure 4.3 Vessel port calls in Africa, 2015

Source: UNCTAD secretariat calculations, based on raw observational data provided by MarineTraffic.

Figure 4.4 Vessel port calls in West Africa, 2015

Source: UNCTAD secretariat calculations, based on raw observational data provided by MarineTraffic.

illustrates the specialty of the ports in West Africa. For instance, Abidjan (Côte d'Ivoire) has a large share of tankers, while Lomé (Togo) has a large share of container ships and Owendo (Gabon), a fairly even split of different vessel types. The uniqueness of the dataset concerning the type of vessels calling at ports relates back to UNCTAD work on the aforementioned balanced scorecard methodology. Using the AIS data to identify ports with similar vessel characteristics makes it possible to compare a sample of similar ports at the same time and counters the long-standing argument that ports cannot be compared because each is unique.

C. CONTAINER PORT DEVELOPMENTS

The dearth of available port statistics is less prevalent with regard to container ports because they are common user facilities, that is, they represent the trade of thousands of cargo owners. Table 4.2 shows throughput volumes for the world's 20 leading container ports from 2013 to 2015. The top 20 container ports, which account for 55 per cent of the throughput of the top 100 ports, showed a 95 per cent decline in growth, from 5.6 per cent in 2014 to 0.5 per cent in 2015. Although this does not appear to be true of other smaller ports, which experienced larger gains. The top 100 container ports are estimated to have handled a throughput of 539 million TEUs in 2015, up by about 6.8 per cent from the 505 million reported in 2014 (Informa PLC, 2016) . The list of top 20 container ports includes 15 ports from developing economies, and as in the previous year, are located in Asia; the remaining five ports are from developed countries, three of which are located in Europe (the Netherlands, Belgium and Germany) and two in North America (Los Angeles and Long Beach, California). The top 10 ports continue to be located in Asia. Nine of the top 20 container ports are located in China, and seven of these (excluding Dalian and Hong Kong, China) experienced positive growth. Overall, the top 20 container ports in China grew by 3.7 per cent in 2015, in spite of the economic slowdown (JOC.com, 2016a). Seven of the top 20 ports experienced a negative growth rate in container port throughput, compared with the previous year, while an additional two barely managed a positive growth rate at less than 1 per cent. The most significant declines occurred in Hong Kong (China), Hamburg (Germany) and Singapore at -9.5, -9.3 and -8.7 per cent, respectively. Conversely the ports of Port Klang (Malaysia), Antwerp (Belgium) and Tanjung Pelepas (Malaysia) experienced the most growth at 8.6 per cent, 7.5 per cent and 7.4 per cent, respectively. The port of Tanjung Pelepas made significant strides in 2014, with 11.4 per cent growth on the completion of infrastructure investments. Growth was expected to be reduced to around 4.4 per cent in 2015 but proved much better. Malaysian ports have consistently expanded their throughput during the last decade so that both Port Klang and Tanjung Pelepas are now handling twice the volume of 2005.

Operational performance of container ports

Table 4.3 shows improvements in container berth productivity in selected developing countries in 2015, compared with 2014. The highest growth is in the

Table 4.2 Top 20 container terminals and their throughput, 2013, 2014 and 2015 (Thousands of 20-foot equivalent units and percentage change)

Rank	Port Name	Country	2013	2014	2015	Percentage change 2014-2013	Percentage change 2015 -2014
1	Shanghai	China	33 617	35 290	36 540	4.98	3.54
2	Singapore	Singapore	32 579	33 869	30 922	3.96	-8.70
3	Shenzhen	China	23 279	24 040	24 200	3.27	0.67
4	Ningbo and Zhoushan	China	17 351	19 450	20 630	12.10	6.07
5	Hong Kong	China	22 352	22 200	20 100	-0.68	-9.46
6	Busan	Republic of Korea	17 686	18 683	19 467	5.64	4.20
7	Guangzhou	China	15 309	16 610	17 590	8.50	5.90
8	Qingdao	China	15 520	16 580	17 430	6.83	5.13
9	Dubai Ports	United Arab Emirates	13 641	15 200	15 590	11.43	2.57
10	Tianjin	China	13 000	14 060	14 110	8.15	0.36
11	Rotterdam	Netherlands	11 621	12 298	12 235	5.83	-0.51
12	Port Klang	Malaysia	10 350	10 946	11 887	5.76	8.60
13	Kaohsiung	Taiwan	9 938	10 593	10 260	6.59	-3.14
14	Antwerp	Belgium	8 578	8 978	9 654	4.66	7.53
15	Dalian	China	10 015	10 130	9 450	1.15	-6.71
16	Xiamen	China	8 008	8 572	9 180	7.04	7.09
17	Tanjung Pelepas	Malaysia	7 628	8 500	9 130	11.43	7.41
18	Hamburg	Germany	9 257	9 720	8 821	5.00	-9.25
19	Los Angeles	United States	7 868	8 340	8 160	6.00	-2.16
20	Long Beach	United States	6 648	6 818	7 190	2.56	5.46
	Total top 20		**294 245**	**310 877**	**312 546**	**5.65**	**0.54**

