PORT BENCHMARKING REPORT: SA TERMINALS 2015/16

PUBLIC CONSULTATION ROADSHOW DISCUSSION DOCUMENT

Comment is invited via written submission by: 30 June 2016, addressed to: The Chairperson, Ports Regulator, Private Bag X54322, Durban, 4000
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Benchmarking efficiency of ports in South Africa

> *"…in the absence of an economic regulator over the ports sector (i.e. prior to 2009 when the Regulator was established) as well as lack of competition within/between South Africa's ports there was little incentive to improve the productivity levels in the ports, maintain the infrastructure to the required standards, invest in sufficient additional infrastructure or update the technology used in the ports." (TIPS, 2014:5).*

1. Introduction

With over 90% of trade facilitated through ports (imports/exports), South African ports play a critical role in fulfilling the country's social and economic development objectives. This was recognised in the National Commercial Ports Policy (2002:07) which articulated a vision for South African ports based on the role they play, espousing that

> *"The basis for pursuing a national commercial ports policy is the recognition that trade, distribution, transport and logistics are among the vital facets of the South African economy and should play a crucial role in the realisation of sustainable economic development……ports are integrated and crucial nodal points in a transport system and play a strategic role in the country's economic growth and social development."*

It is an accepted fact that the exclusive ownership and management of South African commercial ports by the National Ports Authority (the Authority) in line with provisions of the National Ports Act of 2005 as envisioned in the National Commercial Ports Policy of 2002 created a monopoly in the NPA. By definition, when monopolies are unregulated it may result in inefficient outcomes and recognising the need to address such, many all of government's economic policy and strategies that have ports as an integral part of the development process or outcome, have at some time or the other decried the inefficiencies of South African ports.

One of the constant and recurring themes coming out of the Regulator's stakeholder engagement and consultations is the cry about inefficiencies in South African ports which are said to affect the country's trade and thus its competitiveness. Except for a pre-occupation with Gross Crane Moves per hour and complaints about vessels spending too long at anchorage and even at berth, the quantification of the problem reveals a serious dearth in documentation of the magnitude of the problem. From the perspective of shipping lines, GCM has limited value in assessing port efficiency as they are far more interested in Ship Working Hours (SWH) and total port turnaround time.

Accordingly attempts to address the problem through the setting up of Key Performance Indicator (KPI) sub-committees within the Port Consultative Committee (PCC) structures within each port as well as the recently introduced Terminal Operator Performance Standards (TOPS) and related process for marine, road and rail, have experienced challenges in setting performance standards based on clear efficiency targets. In part this reflects a policy approach which was premised on the introduction of competition in the terminal operator environment, and that competition would address efficiencies in the system. However, with container and automotive terminals being almost exclusively operated by one terminal operator (TPT), together with licenses for other terminals which are viewed as precluding competition, thus making the quantification, measurement and pursuit of efficiency even more important.

Port efficiency can be measured in three key areas, i.e. pricing, operational and infrastructure use. On pricing efficiency, the Regulator has conducted research over the past four years that tracks trends in pricing efficiencies in South African terminals against global peers. (see Global Port Pricing Comparator Study http://www.portsregulator.org/images/documents/Port-Tariffs-Benchmarking-Report-2014-15.pdf).

The first five year port review due for publication begins to analyse financial performance of the various ports, further enhancing understanding of how efficient SA terminals are from a pricing perspective. The port pricing reform processes of the Regulator which has focused on changes in the tariff methodology, tariff strategy and the valuation of the Regulatory Asset Base (RAB) represents a systematic process of addressing pricing efficiency concerns in SA commercial ports. These processes are ongoing and entail significant consultations with all stakeholders to ensure that their inputs are considered in effecting lasting and sustainable changes towards efficient port pricing for South Africa. The two other areas is what this report focuses on i.e. operational efficiency and efficient use of infrastructure.

1.1. Objective(s)

In terms of Section 30 (2) (f) of the National Ports Acts, 12 of 2005 (the Act), the Ports Regulator of South Africa (the Regulator) has been mandated to “regulate the provision of adequate, affordable and efficient port services and facilities”. In line with this provision, the Regulator places great importance on port performance. An objective of this study is to monitor the performance improvement strategies adopted by the Authority and whether the desired outcomes are starting to be produced.

1.2. Methodology

For the purposes of this benchmarking exercise, the Regulator selected seventeen ports from amongst fifty of the global, best performing 2014 TEU container ports (as published in the Top

100 Container Terminals by Lloyds List, London). The container terminals in the Ports of Durban, Ngqura, Cape Town and Port Elizabeth will be benchmarked against the chosen ports. Information on the chosen ports were publicly available and additional information was obtainable from the relevant port authorities.

We have selected four input variables namely; length of berths (running metres of quay), terminal area, number of cranes, and average working hours, and one output variable, throughput in calculating productivity, which is in turn used as criteria for evaluating the efficiency of ports.

1.3. Limitations

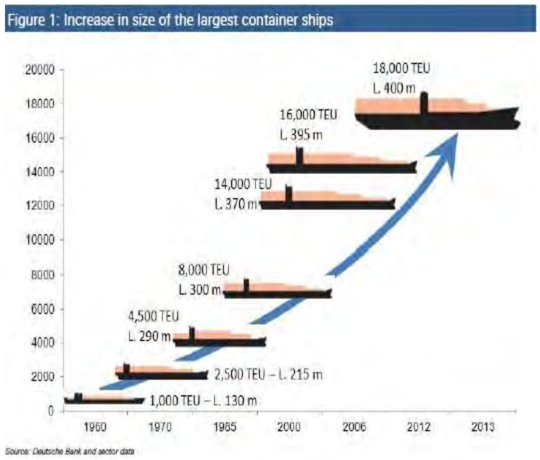
Although the study was carefully prepared, there are both limitations and shortcomings of the study. Firstly, the study solely relies on publicly available information and it is not confirmed whether the presented information deviates from what is happening at these ports. Significant port developments might have possibly occurred in some of the ports used in the study e.g. additional cranes may have been bought or terminals may have been widened; the Regulator may not yet be aware of these developments or public information may not be updated timeously. Secondly because the information is aggregated, the nuances that may apply to a terminal may be lost.

Thirdly, since the study relied greatly on publicly available information and these terminals tend to be private owned or operated, some of the port infrastructure information required was not available further defining a narrow sample. An earlier version of the study (2014/15) covered the big terminals i.e. terminals handling significantly high numbers of TEUs per annum. With the exception of Shanghai included as a benchmark on throughput, the sample only includes terminals with throughput of below 10million TEUs per annum; in order that SA ports are compared to similar sized global ports.

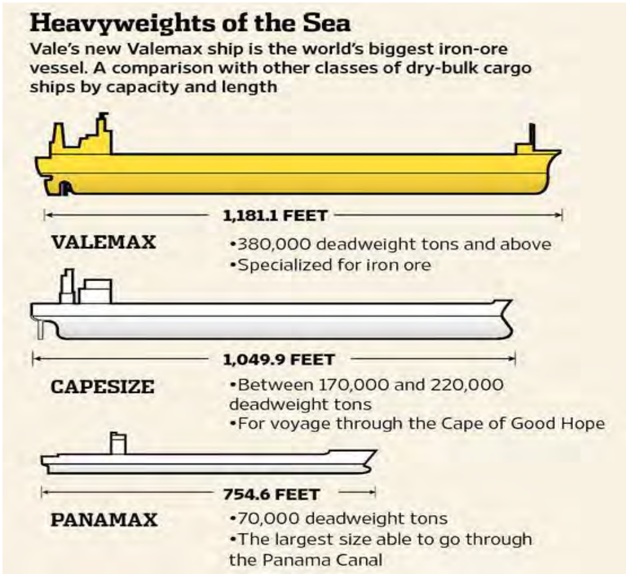
1.4. Brief overview

Operational efficiencies of terminals have been studied and measured from different vantage points since the early ‘70s in response to a the need for improved productivity in developing country ports as they integrated into the global logistics and supply chains, on the one hand. On the other, the focus on productivity and efficiency has been driven by the fact that ports are key nodal points in the global supply chain that in turn has pursued cost cutting measures in pursuit of lower transportation costs as part of tradable GDP and profit margins.

