www.cepal.org/transporte

Issue No. 336 - Number 8 / 2014

BULLETIN FAL

FACILITATION OF TRANSPORT AND TRADE IN LATIN AMERICA AND THE CARIBBEAN

Asset productivity at container terminals in Latin America and the Caribbean: 2005-2013

This issue of the *FAL Bulletin* shows productivity trends at container terminals in Latin America and the Caribbean during the period from 2005 to 2013, comparing them to the trend of earlier years (2000 to 2004). One of the conclusions of the study is that most terminals in the region have improved their quay productivity in recent years, although there are large differences between the three container terminal size categories analysed. However, the author identifies a number of challenges still to be met at the region's ports.

This issue was written by Octavio Doerr of the ECLAC Infrastructure Services Unit.

For more information, please contact Octavio.DOERR@cepal.org.

Background

This issue of the *FAL Bulletin* reports on the evolution of productivity at container terminals in Latin America and the Caribbean in the period from 2005 to 2013, assessing trends in the productivity of assets such as berths, support areas and container cranes in the region's industry over recent years and comparing it with the trend of earlier years (2000 to 2004) in the same industry and with the productivity achieved by terminal operators worldwide. To analyse these trends, both regionally and globally, it uses the port productivity indicators recommended by Doerr and Sánchez (2006). The findings of this study should provide port authorities and operators with an up-to-date picture of productivity at the region's container terminals. The study was carried out by the Natural Resources and Infrastructure Division of the Economic Commission for Latin America and the Caribbean with the collaboration of the 30 terminals surveyed.[1]

I. Productivity measures used at container terminals: berths, terminal areas and cranes

The main physical assets at a container terminal are the berths, storage areas and quayside container cranes used to process ships and handle and store containers. It is a common practice in the industry to measure the productivity of a terminal's assets by the number of containers handled at its berths each year. Thus, the productivity of a container terminal's assets is calculated from the volume of containers moved at its berths, the number of containers moved each year in TEUs and the quantity of assets involved in these operations. In the case of berths, average annual quay productivity is obtained by reckoning the number of containers in TEUs moved per linear metre of quayside available at the terminal per annum. In the case of areas used for storing containers,

[1] Reference is made in this report to the annex, which provides details of the productivity indicator results obtained for each of the terminals in the period studied.

UNITED NATIONS

ECLAC

average productivity is measured by the throughput of containers in TEUs at the terminal each year for each hectare in operational use. In the case of container cranes, average productivity is measured by the number of containers in TEUs moved at the terminal annually by each crane employed for this. Table 1 summarizes the definitions and units of measurement used for these three productivity indicators. See Doerr and Sánchez (2006) for further details on these indicators and others commonly used in the port industry.

Because productivity levels increase with a terminal's size and volume of operations, productivity analyses in the industry classify terminals by their size or level of activity. This study has adopted the classification by annual activity level, taking a large terminal as one handling between 1 million and 3 million TEUs a year, a medium-sized terminal as one handling between 500,000 and 1 million TEUs a year and a small terminal as one handling between 100,000 and 500,000 TEUs a year.

Table 1
PRODUCTIVITY INDICATORS FOR BERTHS, STORAGE AREAS AND CRANES

Asset	Indicator	Formula	Unit of measurement
Container berths	Quay productivity	Number of containers/linear metre of quayside	TEUs/metre
Storage areas	Terminal area productivity	Number of containers/surface area in hectares	TEUs/ha
Quayside cranes	Crane productivity	Number of containers/number of cranes	TEUs/crane

Source: Doerr and Sánchez (2006).

II. Recent activity at container ports in Latin America and the Caribbean

The growth of activity in the region has been driven by a strong and sustained expansion in the market for container transportation, originating in three main factors: (a) a rise in foreign trade, resulting from increased economic activity within and beyond the region, (b) growing supply in the industry, with a steady increase in container logistics services and the development of greater port capacity, and (c) the implementation of a hub and spoke service strategy by shipping lines.[2] This last factor has had a substantial effect on terminals in the Caribbean basin and the ports at either end of the Panama Canal, Colón and Balboa, where activity has increased because of trans-shipment operations and major expansion plans implemented by these terminals.

Container throughput at ports in Latin America and the Caribbean increased by 74% between 2005 and 2013, giving an average annual growth rate of 7%. Different phases in this period need to be singled out, however, because of the effects of the 2009 crisis. From 2005 to 2008, port activity in the region grew by an average of 11% a year. Then, in 2009, there was a sharp drop (-10%) because of the economic crisis, followed by recovery in the three years from 2010 to 2012, with average annual growth of 11%, and finally a sharp slowdown in 2013, when growth was just 1% (see table 2). In this context, the port industry consolidated projects initiated before the period of analysis and also developed a number of projects for new terminals. This exercise examines the evolution of three key productivity indicators for port activity (berths, storage areas and cranes) at a sample of 30 terminals accounting for 53% of all operations of this type in the region. Twenty-four of these terminals were already operating in 2005, two more began operations in 2006, and a new terminal opened in each of 2009, 2010 and 2011.

Table 2
LATIN AMERICA AND THE CARIBBEAN: PORT CONTAINER MOVEMENTS, BY SUBREGION
(Thousands of TEUs)

Subregion	2005	2006	2007	2008	2009	2010	2011	2012	2013	Percentage increase 05/13	Percentage annual increase
					Subregion						
Mexico	2 133	2 677	3 062	3 316	2 884	3 692	4 223	4 878	4 893	129	11
Central America	4 894	5 385	6 763	7 446	6 726	8 449	9 783	10 160	9 970	104	9
The Caribbean	6 392	7 193	7 488	7 650	7 120	7 128	7 506	7 927	7 732	21	2
South America	13 240	15 147	16 839	18 447	16 595	18 819	21 908	22 983	23 702	79	8
					Latin America and the Caribbean						
Total	26 659	30 401	34 153	36 860	33 325	38 087	43 420	45 949	46 297	74	7
Percentage annual change		14	12	8	-10	14	14	6	1		
Percentage average annual change in the period			11		-10		11		1		

Source: Prepared by the author on the basis of figures from the port ranking of the ECLAC Maritime and Logistics Profile, <http://www.cepal.org/perfil/default.asp?idioma=IN>.

[2] The hub and spoke system requires trans-shipment of containers at hub ports and has the effect of increasing the number of container handling operations at a region's ports.