Source: Various sources, including Port of Rotterdam (2015).

port of Sohar, Oman, 160 km from Dubai, which experienced a doubling in the number of container-handling operations following improvements made by its operator, Hutchinson Port Holdings (Handy Shipping Guide, 2015). The figures show that double-digit growth in terminal efficiency is possible. These terminals often benefit from the experience of a global terminal operator who is part owner, part operator (see column 2 of the table for a list of the leading international terminal operators). It is not unusual for more than one competing international terminal operator to have a presence in the same port at different terminals, and in a limited number of cases, within the same terminal. For example, in 2013, the Antwerp Gateway common user terminal at Deurganck Dock was a joint-venture between DP World (42.5 per cent), ZIM ports (20 per cent), the former China Ocean Shipping Pacific (20 per cent), Terminal Link/CMA CGM (10 per cent) and Duisport (7.5 per cent), with DP World acting as the operator (DP World, 2013). As reported in previous editions of the *Review of Maritime Transport*, improvements in terminal operational performance are difficult to sustain year on year.

D. OVERALL PORT DEVELOPMENTS

Unlike container ports, bulk and liquid ports are not common user ports and tend to represent the interests of a few cargo owners. This makes it difficult to obtain statistics on these sectors. Table 4.4 shows the world's leading ports by volume. Fourteen of these top 20 ports are in China, a further three in Asia and one each in Australia, Europe and North America. These 20 ports experienced an 85 per cent decline in growth, from 6.3 per cent in 2014 to 0.9 per cent in 2015. Of the seven ports that experienced declines

Table 4.3 Container berth productivity, selected developing countries, 2015

Terminals	International terminal operators	Ports	Countries	Regions	Improvement (percentage)
Oman International Container Terminal	HPH	Sohar	Oman	Middle East	101
Luanda Container Terminal	APMT	Luanda	Angola	Africa	52
Tanzania International Container Terminal Services	HPH	Dar es Salaam	United Republic of Tanzania	Africa	37
Nam Hai Terminal		Haiphong	Viet Nam	Asia	22
DP World Maputo	DP World	Maputo	Mozambique	Africa	21
Tecon Suape Container Terminal	ICTSI	Suape	Brazil	South America	20
South Container Terminal	DP World	Jeddah	Saudi Arabia	Middle East	20
Shuaiba Area Container Terminal		Shuaiba	Kuwait	Middle East	18
Jawaharlal Nehru Container Terminal	DP World	Nehru	India	Asia	18
Evergreen Container Terminal – LCB2	Evergreen	Laem Chabang	Thailand	Asia	17
Manzanillo International Terminal	SSA Marine	Manzanillo	Panama	South America	16
Panama Ports Company	HPH	Cristobal	Panama	South America	16
First Container Terminal	Global Ports	St. Petersburg	Russian Federation	Europe	14
Société de manutention du terminal à conteneurs	Bolloré Group	Cotonou	Benin	Africa	13
Terminal Petikemas Surabaya	DP World	Surabaya	Indonesia	Asia	11
Korea Express Busan Container Terminal	China Shipping Group	Busan	Republic of Korea	Asia	9
South Harbor International Container Terminal (ATI)	ICTSI	Manila	Philippines	Asia	8
Aqaba Container Terminal	APMT	Aqaba	Jordan	Middle East	7
Walvis Bay Container Terminal		Walvis Bay	Namibia	Africa	6
PSA Singapore Terminals	PSA	Singapore	Singapore	Asia	6
Terminal 2 – Rio Multitermais Container Terminal		Rio de Janeiro	Brazil	South America	5
Dongbu Pusan Container Terminal	Evergreen	Busan	Republic of Korea	Asia	3
Port Akdeniz	Global Ports Holding	Antalya	Turkey	Asia	2
APM Terminals Pecem	APMT	Pecem	Brazil	South America	2