This is evidenced by the growth in the size of vessels in the global container merchant fleet with the largest container vessels now carrying 18 000 TEUs from 1 000 TEU in the 1960's. The largest



Ro-ro vessel now carry 8 500 cars. In the bulk sector, the largest vessels are generally in the range of 180 000 deadweight tons. Although there are Very Large Ore Carriers of more than 300 000 Dead Weight Tons specialising in transportation of iron ore, these call at specific ports. An example of this is the Brazilian Vale Bulkers which was commissioned in 2011. With a draught of 23 m when fully loaded with iron ore , the Valemax is limited to call only several ports in Brazil, China and Europe (Sohar in Oman, Dalian in China, Ōita in Japan, Rotterdam and the trans-shipment hub Vale at the Subic Bay, Philippines)



Source*http://www.largestships.com/wp-content/uploads/2013/10/MS-Vale-Brasil-Comparison.jpg.*

The drive for larger vessels has been the need for increased economies of scale and cost reduction, and/or the various consortium or vessel sharing arrangements that now dominate in the container liner service. The bigger vessels have an impact on the infrastructure and operational systems in a port that translate, overall, in levels of port efficiency. For ports which are outside of the major trading routes, as are South African ports, such impacts are often cascaded later on in the global trade cycle, so that there may currently be less concerns about 18 000 TEU vessel. With the immediate concern being that ports like Durban and some South American port may see vessels that are too large for the sea trade densities in their related trades, they are also required to improve the efficient handling of current vessel sizes and the larger ones in the near future. Moves per ship working hour or across the ship rate as a measure of berth productivity; ship turnaround times for vessels, as well as cargo dwell times are the three main performance areas that are looked at in benchmarking SA terminal's performance. Efficient use of infrastructure is discussed through investigating scale efficiencies in terminals.

With most literature on efficiency focusing on different aspects of the transport logistics and port component in global trade and competition, Merk and Dang's (2012) recent work for the OECD very usefully, assesses not only efficiency in container terminals which the bulk of studies do, but also oil, coal, ores and grain. Secondly, the study also investigates and extensively reports on scale inefficiencies which in essence links overall efficiency of a terminal with *"scale of production"* i.e. whether the use of design infrastructure is optimal or not. Alongside other methodologies, the Data Envelopment Analysis makes it possible to define efficiency frontiers for terminals based on defined parameters (e.g. infrastructure and volumes) that terminals are expected to perform at or strive towards which can be very useful when its limitations are address, which is the case in the OECD work.

With a regulatory framework that is focused directly on infrastructure regulation and to a lesser and indirect extent on terminal operations coupled with a tariff methodology that incentivises investment in infrastructure, the determination of scale efficiency becomes a useful tool in determining the productive use of infrastructure based on improved efficiencies and the levels at which further capacity would be required.

The benchmarking of SA terminals by the Regulator is not intended to provide details, on a case by case basis, of best-case in port operations in container, automotive, liquid bulk, break bulk and dry bulk, which the Authority would then emulate. It is rather pitched at a strategic level where comparisons are made, qualitatively and quantitatively, between South African port performance and those considered to be doing well in the various key performance measures and indicators. Given the collective deficiency in determining and setting of composite measures and targets for South African terminals beyond the 35 Gross Crane Moves per hour in the Presidency 2014 – 2019 Medium Term Strategic Framework, this report alongside other processes of the Regulator (possible review of the tariff methodology to include productivity/efficiency promotion) and the Port Consultative Committees (KPIs subcommittees), the Department of Public Enterprises Shareholder Compact measures, and measures to be enforced through operator licenses (terminal, marine, road and rail) intends to start a process to address this, with inputs from industry players.

The bulk of the work was done through analysis of secondary data from the Journal of Commerce (JOC), the Organisation for Economic and Co-operation and Development (OECD), and Lloyd's list. South African terminal performance measures were determined through the Regulator's own calculations and/or use of information from both the Authority and Transnet Port Terminals (TPT) components in Transnet's Annual Reports (2008/09 through to 2014/15). These together with other sources of information are referenced accordingly in the paper. Port performance matters the most on a regional basis where there is a real possibility that cargo can move to a competing, more efficient port.

Table 1 captures regional and international ports visited by vessels that have also called in SA terminals for handling of respective commodities; containers, dry bulk, breakbulk, RoRos and liquid bulks. It represents a collection of the most common 'last' and 'next' ports of call of vessels calling at SA ports. This ports shows an emerging pattern based on reported port call by vessel, and not necessarily competing ports for SA terminals. The container handling ports such as Maputo and Port Louis may become competition for SA ports in future, whilst as "hub" ports Salalah, Singapore and Kelang are competing ports. The rest, although visited by vessels calling in SA, are not considered as competition at this stage.

Table 1: Port called by the majority of vessels calling at South African terminals, 2013/14

Containers	**Dry Bulk**	**Breakbulk**	**Automotive**	**Liquid Bulk**
Singapore	Singapore	Singapore	Maputo	Singapore
Port Kelang	India	Maputo	Singapore	Beira
Port Louis/Mauritius	China	Walvis Bay	Luanda	Walvis Bay
Santos	Maputo	Luanda	Fremantle- Wa	Maputo
Pointe Noire	Mundra	Dar-Es-Salaam	Southampton	Fujairah
Walvis Bay	Rotterdam	Beira	India	Port Louis/Mauritius
Las Palmas	Mombasa	Abbot Point	Walvis Bay	Sikka
Maputo	Qingdao	Mombasa	Dar-Es-Salaam	India
Lomé	Karachi	India	Mombasa	Indonesia
Luanda	Port Louis/Mauritius	Lagos	Vigo	Mombasa

The ports reflected in blue are international ports that are called at by vessels visiting SA terminals, whiles the ones in green are regional ports. The international ports on the list are mainly from the Far East and South Asia regions; of particular interest in this group of ports is the Port of Singapore. It is well known that the main trading partner of South Africa in Asia or in fact the entire world is China, but the last and next ports of call results do not clearly reflect this. The reason for this is that Singapore is geographically well placed for Transhipment by ships sailing between South Africa and China. Notably, the port of Singapore is the main transhipment port for cargo going to Malaysia, Japan, Korea and even Australia and New Zealand. Liner (container) services vessels call at dominant intermediate hub ports like Singapore, Kelang, and Tangjung Pelepas.

Port developments in the following ports in Sub-Saharan Africa are worth following as these represent ports that share direct vessel routes with SA terminals. Through the high level of proximity to South African ports, Walvis Bay, Maputo and Beira are ports that are direct competitors (geographically positioned for hinterland traffic). The level of substitutability (specifically investment in infrastructure and superstructure, operational efficiency, and the cost of deviating) between ports at or around these locations will decide the amount of competition between ports. Over and above hinterland traffic, ports may also compete for transhipment traffic; in such a situation larger vessels use the port to transfer cargo to smaller feeder vessels. Where ports compete for transhipment traffic; the relevant geographic market is expected to be wider than in the case where ports contend for hinterland traffic only[1]. This then expands the range of competitor ports for consideration. This study does not capture the performance data of all the ports in the table on the Southern African region at this stage. It is envisaged that future studies will include them as part of benchmarking SA ports.

2. Operational Efficiency

With maritime trade characterized by an unrelenting pursuit of lower costs - from containerization to vessel-sharing-arrangements of shipping lines and the building of ever bigger vessels - to compete effectively in the global supply chains, port/terminals must reduce transport times because the competition is such that delays and uncertainty in the handling of inventory can prevent particular player's integration into or participation in the global supply networks.

Cargo dwell times at terminal (time and cost implications on inventory), **vessel time at anchorage** (an indicator of congestion at port), **ship turnaround times**, **crane moves per hour** (for container terminals) or **loading and unloading rates** (automotive) and **cargo handling rates** (bulk cargo) are important indicators of port efficiencies. Addressing a port or terminal's performance on these indicators has influence on both port cost and capacity making these an area of concern and focus for the Regulator. Other measures which include hinterland operations and connectivity with rail and road are yet to be investigated and documented to enable comparisons. The Authority's rail operator's and road operator's performance standards process will provide the first indication of how ports are perceived to be performing on these, notwithstanding anecdotal evidence from industry and local governments on some of these.