III. The evolution of the main container terminal characteristics

A. Data gathering

To conduct this study, it was necessary to obtain information on the evolution of infrastructure and equipment availability and operating data for the berths of each terminal. The first step was to select the terminals that would form the system to be studied, choosing those that were most representative because of their activity level, size, location and degree of development. The information used was obtained directly from the operating companies via personal surveys. This exercise examined the evolution of productivity at 30 terminals, called hereinafter the "terminals", situated in Central America, Mexico, the Caribbean and South America.[3]

B. Infrastructure and equipment at the average terminal

Tables 3 and 4 show the evolution of three key characteristics of the observed average terminal, taking (a) the 30 terminals in the sample (30T) and (b) the 24 original terminals operating in 2005 (24T). Two characteristics concern container operating infrastructure and one the equipment for handling containers at terminal berths. They are the length of the berthing front, the terminal area and the number of quayside cranes. Crane availability is measured by the number of ship-to-shore cranes, the number of mobile harbour cranes, the number of quayside cranes equivalent[4] and the distance between cranes in metres of quayside. The value for the average terminal is obtained by dividing the sum of surface areas, lengths or number of cranes at the terminals by the total number of terminals in operation that year.

Table 3
THREE CHARACTERISTICS OF THE AVERAGE TERMINAL (30T)
QUAY LENGTH, TERMINAL AREA AND NUMBER OF CRANES

	2005	2006	2007	2008	2009	2010	2011	2012	2013	Percentage increase 05/13
No. of terminals	24	24	26	26	28	29	30	30	30	-
Terminal dimensions										
Quay length (m)	626	626	642	689	689	722	742	761	762	22
Terminal area (ha)	19.0	19.4	19.4	20.2	20.9	21.5	22.3	23.0	23.8	25
Number of quay cranes										
Ship-to-shore cranes	3.2	3.5	3.7	4.3	4.8	5.0	5.1	5.5	5.7	81
Mobile harbour cranes	1.1	1.0	1.4	1.5	1.6	1.8	1.8	1.7	1.8	60
Quay crane equivalents	3.8	4.2	4.6	5.2	5.7	6.0	6.2	6.6	6.8	77
Distance (m) between cranes	163	150	141	132	120	120	119	116	112	-

Source: Prepared by the author on the basis of surveys and data published by the terminals.

Table 4
THREE CHARACTERISTICS OF THE AVERAGE TERMINAL (24T)
QUAY LENGTH, TERMINAL AREA AND NUMBER OF CRANES AVAILABLE

	2005	2006	2007	2008	2009	2010	2011	2012	2013	Percentage increase 05/13
No. of terminals	24	24	24	24	24	24	24	24	24	-
Terminal dimensions										
Quay length (m)	626	626	657	708	732	758	796	792	793	27
Terminal area (ha)	19.0	19.4	20.2	21.1	22.4	22.6	23.8	24.2	24.5	29
Number of quay cranes										
Ship-to-shore cranes	3.2	3.5	3.8	4.3	4.9	5.0	5.3	5.5	5.7	80
Mobile harbour cranes	1.1	1.0	1.5	1.7	1.7	1.9	2.0	2.0	2.0	81
Quay crane equivalents	3.8	4.2	4.7	5.3	5.9	6.1	6.5	6.6	6.9	80
Distance (m) between cranes	163	150	140	135	123	124	123	119	114	

Source: Prepared by the author on the basis of surveys and data published by the terminals.

[3] The terminals are in Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Panama, Peru, Uruguay and countries of Central America and the Caribbean. This report maintains confidentiality as to the terminals surveyed and the information provided by them.

[4] This is calculated by adding the number of ship-to-shore and mobile harbour cranes and multiplying the result by 0.6 for each terminal.

The sample originally included 24 terminals operating in 2005, increasing to 30 by 2013 after six new terminals were brought into service. Table 3 shows an increase in average terminal dimensions (30T), with quay length increasing from 626 m to 762 m and the terminal area from 19 ha to 23.8 ha. However, the greatest increase at the average terminal has been in the availability of quay cranes, with the numbers rising in eight years from 3.2 to 5.7 ship-to-shore gantry cranes and from 1.1 to 1.8 mobile harbour cranes. This indicates that new infrastructure has been created at container terminals and more equipment made available, allowing for greater ship throughput capacity and more intensive ship usage. The increase in equipment availability at the average terminal (77%) has been well in excess of infrastructure growth (22%), indicating that terminals have applied a capacity expansion strategy based mainly on adding equipment and using existing assets intensively rather than adding new assets to the system or extending existing berths. This strategy has its origin in the greater quay productivity demanded by shipping services owing to the increase in the size of their vessels and the consignments handled each time they call in to port, something that is feasible as long as there are spare berths that can take the new equipment and have the characteristics needed to service larger container vessels. Once no more spare infrastructure is available, capacity can only be increased by building new berthing facilities, as has been done at a number of the region's ports. Table 4 shows similar increases in average terminal dimensions for 24T, with quay length increasing from 626 m to 793 m and the terminal area from 19 ha to 24.5 ha. Also, the greatest increase at the average terminal has been in the availability of quay cranes, with the numbers rising in eight years from 3.2 to 5.7 ship-to-shore gantry cranes and from 1.1 to 2.0 mobile harbour cranes, very similar to the increases seen for 30T.

C. Container movements

In the period from 2005 to 2013, the 24 terminals that were there at the start of the period (24T) increased their container movements by an average of 7% a year, with cumulative growth of 75% in annual throughput. Table 5 shows the increase in average productivity at the terminals analysed. For the 30T, the volume moved (TEUs/terminal) increased by 66%, productivity per berth (TEUs/metre of quay) rose by 36%, crane productivity dropped by 7% and area use (TEUs/ha) rose by 32%. For the 24T, the volume moved (TEUs/terminal) increased by 75%, productivity per berth (TEUs/metre of quay) increased by 38%, crane productivity dropped by 3% and terminal area use (TEUs/ha) rose by 35%.