Source: UNCTAD secretariat calculations, based on the port productivity database of JOC.com (2016b) and other sources.
Note: For the purpose of this research, berth productivity is defined by JOC.com as "the average number of container moves per crane, per hour while a ship is at berth". The relative improvement has been measured and then weighted by call size to achieve actual improvement in year-on-year performance.

in throughput in 2015, Singapore was the only one not located in China. The Chinese port of Suzhou experienced the largest increase in throughput, 12.5 per cent. The next largest gain in port throughput was recorded by Rotterdam, the Netherlands, which experienced a growth of 4.9 per cent. Rotterdam's growth stemmed from increased trade in liquid bulks, in particular crude oil (up 8 per cent), mineral oil products (up 18 per cent) and liquefied natural gas (up 92 per cent) (Port of Rotterdam, 2016).

Despite the difficulty of obtaining dry bulk port statistics, UNCTAD has been successful in obtaining a unique dataset from a leading shipping agency, Wilhelmsen Ships Service. Table 4.5 shows data from bulk vessels calling at ports in several countries engaged in the iron ore and coal trades. The data are part of the company's internal record keeping and include port calls serviced by the company or observed to have taken place. The database recorded nearly 34,000 port calls in 2014 and 2015.

The database includes information on individual vessels, arrival times, berthing times and departure times that have been entered manually. The risk of manually entering data is the introduction of human error caused by creating shortcuts. That said, because there were numerous data fields, the data were filtered for obvious errors or questionable figures, for example where the load factor was greater than 100 per

Table 4.4 World's leading ports by total volume, 2013–2015 (Thousands of tons)

Rank	Port	Country	2013	2014	2015	Percentage change 2014–2013	Percentage change 2015–2014
1	Ningbo and Zhoushan	China	809 800	873 000	889 000	7.80	1.83
2	Shanghai	China	776 000	755 300	717 400	-2.67	-5.02
3	Singapore	Singapore	560 800	581 300	574 900	3.66	-1.10
4	Tianjin	China	500 600	540 000	541 000	7.87	0.19
5	Suzhou	China	454 000	480 000	540 000	5.73	12.50
6	Guangzhou	China	454 700	500 400	519 900	10.05	3.90
7	Qingdao	China	450 000	480 000	500 000	6.67	4.17
8	Tangshan	China	446 200	500 800	490 000	12.24	-2.16
9	Rotterdam	Netherlands	440 500	444 700	466 400	0.95	4.88
10	Port Hedland	Australia	326 000	421 800	452 900	29.39	7.37
11	Dalian	China	408 400	420 000	415 000	2.84	-1.19
12	Rizhao	China	309 200	353 000	361 000	14.17	2.27
13	Yingkou	China	330 000	330 700	338 500	0.21	2.36
14	Busan	Republic of Korea	292 400	312 000	323 700	6.70	3.75
15	South Louisiana	United States	241 500	264 700	265 600	9.61	0.34
16	Hong Kong	China	276 100	297 700	256 600	7.82	-13.81
17	Qinhuangdao	China	272 600	274 000	253 100	0.51	-7.63
18	Port Klang	Malaysia	200 200	217 200	219 800	8.49	1.20
19	Shenzen	China	234 000	223 300	217 100	-4.57	-2.78
20	Xiamen	China	191 000	205 000	210 000	7.33	2.44
	Total top 20		**7 974 000**	**8 474 900**	**8 551 900**	**6.28**	**0.91**

Source: Various sources, including Port of Rotterdam (2015).