The aspects of maritime operations that are generally considered in measuring port performance and efficiency are:

[1]OECD. (2011)

- Berth productivity measured in moves or volumes per ship working hour also known as across the ship rate
- Cargo dwell times
- Crane moves per hour
- Ship turnaround times
- Time spent at anchorage

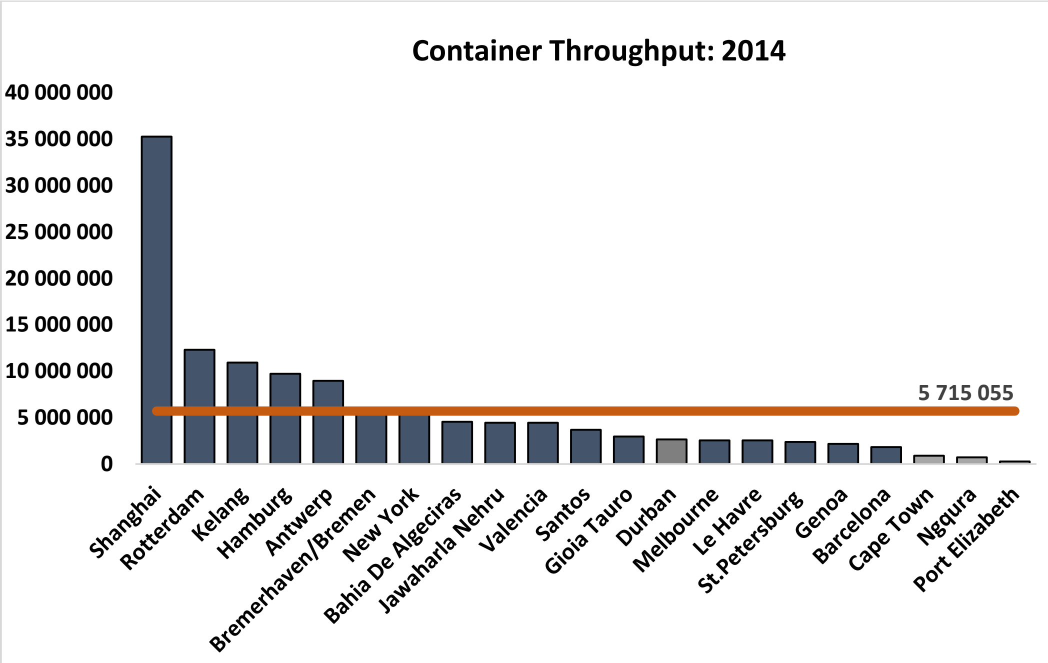
This brief benchmark report compares the performance of SA terminals on these indicators against global best performers as well as some of those visited by vessels also calling at SA terminals.

This benchmarking exercise faced data challenges i.e. the inability of the Regulator to acquire full data-sets with information about relevant ports against which SA terminals can be benchmarked which information is not always readily and publicly available, due to the relatively high cost of such datasets. The Journal of Commerce (JOC)'s data for one region would cost more than R300 000. Drewry's Maritime Research and publication on container terminal capacity and performance benchmarks was also similarly unaffordable, yet collectively, they could provide primary data that would significantly enhance the research conducted by the Regulator. These datasets are a practical option where the Regulator, though it may acquire information from shipping lines and other key players operating in South African ports and terminals, the Regulator would be challenged in extending its reach beyond most local players which is a considerable limitation in this global industry. An additional challenge would be in ensuring credibility of acquired data which may carry some self-reporting bias and thus impose a burden for independent verification.

The acquisition of data from these and similar sources, remains a practical option if the Regulator is to effectively drive an agenda for improving efficiencies in SA ports. It is anticipated that in the near future these challenges will be overcome. The second challenge has to do with conducting benchmarking of SA port performance mainly on a desktop basis. It is anticipated that observation and engagements with phenomena discussed in the various ports, at home and abroad, would be beneficial in bringing realism to the benchmarking exercise. This challenge will be addressed through engagements and consultations locally with port stakeholders who experience the service levels discussed, with terminals operators in the SA system as well as other regional and or international ports.

2.1. Comparing volumes and utilisation of container terminals

Figure 1: Container Throughput



The above graph shows the total throughput in (TEUs) moved by each port in the sample in the 2014 year. SA ports are all below the average; which means our ports are small compared to some of the other ports in the sample, from a throughput perspective.

Figure 2: TEU/Container Terminal square metre

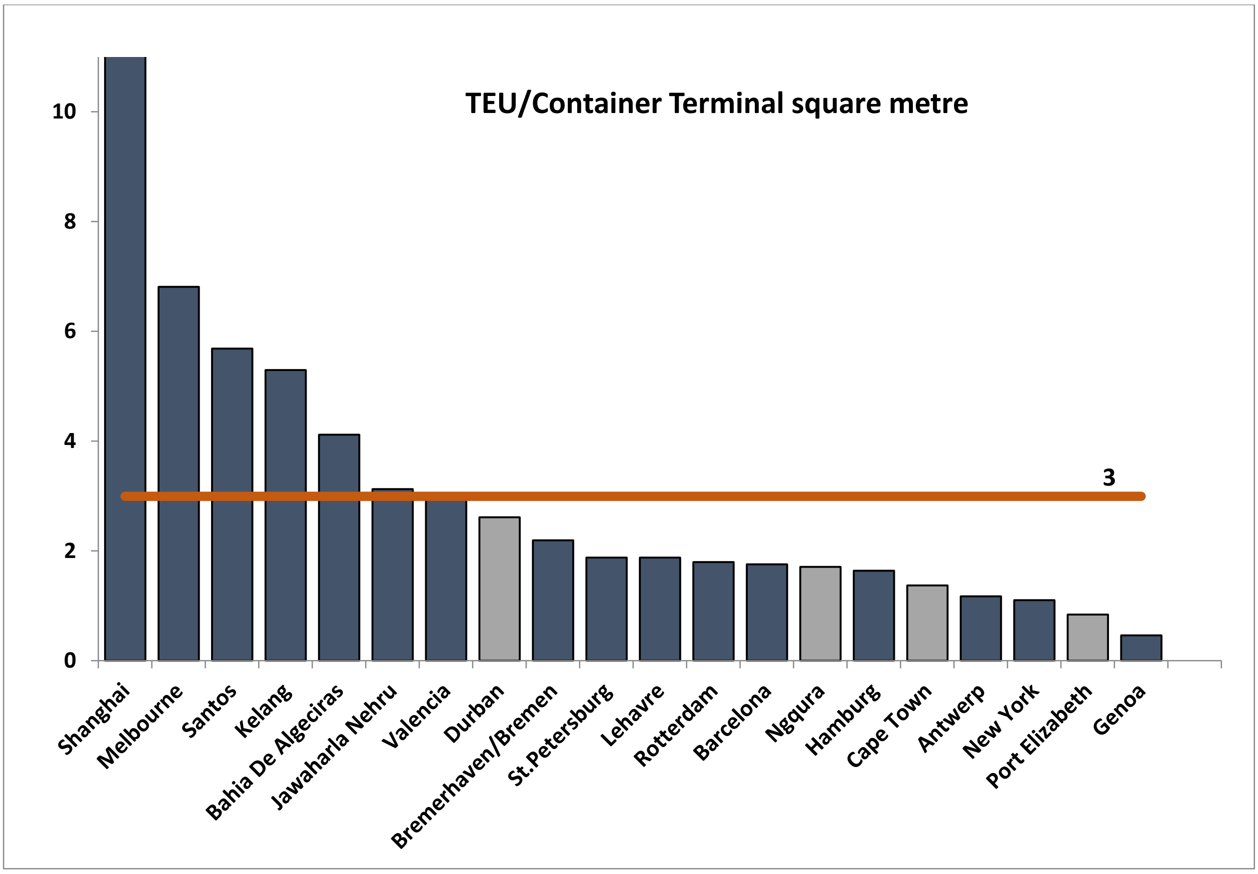
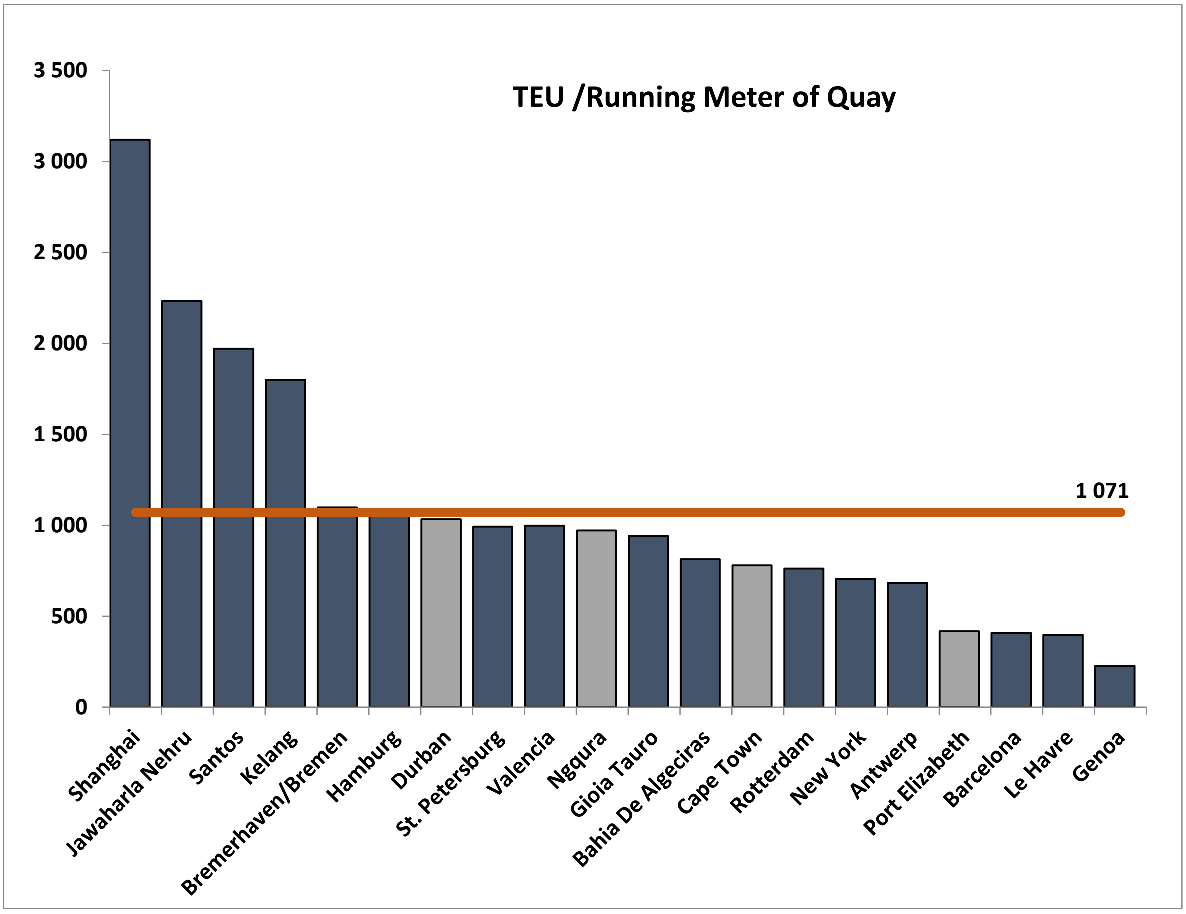