Table 5
CONTAINER MOVEMENTS AT TERMINALS AND PRODUCTIVITY AT THE AVERAGE TERMINAL, PER ANNUM
(Thousands of TEUs)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	Percentage increase per annum	Percentage increase 05/13
30 terminals	11 889	13 119	15 410	17 199	15 998	19 338	22 687	24 563	24 610	-	-
24 terminals	11 889	13 119	14 944	16 625	14 956	17 274	19 386	20 905	20 800	7	75
Latin America and the Caribbean	26 659	30 401	34 153	36 860	33 325	38 087	43 420	45 949	46 297	7	74
30 terminals' share of regional total	42.2%	40.8%	45.2%	46.8%	48.0%	50.8%	52.2%	53.5%	53.2%	-	-
Productivity of the average terminal (30T)											
Terminal (thousands of TEUs)	495.4	546.6	592.7	661.5	571.3	666.8	756.2	818.8	820.3	6.5	66
Berths (TEUs/metre)	792	873	923	959	829	924	1 019	1 075	1 077	3.9	36
Terminal area (thousands of TEUs /ha)	26.1	28.1	30.6	32.7	27.4	31.0	33.9	35.6	34.5	3.6	32
Cranes (thousands of TEUs/crane)	128.9	131.2	129.9	126.5	99.6	110.8	121.3	124.9	120.4	-0.9	-7
Productivity of the average terminal (24T)											
Terminal (thousands of TEUs)	495.4	546.6	622.7	692.7	623.2	719.7	807.8	871.0	866.7	7.2	75
Berths (TEUs/metre)	792	873	948	978	851	949	1 015	1 099	1 093	4.1	38
Terminal area (thousands of TEUs/ha)	26.1	28.1	30.8	32.8	27.8	31.8	34.0	36.0	35.4	3.9	35
Cranes (thousands of TEUs/crane)	128.9	131.2	132.3	132.0	104.9	117.8	125.2	131.3	125.0	-0.4	-3

Source: Prepared by the author on the basis of surveys, data published by the terminals and figures from the port ranking of the ECLAC Maritime and Logistics Profile.

IV. Indicators of productivity at container terminals

A. Terminals in Latin America and the Caribbean: 2000-2004

The evolution of productivity indicators for the container port industry in Latin America and the Caribbean during the period from 2000 to 2004 was examined by ECLAC (2006). This evolution also occurred in a context of strong growth in seaborne trade, privatizations and strong growth in container movements. Container port growth in Latin America and the Caribbean averaged 10% a year during the period. Table 6 presents the increase in the average productivity of terminals by size and of the average terminal for the sample analysed in the period. In the case of the average terminal, productivity per berth was 504 TEUs/metre in 2004, terminal area productivity was 17,244 TEUs/ha and crane productivity was 101,331 TEUs/crane.

Table 6
PRODUCTIVITY AT TERMINALS BY TERMINAL SIZE

Terminal	2000	2001	2002	2003	2004
Large terminal: length 1,200 metres					
Berths (TEUs/metre)	675	645	766	928	1 124
Terminal area (TEUs/ha)	16 896	16 156	19 183	23 230	28 136
Cranes (TEUs/crane)	87 264	83 441	99 075	119 981	145 316
Medium-sized terminal: length 900 metres					
Berths (TEUs/metre)	433	511	569	640	762
Terminal area (TEUs/ha)	11 926	14 090	15 672	17 617	20 984
Cranes (TEUs/crane)	69 413	82 007	91 220	102 538	122 134
Small terminal: length 750 metres					
Berths (TEUs/metre)	193	217	227	270	330
Terminal area (TEUs/ha)	7 639	8 583	8 984	10 691	13 064
Cranes (TEUs/crane)	46 432	52 167	54 609	64 984	79 404
Average terminal: length 800 metres					
Berths (TEUs/metre)	293	326	357	417	504
Terminal area (TEUs/ha)	10 032	11 145	12 214	14 271	17 244
Cranes (TEUs/crane)	58 950	65 490	71 777	83 859	101 331

Source: Prepared by the author on the basis of data from Doerr and Sánchez (2006).

B. Terminals in Latin America and the Caribbean: 2005-2013

1. Quay productivity

Most terminals have been improving their productivity steadily each year.[5] Improvements involving more intensive use of berthing facilities may originate in: (i) increases in ship productivity achieved by adding transfer equipment or improving the productivity of equipment or operating procedures, or (ii) increases in cargo throughput at the terminal, or a combination of these factors. The indicator may decline in value from the previous year when the rate at which new infrastructure is brought into service over the year is greater than the rate of activity growth that year, or simply when activity declines because of a loss of market share or lower overall demand. Figure 1 shows the general trend in the period, with growth in terminal throughput and an increase in quay productivity. In 2005, productivity at T30 terminals ranged from 114 to 1,490 TEUs/metre, while in 2013 it ranged from 274 to 2,074 TEUs/metre. Segmentation by terminal activity level in 2013 shows that larger terminals were more productive throughout the period, with more intensive berth usage, although all of them managed substantial improvements over the eight years. In 2013, large terminals managed 1,441 TEUs/metre, 39% more than in 2005, while medium-sized terminals averaged 877 TEUs/metre, 5% less than in 2005, and small terminals 548 TEUs/metre, 76% more than in 2005. Figure 2 shows the range of quay productivity at each type of terminal in 2013, identifying terminals by size. Table 7 shows the evolution of average productivity at each type of terminal. Figure 3 shows the evolution of average productivity using this approach.

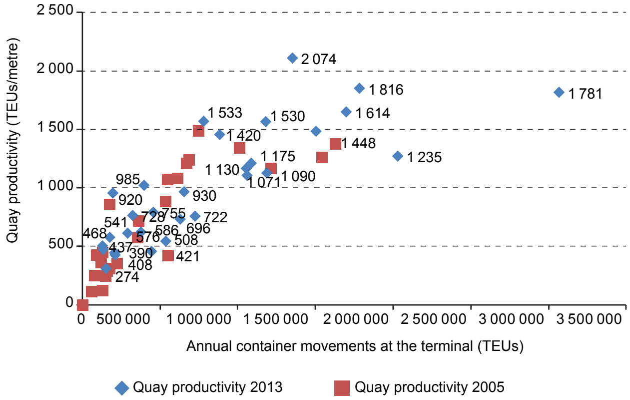
[5] Table A.1 shows the evolution of quay productivity at the terminals in the period from 2005 to 2013.