Table 4.5 Average dwell times for bulk vessels, selected countries, 2015

	2014				2015			
Row labels	Sample size	Quantity (thousand tons)	Average waiting time (days)	Average working time (days)	Sample size	Quantity (thousand tons)	Average waiting time (days)	Average working time (days)
Australia	4 438	455 907	5.50	10.95	2 461	517 066	4.52	5.55
Brazil	1 533	252 707	6.44	12.08	1 537	258 899	5.17	2.04
Canada	151	17 779	5.08	2.58	36	3 327	2.33	2.69
China	599	76 347	3.73	2.74	1 470	183 976	1.81	2.42
Taiwan	..	..	..	..	107	8 858	0.68	3.40
Colombia	48	4 838	1.75	0.82	213	19 304	0.36	1.95
India	2 302	163 729	3.96	10.68	1 865	124 192	2.28	3.63
Indonesia	2 609	182 875	2.55	4.06	281	19 430	2.99	4.05
Netherlands	51	7 416	0.12	2.78	72	8 947	1.09	2.59
Republic of Korea	..	..	..	..	167	19 145	2.64	3.75
South Africa	..	..	..	..	994	89 376	2.32	2.33
United States	188	13 819	4.74	2.31	55	5 129	1.51	1.63
Grand total	**11 925**	**1 176 315**	**4.53**	**8.80**	**9 258**	**1 257 650**	**3.46**	**3.86**

Source: UNCTAD secretariat calculations, based on raw observational data provided by Wilhelmsen Ships Service.

cent or lower than 10 per cent or the IMO number corresponded to a different type of vessel incapable of carrying the specified cargo. In addition, in some instances, the time element showed dates, not hours; therefore, the time averages and fiscal calculations are estimated averages. The data entries were cross-checked with datasets of IMO for details concerning the ship type (IMO number) and of the Economic Commission for Europe concerning the location (UN/LOCODE). This process removed around 40 per cent of the data received to provide a database of 20,000 port calls for analysis.

The data, based on a sample size of almost 12,000 port calls in 2014, shows that the average waiting time for a berth was 4.5 days and the average time spent alongside a berth was 8.8 days, either loading or discharging a total of 1.176 billion tons of cargo, equivalent to approximately 12 per cent of the annual global seaborne trade. For 2015, the comparable figures are around 9,250 observations with an average of 3.5 days spent waiting for a berth and 3.9 days alongside a berth, handling 1.257 billion tons of cargo. The waiting time can be attributed to any number of reasons such as undertaking repairs, loading victualling, awaiting new instructions and cargo or port and sea-lane congestion. The most significant improvements in waiting times occurred in ports located in Brazil (83 per cent less waiting), India (66 per cent less waiting) and Australia (49 per cent less waiting).

Dwell time in Colombian ports increased by 137 per cent, as the recorded number of observations doubled. This may be attributable to the rebound effect of an export ban imposed on one of the largest exports of thermal coal in the first half of 2014. In 2015, Colombian thermal coal exports rose by 7.6 per cent, while coking coal exports declined by 1 per cent (S and P Global Platts, 2016). At 19.3 million tons, the Wilhelmsen Ships Service data sample covers about a quarter of Colombia's coal exports in 2015. For Indonesia, the data sample covers around 40 per cent of the country's coal exports in 2014 (Indonesia Investments, 2016). Yet for 2015, the Indonesian data sample size dropped by 90 per cent, while the average work time figures remained the same. This may relate to an internal change in the collection of data, and a longer time series would therefore be needed to highlight any trends.

The estimated cost of the sample wait is derived by taking the average daily charter rate over the year for the specific size of vessel carrying the cargo and multiplying this by the time. Both yearly figures involve different samples sizes and cannot be directly

Table 4.6 Estimated cost of dwell time, selected countries, 2014–2015

Country	2014 Sample size	2014 Average waiting time (days)	2014 Estimated cost of sample wait (thousands of dollars)	2015 Sample size	2015 Average of waiting time (days)	2015 Estimated cost of sample wait (thousands of dollars)
Australia	4 438	5.50	421 352	2 461	4.52	182 815
Brazil	1 533	6.44	188 822	1 537	5.17	73 630
Canada	151	5.08	13 594	36	2.33	702
China	599	3.73	43 636	1 470	1.81	26 087
Taiwan	..	..	..	107	0.68	703
Colombia	48	1.75	1 349	213	0.36	690
India	2 302	3.96	128 000	1 865	2.28	33 640
Indonesia	2 609	2.55	82 442	281	2.99	6 424
Netherlands	51	0.12	129	72	1.09	713
Republic of Korea	..	..	..	167	2.64	4 470
South Africa	..	..	..	994	2.32	19 067
United States	188	4.74	12 785	55	1.51	757
Grand total	**11 925**	**4.53**	**892 379**	**9 258**	**3.46**	**349 699**

Source: UNCTAD secretariat calculations, based on data supplied by Clarksons Research (2016) and raw observational data provided by Wilhelmsen Ships Service.