Figure 2 indicates an average TEU per square metre of the terminal. On average three TEUs are moved per square metre in 2013/14. Again, SA ports are below the average although the Port of Ngqura is utilising its terminal fairly well even though it has lower throughput. As per figure the Port of Durban is close to the average which is good considering the fact that the port is small from a throughput perspective compared to the other ports in the sample. It can therefore be concluded that SA ports are performing reasonably efficiently as they are working more TEUs per each square metre of the container terminal compared to many in the sample. The Port of Antwerp and Rotterdam may be below average but that does not mean the port is inefficient, it simply means the port is possibly not utilising its terminal as effectively or productively as the ports that are above average.

Figure 3: TEU/Running meter of quay (2014)



The above graph shows how many TEUs are moved per running metre of quay. On average there are 1 071 TEUs per running metre of quay, co-incidentally although this is an average of the sampled terminals, it is also the same average determined in the Drewry global port productivity study. The Port of Durban has on average moved 1 034 TEU per running metre of quay, which is lower than its 2013 levels of 1 071 which was in line with global average. However ports such as Shanghai and Jawaharlal Nehru are doing exceptionally well in their quay productivity as they are respectively moving 3 120 and 2 233 TEU per running metre of quay. The ports of Cape Town and Port Elizabeth are functioning below the average.

Figure 4: TEU per crane/annum (Container ports)

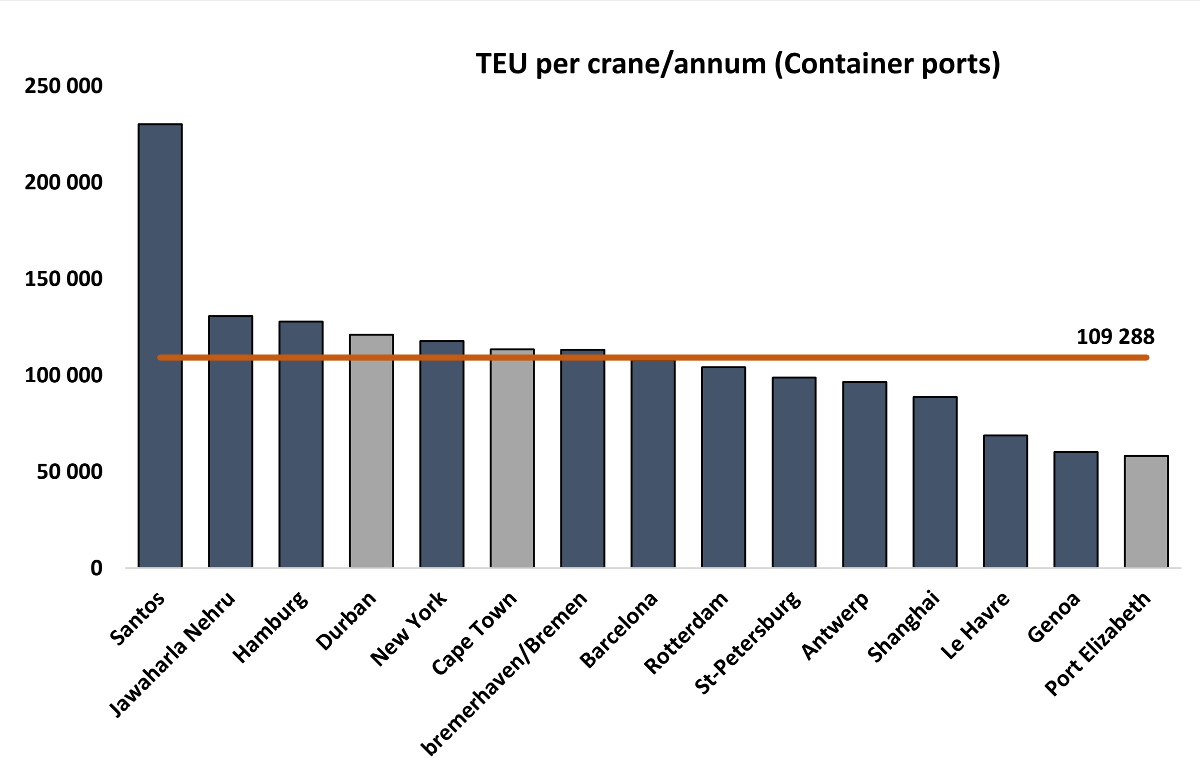
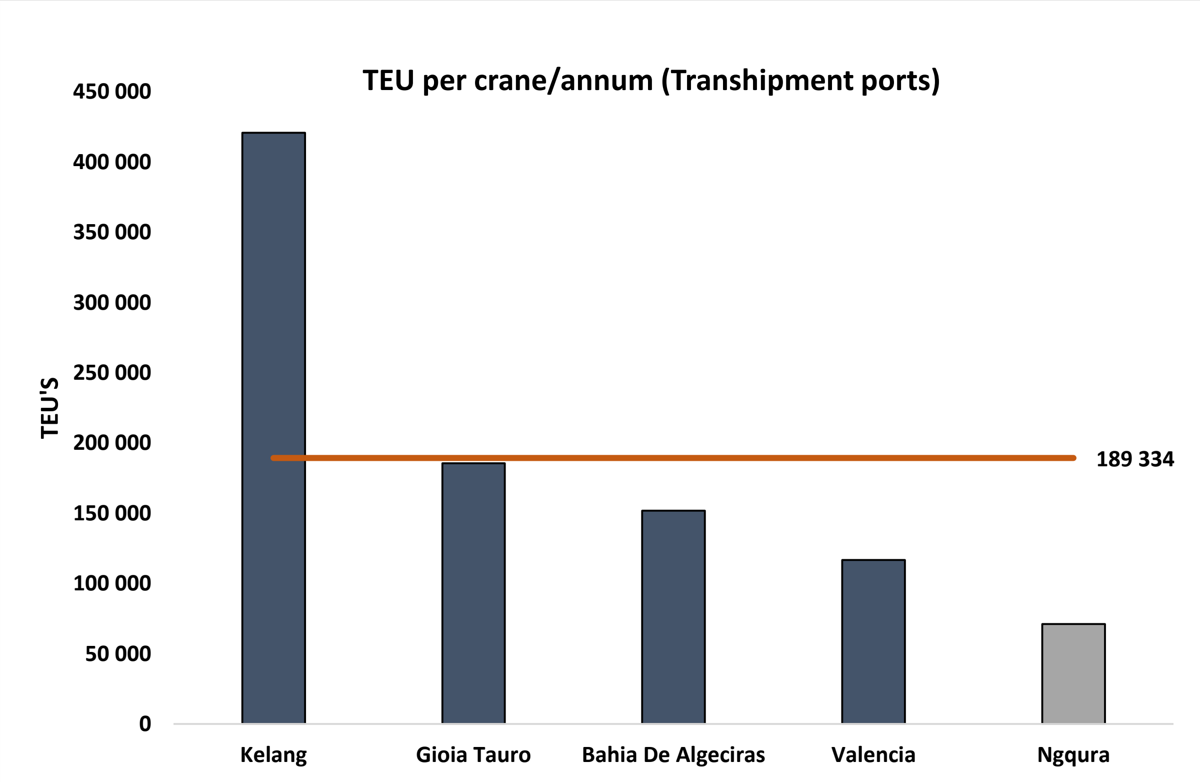