Table 7
AVERAGE QUAY PRODUCTIVITY AT TERMINALS, BY TERMINAL SIZE
(TEUs/metre per annum)

Terminal size	Average quay length (metres)	2005	2006	2007	2008	2009	2010	2011	2012	2013	Percentage increase 05/13
Large	1 100	1 039	1 119	1 145	1 145	1 034	1 125	1 266	1 443	1 441	39
Medium-sized	800	924	1 036	996	1 052	818	1 016	1 066	883	877	-5
Small	500	311	376	492	538	453	469	515	534	548	76

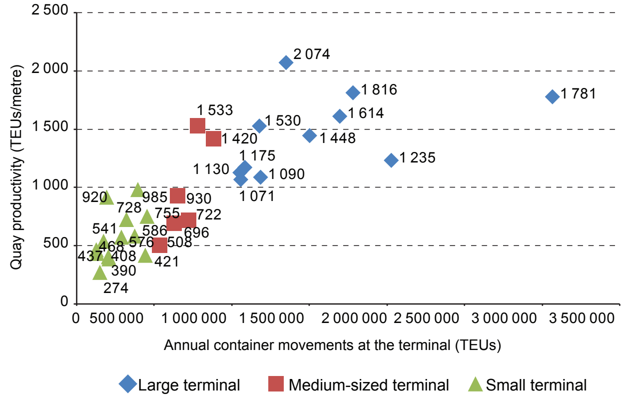
Source: Prepared by the author on the basis of table A.1.

Figure 1
T30 QUAY PRODUCTIVITY, 2005 AND 2013



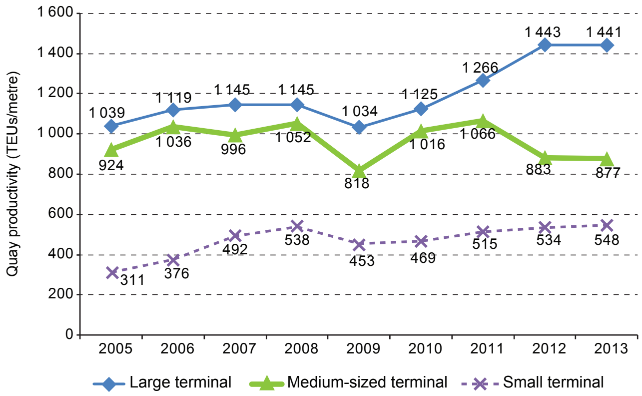
Source: Prepared by the author on the basis of figures from table A.1.

Figure 2
T30 QUAY PRODUCTIVITY, BY TERMINAL SIZE, 2013



Source: Prepared by the author on the basis of figures from table A.1.

Figure 3
AVERAGE QUAY PRODUCTIVITY AT TERMINALS, BY TERMINAL SIZE

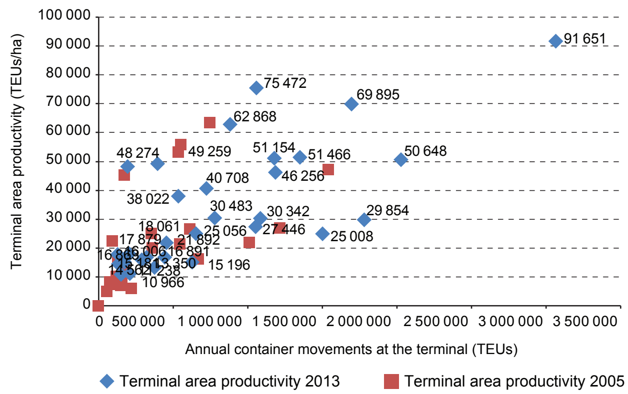


Source: Prepared by the author on the basis of table 7.

2. Terminal area productivity

This indicator also improved steadily each year at most of the terminals.[6] In this case, more intensive use of terminal support areas has originated in: (i) extra handling equipment in yards, allowing support areas to be used more intensively, or (ii) increased cargo throughput at the terminal, or a combination of these factors. The indicator may decline in value from the previous year when there is a drop in activity, a loss of market share or lower overall demand. Figure 4 shows the general trend in the period, which was one of rising terminal throughput and increased terminal area productivity. In 2005, the productivity of the terminals in the sample ranged from 3,211 to 63,334 TEUs/ha, while in 2013 the range was from 10,966 to 91,651 TEUs/ha.

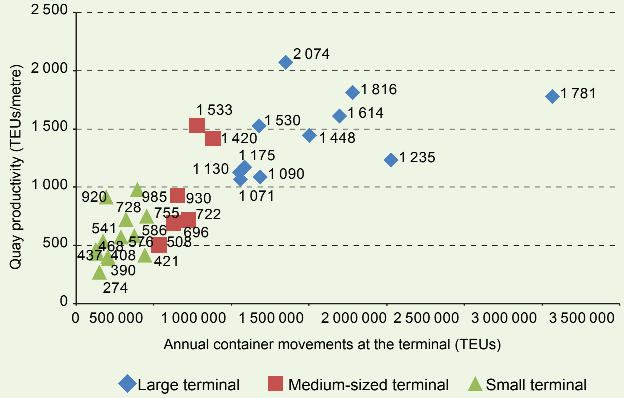
Figure 4
T30 TERMINAL AREA PRODUCTIVITY, 2005 AND 2013



Source: Prepared by the author on the basis of figures from table A.2.

[6] Table A.2 of annex A shows the evolution of terminal area productivity.

Figure 5
T30 TERMINAL AREA PRODUCTIVITY, BY TERMINAL SIZE, 2013



Source: Prepared by the author on the basis of figures from table A.2.

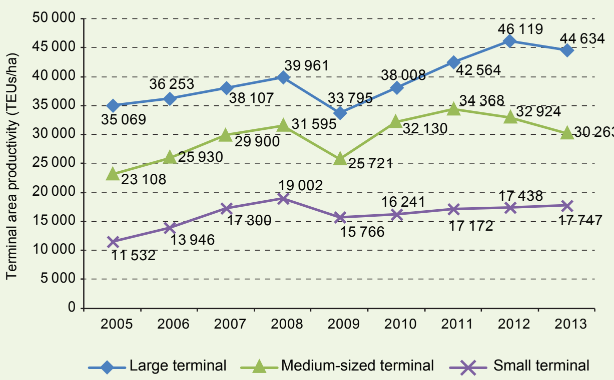
Table 8 shows the evolution of average productivity by terminal type. Large terminals achieved average productivity of 35,069 TEUs/ha in 2005, rising to 44,634 TEUs/ha in 2013, an increase of 27%. Medium-sized terminals achieved average productivity of 23,108 TEUs/ha in 2005, rising to 30,263 TEUs/ha in 2013, an increase of 31%. Small terminals managed average productivity of 11,532 TEUs/ha in 2005, rising to 17,747 TEUs/ha in 2013, a 54% increase. Figure 5 shows productivity ranges for terminal areas at each type of terminal in 2013, identifying the size class. Figure 6 shows the evolution of average productivity by terminal size.