Note: ".." indicates data unavailable or sample too small.

compared. The cost is part of the price (that is, it excludes other factors such as crew wages, victualling and fuel oil) of an underutilized asset, which will ultimately be borne by consumers as a higher transport cost component of the value of the final good.

The estimated cost of dwell time in selected countries was calculated using average yearly charter rates for various sized vessels based on financial data from Clarksons Research (table 4.6). In 2014, this cost was estimated at $0.9 billion and in 2015, for a different sample, it was estimated at $350 million. The financial figures are approximate, since the charter rate would have fluctuated throughout the year. The figures pertain to coal and iron ore loading and discharging. The waiting costs for the two samples were significantly different because of a reduction in waiting time and the average daily charter hire rate that may have occurred as a result of the downturn in trade described in chapter 1. The total costs are estimates with regard to the economy as a whole, since this will either be a loss of revenue incurred by the shipowner or an extra cost incurred by a charterer having to pay hire for the use of the vessel. Regardless of which party directly pays for these costs, they will be passed onto the consumer through higher transport costs as a component of the final purchase price of the goods. In any business, the goal should always be to eliminate idle time of equipment within the source of production to improve efficiency. The data are useful to policymakers in exploring ways to increase a county's competitiveness and serve to highlight the need for more statistics on port operations.

E. CONCLUSION

This chapter has shown that the port industry experienced growth in 2015, but by a significantly lower rate than in 2014. Although this analysis was based on a limited sample, it is one that represents a significant market share. The largest ports recorded the sharpest declines in growth, which for the most part remained positive. Container ports suffered more of a downturn than the overall port sector, signifying that production capacity remains strong but demand for finished goods remains weak.

With the help of third parties, it is now possible to obtain an alternative view of official statistics and fill in certain gaps. Data derived from a seemingly unconnected need to provide ships with a collision avoidance system can be used to see how trade within a region, country or port is performing. As in most pioneering studies, the data initially ask more questions than they answer. Further analysis of the data is ongoing, with a view to reporting on information such as ship dwell time, vessel-carrying capacity and port productivity.

When companies encounter difficulties in reporting on growth metrics, such as market share, turnover or throughput, they focus on other factors, such as productivity or efficiency. A continued downward pressure in trade may therefore put pressure on ports to be seen as more operationally efficient. This means the release of statistics not previously considered newsworthy may become more common. Alternatively, the publication of third-party data that could be used to assess port performance may compel ports to issue their own data to prevent any negative interpretations.

Importantly, statistics should not be produced for the sake of statistics alone, but to explain how the world works and how it can be improved. Any increase in data on port metrics may influence shippers or carriers on which ports to use, and the resulting competition for business may drive improvements. If that data were freely available and centrally stored for analysis by researchers, greater insight into the workings of ports could be ensured. This could then lead to improvements in ports that would help lower transport costs and make international trade cheaper for all.

One of the factors influencing the growth of globalization has been the increased certainty in quotas and trade tariffs though membership of the World Trade Organization. A gradual reduction in trade tariffs, combined with improvements in industry practices, such as increased use of containerization, communications and banking, has also helped fuel this process. Improvements in port efficiency, facilitated by the availability of data, could add further to a reduction in transport costs and provide a much-needed boost to international trade.

In today's world of increased technology, people and businesses are more likely to be assessed by third parties. This thought should thus be a stimulus for port authorities to share more of their own data.

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ENDNOTES

1 The Port Management Programme of the Human Resources Development Section of the Division on Technology and Logistics of UNCTAD is known as TrainForTrade in the Knowledge Development Branch. The Programme supports port communities from developing countries in their efforts to achieve higher efficiency and competitiveness.