Figure 4 shows the average TEUs moved by each crane. The effectiveness of the crane depends on the type of cranes used, a variable that isn't reflected in the study. The above figure depicts that on average, 109 288TEUs are moved per crane per year. Although SA ports are functioning close to and below the average, they are utilising their cranes more productively as they have the least number of cranes compared to other ports in the sample with the exception of the Port of Santos. The Port of Santos has fewer cranes than South African ports but their utilisation is higher and above the average. This could be due to the type of cranes used by the port. The Port of Shanghai which has the highest TEU throughput is below the average, meaning the port has lower crane productivity.

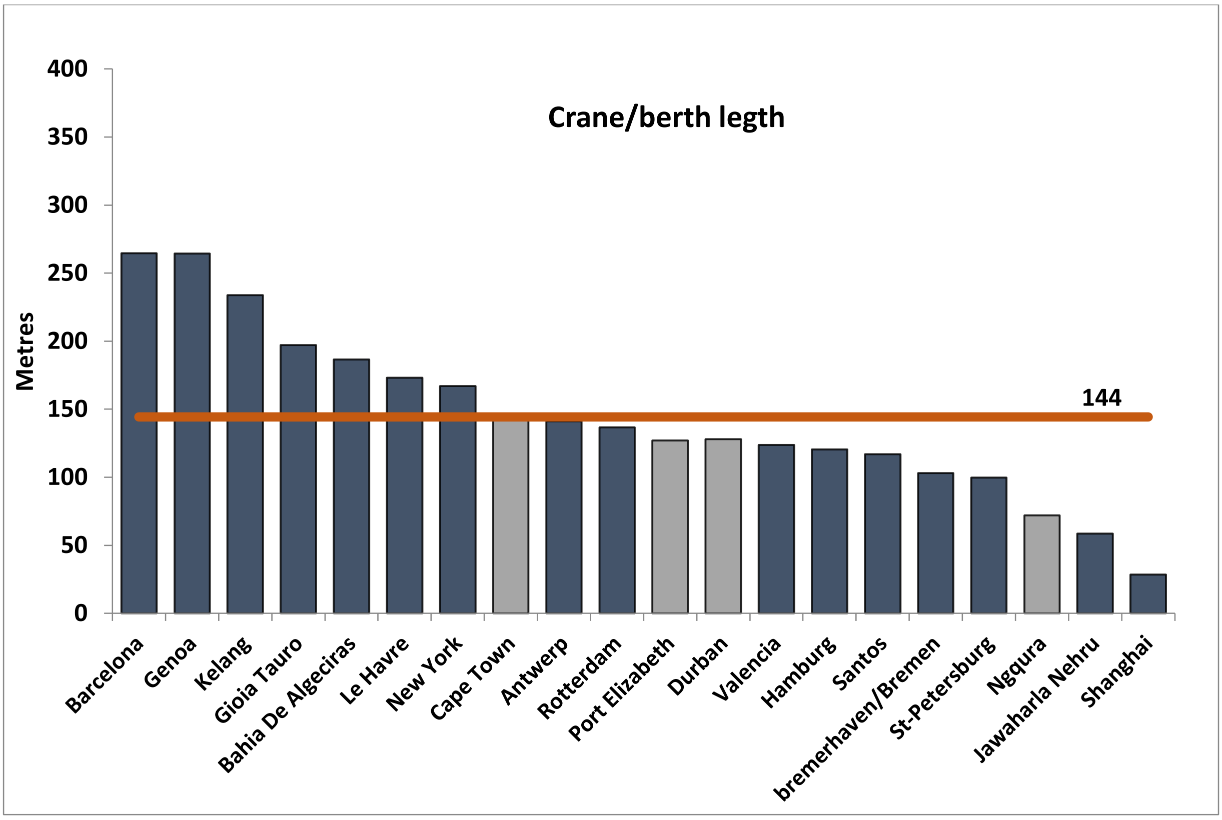
Figure 5: TEU per Crane/annum (Transhipment ports)



However if we are looking at transhipment hub ports comparative as depicted in the figure above, The Port of Kelang ranked first on the sample, although the port has medium infrastructure and superstructure, it has higher superstructure utilization. The port is moving 420 992 TEUs per crane which is extremely high when being compared to the other ports in the sample. Looking at South African port (Ngqura) it is far below the average moving 71 331 TEU per crane.

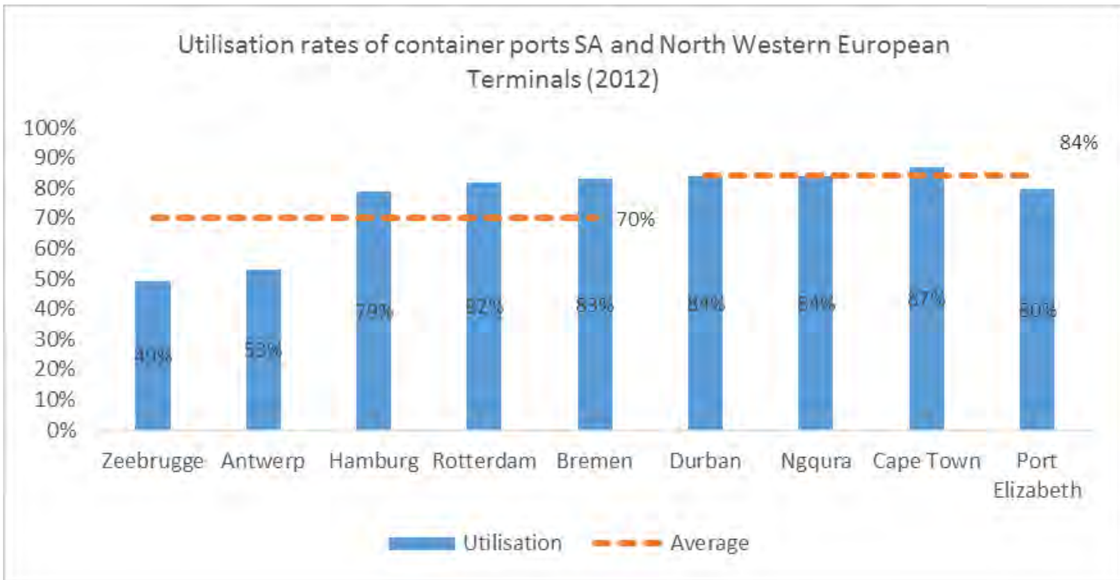
Next we look at the utilisation level of container terminals as a function of throughput against installed capacity, a measure that also indicates whether additional capacity should be considered or there is sufficient capacity in the system. Capacity was determined as the maximum volume a port could reasonably handle a year based on the available yard area, quay length and cranes i.e. installed capacity.

Figure 6: Crane per berth length



On average there is one crane for every 144m of berth length. The Port of Shanghai has lot of cranes on its quay wall simply because for every 28 metres of berth length there is a crane, this suggests that the port has to improve their crane productivity since they are below average in figure 4 which looks at TEU per crane. Looking at South African Ports particularly Cape Town, Port Elizabeth and Durban they are around the average. The Port of Ngqura is at the lower extreme where it has one crane for every 72 metres of berth, indicating that the port has not much room for expansion of superstructure.

Figure 7: Utilisation of container terminals (SA and NWE: 2012).