Table 8
AVERAGE AREA PRODUCTIVITY AT TERMINALS, BY TERMINAL SIZE
(TEUs/ha)

Terminal size	Quay length (metres)	2005	2006	2007	2008	2009	2010	2011	2012	2013	Percentage increase 05/13
Large	1 100	35 069	36 253	38 107	39 961	33 795	38 008	42 564	46 119	44 634	27
Medium-sized	800	23 108	25 930	29 900	31 595	25 721	32 130	34 368	32 924	30 263	31
Small	500	11 532	13 946	17 300	19 002	15 766	16 241	17 172	17 438	17 747	54

Source: Prepared by the author on the basis of table A.2.

Figure 6
AVERAGE TERMINAL AREA PRODUCTIVITY, BY TERMINAL SIZE

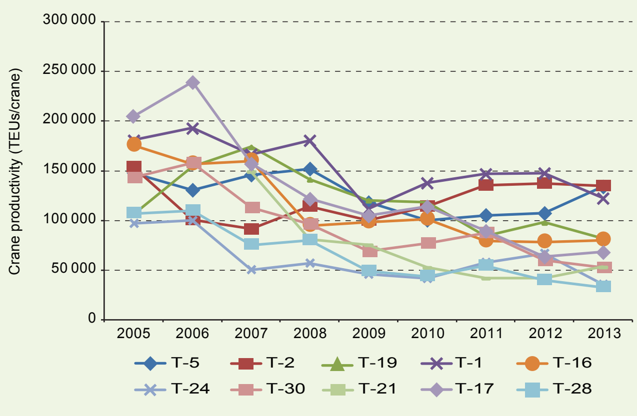


Source: Prepared by the author on the basis of table 8.

3. Quay crane productivity

In this case, there have been two types of developments at the terminals examined. One group of terminals has shown a steady increase in the number of cranes per terminal because of new acquisitions, while a second group has managed sustained annual crane productivity improvements. There may be two main reasons for this.[7] In the first group, the productivity indicator may decline from the previous year when the percentage increase in the number of cranes available outstrips traffic growth in the year or when commercial activity falls because of a drop in market share or lower overall demand (see figure 7). The second group shows sustained productivity improvements, with ever more intensive use of equipment at berthing facilities as a result of rising cargo throughput at the terminal, perhaps supplemented by increases in the hourly productivity of equipment resulting, for example, from improvements in operating procedures (see figure 8).

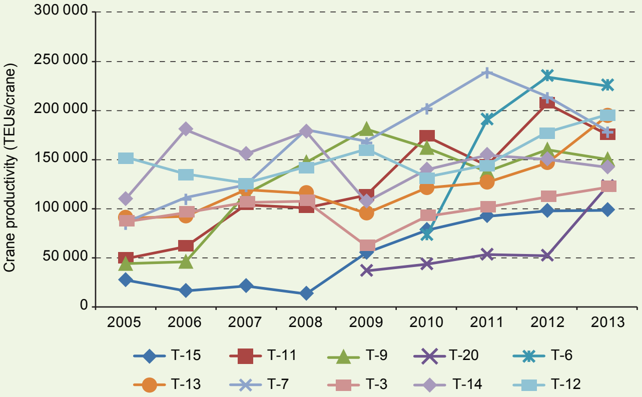
Figure 7
T30 CRANE PRODUCTIVITY (FIRST GROUP)



Source: Prepared by the author on the basis of table A.3.

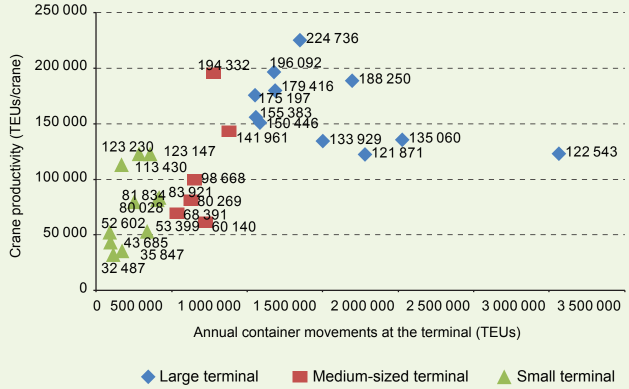
[7] Table A.3 shows the evolution of crane productivity at the terminals. This evolution reveals two phenomena in the industry for this indicator.

Figure 8
T30 CRANE PRODUCTIVITY (SECOND GROUP)



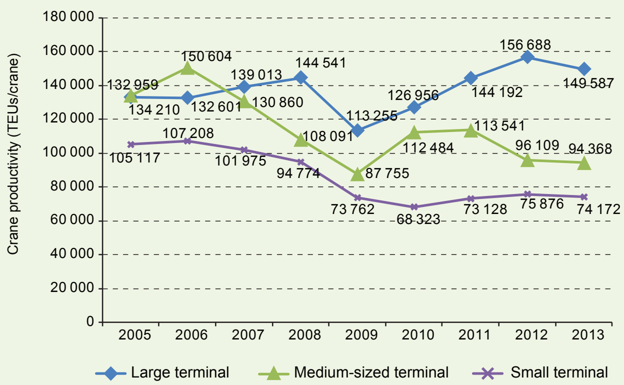
Source: Prepared by the author on the basis of table A.3.

Figure 10
T30 CRANE PRODUCTIVITY, BY TERMINAL SIZE, 2013



Source: Prepared by the author on the basis of table A.3.

Figure 9
AVERAGE T30 CRANE PRODUCTIVITY, BY TERMINAL SIZE



Source: Prepared by the author on the basis of table 9.

Table 9 shows the evolution of average productivity at each terminal type. Large terminals increased productivity throughout the period, with more intensive crane use. These terminals achieved substantial improvements over the eight years (19%). The intensity of crane use at medium-sized and small terminals decreased by 15% and 19%, respectively. Figure 9 shows the evolution of average crane productivity. Large terminals had average productivity of 132,959 TEUs/crane in 2005, rising to 149,587 TEUs/crane in 2013. Medium-sized terminals had average productivity of 134,210 TEUs/crane in 2005, falling to 94,368 TEUs/crane in 2013. Small terminals had average productivity of 105,117 TEUs/crane in 2005, falling to 74,172 TEUs/crane in 2013. Figure 10 shows the spread of crane productivity at each terminal in 2013, identifying the size of terminal.

Table 9
AVERAGE CRANE PRODUCTIVITY AT TERMINALS, BY TERMINAL SIZE
(TEUs/crane)

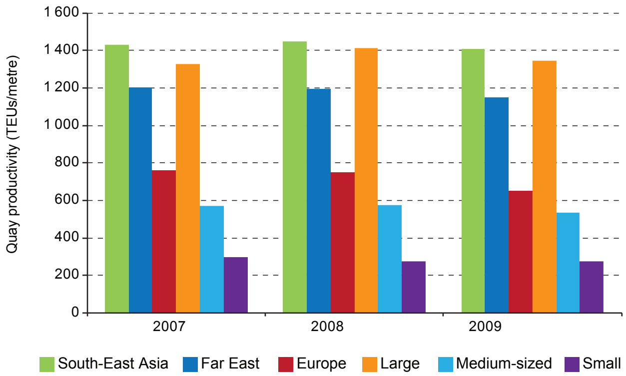
Terminal size	Quay length (metres)	2005	2006	2007	2008	2009	2010	2011	2012	2013	Percentage increase 05/13
Large	1 100	132 959	132 601	139 013	144 541	113 255	126 956	144 192	156 688	149 587	19
Medium-sized	800	134 210	150 604	130 860	108 091	87 755	112 484	113 541	96 109	94 368	-15
Small	500	105 117	107 208	101 975	94 774	73 762	68 323	73 128	75 876	74 172	-19

Source: Prepared by the author on the basis of table A.3.

C. Global trends

Figure 11 shows the evolution of quay productivity at ports in three regions of the world, by terminal size, in the period from 2007 to 2009. The highest average quay productivity achieved in the period was 1,400 TEUs/metre at South-East Asian ports, 1,200 TEUs/metre at Far Eastern ports and about 800 TEUs/metre at European ports. On average around the world, small terminals managed 300 TEUs/metre, medium-sized ones 570 TEUs/metre and large ones 1,400 TEUs/metre.

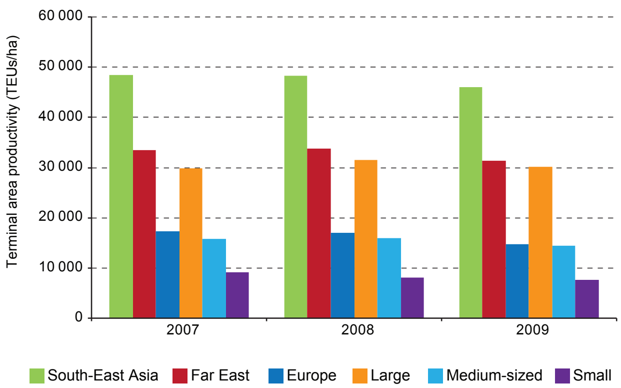
Figure 11
QUAY PRODUCTIVITY, BY REGION AND TERMINAL SIZE



Source: Drewry, 2010.
Note: Average quay length is: large terminals, 1,500 metres; medium-sized terminals, 800 metres; small terminals, 600 metres.

Figure 12 shows the evolution of terminal area productivity at ports in the same regions, by terminal size, over the period. In 2009, terminal area productivity averaged 56,000 TEUs/ha at South-East Asian ports, 40,000 TEUs/ha at Far Eastern ports and about 21,000 TEUs/ha at European ports. Globally, small terminals averaged 9,000 TEUs/ha, medium-sized ones 16,000 TEUs/ha and large ones 30,000 TEUs/ha.

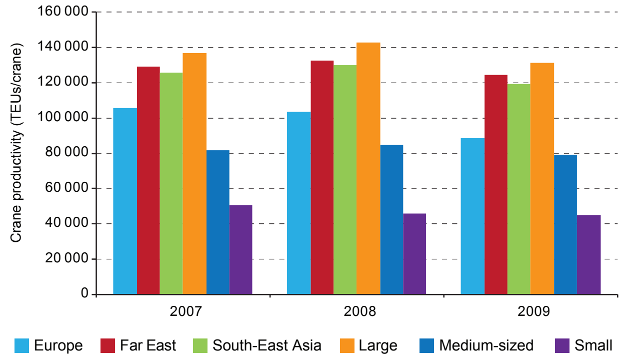
Figure 12
TERMINAL AREA PRODUCTIVITY, BY REGION AND TERMINAL SIZE



Source: Drewry 2010.

Figure 13 shows the evolution of crane productivity at ports in the same regions, and globally by terminal size, over the same period. In 2009, crane productivity averaged 130,000 TEUs/crane at South-East Asian ports, 160,000 TEUs/crane in the Far East and about 100,000 TEUs/crane in Europe. Globally, small terminals averaged 50,000 TEUs/crane, medium-sized ones 80,000 TEUs/crane and large ones 140,000 TEUs/crane.

Figure 13
CRANE PRODUCTIVITY, BY REGION AND TERMINAL SIZE



Source: Drewry 2010.

V. Conclusions

The purpose of this study has been to evaluate asset productivity in the container port industry of Latin America and the Caribbean in the period from 2005 to 2013. Substantial investments and improvements in both capacity and operating performance have been necessary to accommodate the ever larger volumes of cargo moved in the region. Given this, one of the topics of greatest interest to port authorities and operators is the productivity of the assets available at their terminals. The operational productivity of assets at a terminal is a measure of the performance of the resources used. Terminal productivity indicators were selected by adopting the standards applied in earlier studies and used in a number of ports around the world. The region has no systematic practice for gathering data and determining these indicators. The findings of the surveys carried out revealed a degree of difficulty in obtaining information, although it is considered that there may still be scope for improving their quality so that fuller answers can be obtained.