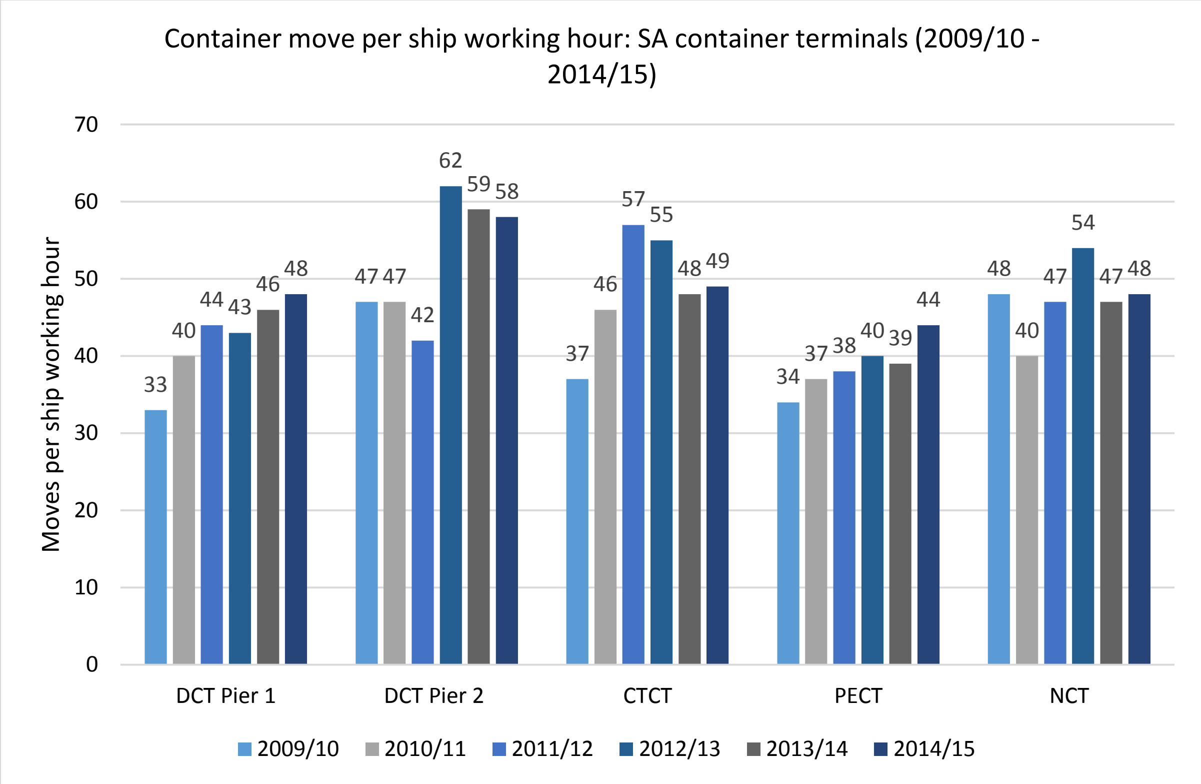
Source: Adstrat for North Western European Terminals and Regulators calculation based on NPA capacity and volume data for SA.

The Adstrat (2012) research determined the utilisation levels of 5 North Western European terminals, which are amongst the leading world container terminals by volume (the leading ports are in China, the Far East and South East Asian ports). These North Western European terminals had an overall utilisation of 70% which is the accepted benchmark indicating full utilisation of the terminals. The average hides the much lower utilisation rates for Zeebrugge and Antwerp terminals. In comparison South Africa's container terminals' utilisation rate were overall much higher at an average of 84% (based on installed capacity).

2.2. Berth productivity – moves per ship working hour/across the ship rate

The 2014 study by Drewry provided average TEU per metre of quay per year at 1 072TEUs while the TEU per hectare was 24 791 and TEU per gantry was 123 489 (Drewry, 2014b). The Regulator's report (See Benchmarking SA ports: containers and automotive terminals 2014/15) put the performance of the South African container terminals as below these global averages, except for the port of Durban's 1 071 TEUs per running meter of berth which was on the global average. This section focusses on moves per ship working hours for each of the four SA container terminals. Terminal performance on this measure was calculated using berth utilisation rates and throughput handled by the terminals and the results are captured below for all four terminals over a six year period.

Figure 8: Container moves per ship working hour, SA container terminals



Source: Input data from Transnet (SOC) Integrated annual reports (2009/10 – 2013/14).

The Durban container terminals, which feature in the International Top 100 container terminals have recorded the highest moves per ship working hour in the SA system. The overall performance of SA terminals places them with a majority of other global terminals in the range of 40 – 80 moves per ship working hour as reflected in Table 2.

Table 2: Port productivity - moves per ship working hour (2014 Global ports)

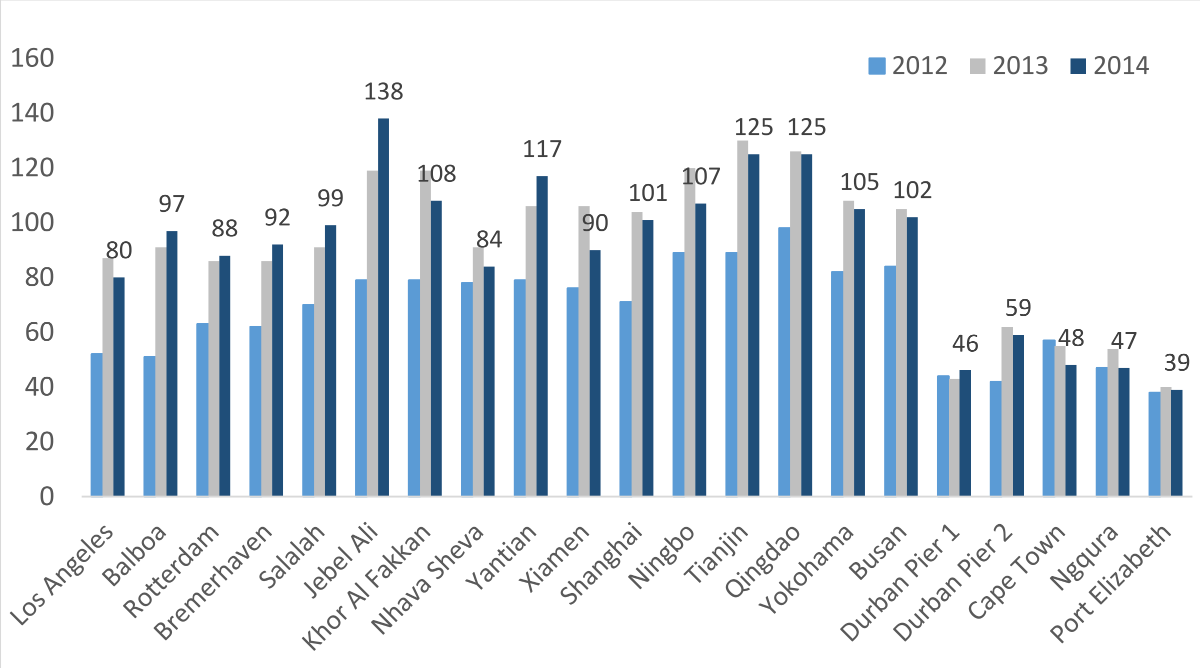
Port	Country	2014 moves per ship working hour
Alexandria	Egypt	Less than 40
Marseiles	France	Less than 40
Singapore	Malaysia	40 – 80
Le Havre	France	40 – 80
Valencia	Spain	40 – 80
Algeciras	Spain	40 – 80
Jeddah	Saudi Arabia	40 – 80
St. Petersburg	Russia	40 – 80
Rotterdam	Netherlands	40 – 80
Gioia Tauro	Italy	40 – 80
Antwerp	Belgium	40 – 80
Sydney	Australia	40 – 80
Melbourne	Australia	40 – 80
Santos	Brazil	40 -80
Nhava Sheva	India	40 - 80
Yokohama	Japan	40 - 80
Felixstowe	United Kingdom	80 – 120
New Jersey	USA	80 – 120
Tianjin	China	120 - 167
Shanghai	China	120 - 167
Shenzhen	China	120 - 167

Source: Merk. O. (2015) Impact of Mega[2]ships: Case specific policy analysis, OECD.

Recorded performance within the bands over a three year period, shows that where there has been general improvement, the SA terminal's rates are relatively at a slower pace than others.

[2] Mega ships are defined as container ship with dead weight tonnage of at least 150 000 which translate to a 13 300 TEU capacity. In almost all port they call they several hours longer than ships below that threshold in some ports they have turnaround twice as long as the average including in Santos. In Oakland, Algeciras, and Khor Fakkan their turnaround is shorter than for other ships.

Figure 9: Berth productivity- moves per ship working hour trends 2012, 2013 and 2014



Source: UNCTAD secretariat and JOC Port Productivity Database 2015. From UNCTAD Maritime Review 2015 with own numbers Port Elizabeth, Ngqura, Cape Town, Durban (Pier 1 and Pier 2).

Overall, moves per ship working hour, SA terminals can strive for improved performance in working the vessels faster. This especially so when considering that the terminals that are showing a trend of higher rates and increasing improvements are handling volumes that SA terminals are anticipated to handle in the future, in addition to the cascading of bigger vessels whose attraction and retention in a port is dependent in part on how fast the vessels can be worked. The next section looks at SA terminal performance on the related measure of ship-turn-around time.