Container operations grew steadily at most of the terminals in the period studied. This was due to an increase in the countries' external trade and in specialized shipping and port services. More extensive use of larger container ships, with greater servicing requirements, is driving operators to improve operations at the region's specialized terminals with a view to improving service and productivity standards. The growth in volumes and ship sizes has forced them to produce more services and enhance performance with the infrastructure available, and the approach used for this has been to achieve continuous productivity improvements by introducing new technologies and adding equipment at terminals. When this approach has not been possible or adequate for the volumes expected, the second approach has been to bring new assets, berths and dockside areas into use, which also entails greater use of technology, high-skilled and specialized labour, and berth and yard equipment. Accordingly, meeting the challenge of expanding capacity at the region's ports to cope with future demand growth will have to involve adapting existing installations at more lightly used ports and investing heavily to develop new infrastructure at existing larger ports (brownfield projects) or at new ports (greenfield projects) so that they can cope with growing demand for new technologies and larger ships.

Productivity indicator trends for a great many ports in the region are much like those for other ports and regions of the world. Its larger terminals are more productive than those in some other regions, such as Europe. A number of the region's terminals are applying the same technologies as their peers, sometimes with even more productive results. Productivity is higher at large terminals than at medium-sized ones, and larger at medium-sized than at small ones. Among the different factors determining quay productivity, ships at large terminals usually load and unload larger consignments of containers each time they call in, meaning that crane speed can be increased and asset use intensified.

Most of the region's container terminals have improved their quay productivity in recent years in response to the new requirements of shipping services. Although there are large differences in outcomes at the terminals examined, quay productivity improvements during the period of analysis in the three typical size categories analysed show that operators in the region are responding quickly to these new challenges. Productivity improvements have been made possible by the increased availability of quayside cranes, since whereas the average terminal in the sample analysed had 3.2 ship-to-shore quay cranes in 2005, by 2013 the number had increased to 5.7, resulting in more intensive use of assets. However, a port's operations are not confined to quayside or yard activities at the terminal, and one of the main problems in the region is with capacity on the landward side of ports: entranceways and interfaces with railways and highways. The arrival of larger container ships brings larger consignments of cargo that are less spaced out over time, and this requires not only higher quay productivity but also more intensive access route usage, input and output processes, clearance and cargo reception, as well as greater inland transport frequencies, and these systems are not always properly prepared or adequate in terms of capacity.

In summary, container ports in Latin America and the Caribbean have adjusted to the evolution of demand in recent years. However, all the stress has really been on improving productivity and expanding capacity at terminals, something that has been achieved by successfully involving private-sector operators in their development. The region has proved somewhat slow to adapt and modernize other port components and factors (access, connectivity, port communities, integration of logistical processes, labour issues, port city, etc.) that are necessary to make their development sustainable and more efficient in future. A lack of comprehensive port policies with a fuller vision of port development encompassing not just the investment needed to improve terminal productivity and expand and add infrastructure but also improvements in connectivity with the countries' interior, among other things, means that these are now urgently needed to improve efficiency throughout the logistics chain, with the ultimate aim of securing greater competitiveness (productivity and efficiency) in our countries' markets and foreign trade (see Doerr, 2011a). To this should be added an integrated transport and infrastructure policy aimed at ensuring that the rest of the supply chain attains the same levels of efficiency and sustainability as are sought in the case of the ports themselves (see Cipoletta and others, 2010).

This study has confined itself to evaluating the productivity of three types of container terminal assets. Given the diversity of operations at a port and its terminals, there are other aspects on which further research could be done. It is recommended that additional studies should be carried out on other facets of port operations, such as the output per hour of transfer systems or throughput times for land access, among other port measures and indicators.

Bibliography

Cipoletta Tomassian, G., G. Pérez and R. Sánchez (2010), "Políticas integradas de infraestructura, transporte y logística: experiencias internacionales y propuestas iniciales", Recursos Naturales e Infraestructura series, No. 150, ECLAC, United Nations, Santiago, Chile, May.

Doerr, O. (2011a), "Políticas portuarias", Recursos Naturales e Infraestructura series, No. 159, ECLAC, United Nations, Santiago, Chile, December.

Doerr, O. (2011b), "Sustainable port polices", FAL Bulletin, Issue No. 299, Number 7, ECLAC, United Nations, Santiago, Chile.

Doerr, O. and R. J. Sánchez (2006), "Indicadores de productividad para la industria portuaria. Aplicación en América Latina y el Caribe", Recursos Naturales e Infraestructura series, No. 112, ECLAC, United Nations, Santiago, Chile, August.

Annex

Terminal productivity tables (2005-2013)

Table A.1
QUAY PRODUCTIVITY AT TERMINALS

	TEUs per metre of quayside per annum								
Terminal	2005	2006	2007	2008	2009	2010	2011	2012	2013
T-1	1 378	1 471	1 554	1 837	1 584	1 839	1 879	1 890	1 781
T-2	1 262	860	780	976	857	975	1 158	1 256	1 235
T-3	1 342	1 487	1 272	1 288	1 063	1 379	1 511	1 669	1 816
T-4	1 490	1 744	2 192	1 100	851	1 102	1 341	1 505	1 614
T-5	1 169	1 412	1 577	1 643	1 277	1 086	1 077	1 160	1 448
T-6	-	-	-	-	-	670	1 754	2 162	2 074
T-7	422	787	880	982	919	863	900	1 303	1 090
T-8	1 083	963	657	742	836	1 031	1 131	1 389	1 530
T-9	355	372	924	1 185	1 457	1 616	1 078	1 251	1 175
T-10	1 243	1 357	948	902	860	703	958	984	1 071
T-11	449	562	945	588	664	895	1 024	1 336	1 130
T-12	575	948	1 326	1 520	1 090	1 420	1 572	1 526	1 420
T-13	1 073	1 092	1 180	1 142	939	1 194	1 248	1 445	1 533
T-14	-	-	256	383	546	1 060	1 509	850	722
T-15	-	-	-	-	664	942	1 111	839	930
T-16	1 212	1 083	1 104	1 104	700	719	687	679	696
T-17	886	1 037	1 206	1 179	1 016	921	627	474	508
T-18	247	426	821	1 008	824	606	710	975	755
T-19	125	271	306	243	207	338	338	392	421
T-20	-	-	-	-	296	349	427	419	985
T-21	-	-	1 067	1 159	1 082	664	528	530	586
T-22	-	-	-	-	-	-	517	706	728
T-23	718	699	623	734	528	586	723	598	576
T-24	291	300	360	407	327	297	413	477	390
T-25	114	136	175	233	219	262	340	364	408
T-26	429	301	637	809	608	740	800	878	920
T-27	364	367	370	334	506	548	524	528	541
T-28	314	322	359	381	323	289	359	335	274
T-29	250	412	401	368	370	452	442	468	437
T-30	859	948	1 018	1 157	1 033	1 158	1 166	532	468

Source: Prepared by the author on the basis of surveys, data published by the terminals and the ECLAC Maritime and Logistics Profile, 2014.

Table A.2
AREA PRODUCTIVITY AT TERMINALS

	TEUs per hectare per annum								
Terminal	2005	2006	2007	2008	2009	2010	2011	2012	2013
T-1	-	120 060	126 817	149 929	85 894	114 643	130 852	113 749	91 651
T-2	47 222	35 242	31 998	40 020	35 151	39 991	47 495	51 494	50 648
T-3	21 867	24 232	20 721	20 990	17 315	22 668	24 849	27 445	29 854
T-4	63 334	74 144	93 214	47 655	36 858	47 715	58 075	65 184	69 895
T-5	26 857	32 432	34 766	34 813	25 886	21 096	20 092	20 809	25 008
T-6	-	-	-	-	-	20 251	53 016	65 373	51 466
T-7	55 767	72 163	80 667	95 005	35 626	42 945	50 682	55 284	46 256
T-8	26 546	23 603	21 976	24 823	27 959	34 473	37 809	46 428	51 154
T-9	6 182	6 480	16 091	20 641	25 386	28 148	27 831	32 319	30 342
T-10			58 023	55 223	60 610	49 535	67 525	69 360	75 472
T-11	16 054	20 087	33 780	32 760	37 014	49 872	26 309	32 448	27 446
T-12	25 071	41 286	57 786	66 214	47 500	61 857	68 500	66 500	62 868
T-13	21 335	21 702	23 465	22 698	18 678	23 733	24 823	28 727	30 483
T-14	-	-	25 418	38 018	33 242	56 920	81 014	47 946	40 708
T-15	-	-	-	-	17 239	24 461	28 868	38 123	25 056
T-16	16 185	14 461	14 740	14 737	15 281	15 708	15 001	14 833	15 196
T-17	53 690	62 820	73 074	71 436	61 574	57 512	40 933	35 482	38 022
T-18	7 148	12 346	23 812	29 206	23 878	17 563	20 578	28 274	21 892
T-19	7 350	15 976	15 255	12 394	8 291	13 560	13 560	15 752	16 891
T-20	-	-	-	-	14 782	17 434	21 346	20 960	49 259
T-21	-	-	25 160	27 326	25 516	18 395	14 627	12 658	13 350
T-22	-	-	-	-	-	-	11 983	16 343	16 863
T-23	19 950	19 406	17 317	20 383	14 678	16 283	20 089	16 600	16 006
T-24	8 439	8 685	10 437	11 799	9 481	8 601	11 954	13 825	11 238
T-25	5 058	6 020	7 725	10 325	9 692	11 586	15 047	16 103	18 061
T-26	22 522	15 777	33 430	42 457	31 915	38 827	42 010	46 079	48 274
T-27	10 217	10 299	10 381	9 382	14 214	15 391	14 719	14 812	15 181
T-28	12 540	12 867	14 365	15 235	12 904	11 538	14 345	13 417	10 966
T-29	8 345	13 746	13 369	12 269	12 328	15 067	14 747	15 608	14 562
T-30	45 268	49 977	53 632	60 974	54 425	61 037	48 903	20 817	17 879

Source: Prepared by the author on the basis of surveys, data published by the terminals and the ECLAC Maritime and Logistics Profile, 2014.

Table A.3
CRANE PRODUCTIVITY AT TERMINALS

	TEUs per crane per annum								
Terminal	2005	2006	2007	2008	2009	2010	2011	2012	2013
T-1	180 721	192 896	166 707	180 665	111 765	137 925	146 921	147 779	122 543
T-2	153 944	100 691	91 422	114 342	100 431	114 261	135 700	137 318	135 060
T-3	86 897	96 293	106 466	107 845	62 169	92 534	101 438	112 037	121 871
T-4	186 203	217 984	274 048	128 350	99 271	128 511	156 414	175 562	188 250
T-5	147 744	130 625	145 893	151 964	118 125	100 446	105 283	107 321	133 929
T-6	-	-	-	-	-	72 566	189 973	234 252	224 736
T-7	85 915	111 176	124 278	180 144	168 537	203 162	239 765	214 435	179 416
T-8	152 637	135 715	126 365	142 732	160 766	132 148	144 936	177 974	196 092
T-9	44 137	46 266	114 888	147 376	181 256	162 081	137 995	160 248	150 446
T-10	-	-	338 465	429 512	176 779	182 497	196 947	202 299	155 383
T-11	49 396	61 806	103 938	100 798	113 890	173 467	144 301	207 130	175 197
T-12	109 688	180 625	155 577	178 269	107 258	139 677	154 677	150 161	141 961
T-13	90 675	92 233	119 674	115 758	95 259	121 040	126 597	146 508	194 332
T-14	-	-	46 289	41 541	59 159	114 843	140 105	77 273	60 140
T-15	-	-	-	-	55 309	78 479	92 618	97 849	98 668
T-16	175 483	156 790	159 809	94 871	98 373	101 123	79 236	78 350	80 269
T-17	204 537	239 320	157 347	121 995	105 154	114 279	89 700	63 822	68 391
T-18	82 204	141 981	205 382	143 943	117 685	86 561	101 421	108 385	83 921
T-19	106 464	154 275	174 123	141 460	120 508	118 259	84 471	98 124	81 834
T-20	-	-	-	-	36 954	43 586	53 366	52 401	123 147
T-21	-	-	149 350	81 105	75 733	52 982	42 129	42 245	53 399
T-22	-	-	-	-	-	-	113 836	119 432	123 230
T-23	78 065	75 935	67 761	79 761	57 435	63 717	78 609	83 000	80 028
T-24	97 054	99 878	50 539	57 130	45 908	41 646	57 883	66 940	35 847
T-25	-	-	-	-	-	109 153	94 506	101 133	113 430
T-28	106 807	109 587	75 292	79 848	48 846	43 677	54 302	39 747	32 487
T-29	37 551	30 928	30 081	27 606	27 738	33 902	44 242	46 823	43 685
T-30	143 159	158 051	113 075	96 415	68 847	77 212	87 482	59 848	52 602

Source: Prepared by the author on the basis of surveys, data published by the terminals and the ECLAC Maritime and Logistics Profile, 2014.