2.3. Ship turn-around time

> *"Every minute that a vessel stays at a terminal means money lost for the shipping company, and this in turn places pressure upon a terminal operator to ensure it does not lose business to more efficient competitors"*
>
> *UNCTAD 2015: 71.*

The quote from UNCTAD reflects one of the considerations for vessels in making decisions about port calls. Taking again from the OECD 2014 study, the average ship turnaround time[3] of world container ports was 1.03 days in 2014 with most ports achieving average ship turnaround times lower than two days. Asian ports had a turnaround of less than one day, Japan had half a day, etc.

[3] According to the report, the calculation of turnaround was based on vessel movements in May 2014 (38 843 port calls) and May 2011 (25 989 port calls) from Lloyds List Intelligence Unit. There are concerns with the month chosen. The database is above 95% of vessel movements globally, using only fully cellular container ships with GT greater than 100. Data used had arrival time at berth and departure time from berth as part of vessel call, allowing for calculation of duration of port stay. Port stay smaller than 0.20 days and longer than 7 days were excluded, which excludes bunkering and other extreme value call.

Ports in Africa have generally longer ship turnaround times, where an average turnaround time of more than three days are no exception, for example, Mombasa's is 4.1. Days.

Table 3: Ship turnaround times in Global Ports (2014)

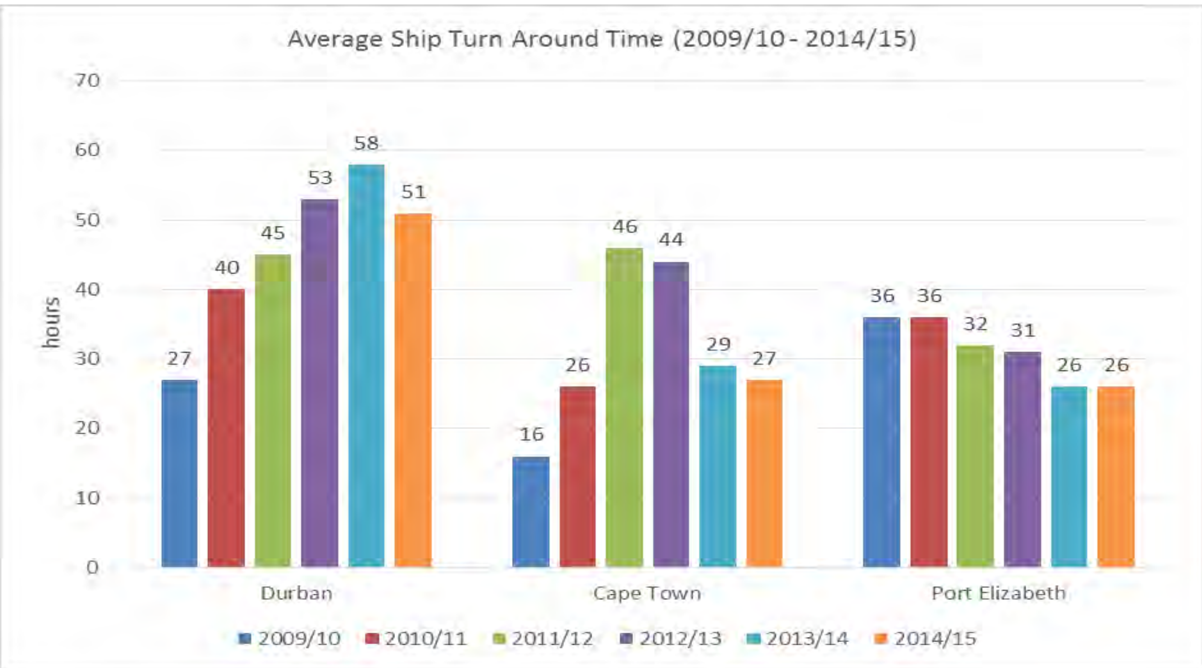
	Accepts megaships (Y/N)	2014 STAT Mega vessels	Number of ship calls per month(mega vessels)
Port of Kelang/Klang	Y	0- 1 day	1 000
Tanjung Pelepas	Y	1 – 2 days	500
Singapore	Y	1 – 2 days	1 500
Shanghai	Y	0 – 1 day	1 500
Yokohama	Y	0 -1 day	500
Hamburg	Y	1 -2 days	400
Le Havre	Y	0 – 1 day	400
Rotterdam	Y	1 – 2 days	600
Bremerhaven	Y	0 – 1 day	400
Felixstowe	Y	0 – 1 day	400
Antwerp	Y	1 -2 days	400
Genoa	Y	1 -2 days	400
Barcelona	Y	0 – 1 day	400
Valencia	Y	0 – 1 day	650
Gioia Tauro	Y	1 -2 days	400
Algeciras	Y	0 – 1 day	650
Valencia	Y	0 – 1 day	650
Tangier	Y	0 – 1 day	400

Source: Merk. O. (2015) Impact of Mega[4]ships: Case specific policy analysis.

Ports captured in this table handle the bulk of TEUs in global trade and operate on routes that are catered for by the larger container vessels. South African terminals handle far less TEUs and operate in the global trade route serviced mainly by 4 500 TEUs vessel although in recent years 8 000 to 10 000 TEUs are handled on a regular basis. Furthermore, Davidson (2014:08) reports that the trend over ever larger vessel being cascaded has seen the Europe-South Africa-Asia route increasingly serviced by 12 500 TEU vessels. Significant investment in infrastructure, superstructure and port management systems are required to enable the handling of TEUs from large vessels and allow these to depart within one to two days.

[4] Mega ships are defined as container ship with dead weight tonnage of at least 150 000 which translate to a 13 300 TEU capacity. In almost all port they call they several hours longer than ships below that threshold in some ports they have turnaround twice as long as the average including in Santos. In Oakland, Algeciras, and Khor Fakkan their turnaround is shorter than for other ships.

Figure 10: Average ship turnaround time in SA terminals (2009/10 - 2014/15)



The average ship turnaround time in the port of Durban has deteriorated from just over a day to two days and 10 hours in 2013/14, with Cape Town terminal also following a similar trend from less than a day to peaking at almost two days and then reducing to just over 1 day. Port Elizabeth has shaved off 10 hours from its turnaround times. This performance must also be seen in the context of the number of vessels calling. There has been a marked reduction in the number of vessels calling (Table 4) with noticeable increases in the vessel sizes especially in Durban, Ngqura and Cape Town.

The ship turnaround times recorded in Table 3, which includes handling of mega-vessels, when contrasted with the trend in SA terminals captured in Figure 8 suggests that there may be challenges if too many larger vessels are cascaded on the SA trading route, unless there is sustained improvement in efficiencies on the port operations, road and rail and the interface between these.

Table 4: Vessel calls in SA terminals 2009/10 to 2013/14

Port[5]	2009/10	2010/11	2011/12	2012/13	2013/14	CAGR
Richards Bay	1,871	1,844	1646	1,680	1,790	-1.1%
Durban	4,623	4,536	4,125	4050	3,975	-3.7%
East London	269	297	320	270	281	1.1%
Ngqura	84	364	392	439	534	58.8%
Port Elizabeth	857	921	912	872	976	3.3%
Cape Town	2,820	2,550	2,123	2279	2,435	-3.6%
Saldanha Bay	477	480	502	505	489	0.6%
Average monthly calls per port	**131**	**131**	**119**	**120**	**125**	**-1.17%**
Total	**11,001**	**10,992**	**10,020**	**10,095**	**10,480**	**-1.2%**

Source: Extracted and calculated from NPA's VTS system (2009/10 – 2013/14).

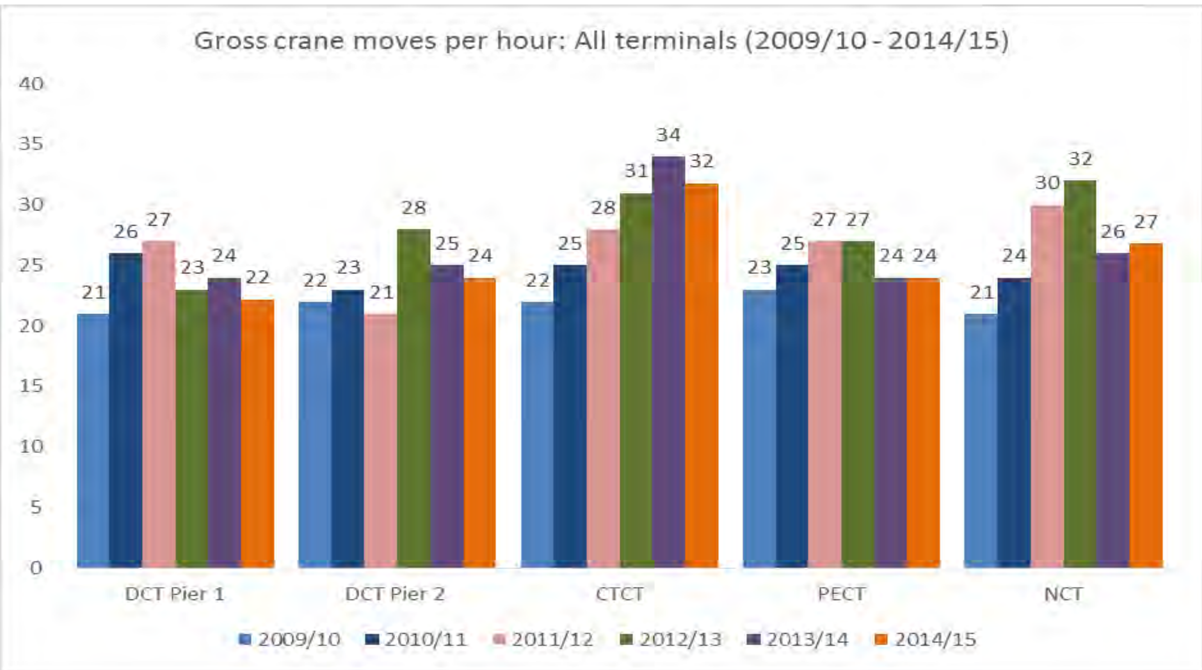
Compared to the number of ships calling per month in Table 3 i.e. between 400 and 1500, South African average vessel calls per month are low at about 125.

2.4. Gross Crane moves per hour (GCH)

This measure has seen sustained focus both in terms of its measurement but also investment in superstructure. Transnet Port Terminals has invested in superstructure across the system; according to public reports, about R510m was invested at the DCT Pier 2 for seven tandem lift cranes (three commissioned in 2012 and four in the process of being commissioned) and R438million in container handling equipment (mobile cranes, trucks, trailer and reach stackers) and has on order 4 Ship to Shore (STS) cranes and 18 Rubber Tyre Gantry (RTG) for Ngqura Container Terminal. This investment puts SA terminals on par with many European terminals handling similar volumes and vessel sizes. The use of the cranes must still yield similar outcomes, though. Where MTSF 2014 – 2019 has set a target for 35 gross crane moves per hour to be achieved by 2019, Figure 11 shows variable performance at the four terminals, all of which are still below the set target, notwithstanding the ports of Cape Town and Ngqura coming close to the target, in previous years.

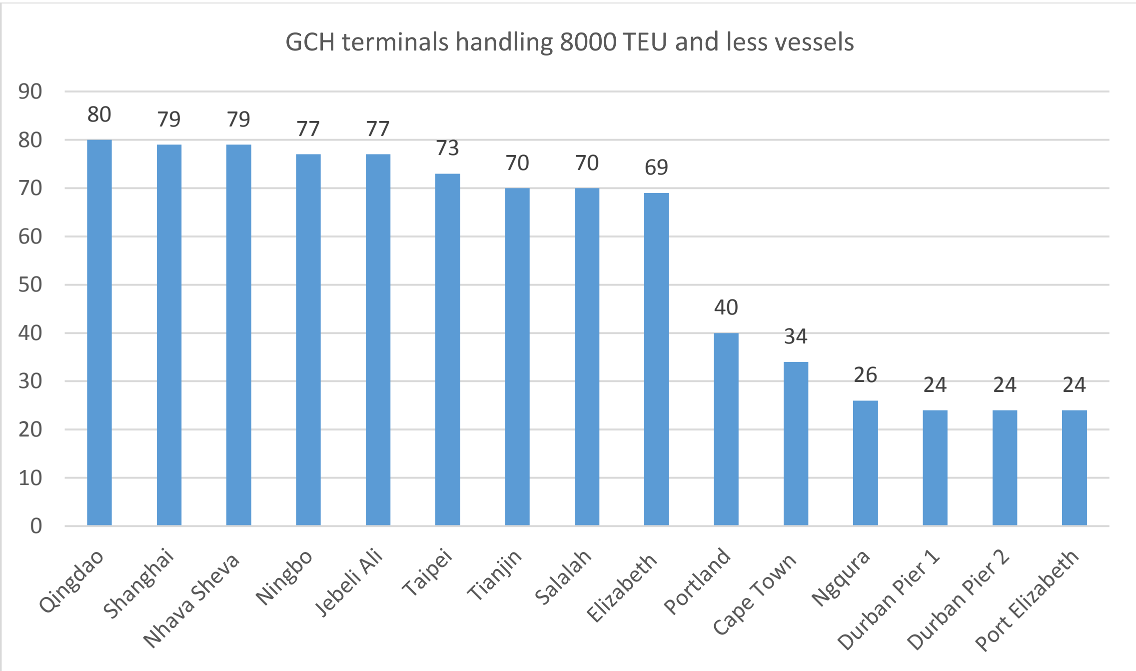
[5] Collated from the NPAs VTS system which excludes the Port of Mossel Bay whose data is still capture and kept manually.

Figure 11: Gross crane moves per hour



The global average is understood to be around 35 to 40 GCH. However, ports handling different type of vessels will be expected to perform at different levels. Based on the JOC's White Paper on Port Productivity, the following high level comparisons can be made.

Figure 12: GCH for terminals handling 8000 TEU vessel and less

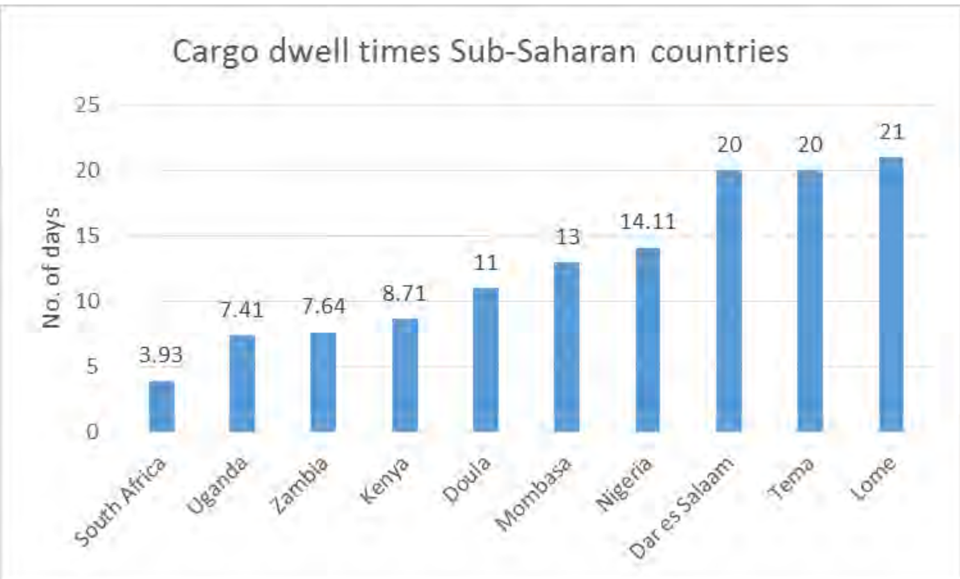


The numbers reflect what is achievable in terminal performance rather than being an indication of what South African terminals are expected to achieve with their current position in the global container terminal market. This is an area that will benefit from further analysis when datasets with appropriate information for terminals of different sizes and handling different vessel sizes are acquired, allowing for comparisons with similar ports and those whose performance would be an appropriate benchmark.

2.5. Dwell times in terminal

Cargo dwell time in a terminal is the average period that cargo stays within the terminal between the times of arrival to loading and vessel discharge to terminal gate exit for import, export and transhipment. *"Dwell time figures have become a major commercial instrument to attract cargo and generate revenue"* Raballand, et.al (2012:01) with linkages being made between dwell times and anti-competitive behaviour in ports which is similar to predatory pricing where long dwell times are used to prevent competition and/or to sustain comfortable rent generation. From a terminal capacity perspective, where high dwell times can be used as justification for expanding port capacity, improving dwell times would have the effect of increasing capacity for container handling without requisite investment in physical extensions (Raballand et al., 2012), therefore efforts to reduce overall dwell time times are a key element towards reducing logistics costs. Dwell times in South Africa's terminals are considered a good benchmark for ports in Sub-Saharan Africa as significant improvements have been made in reducing dwell times to between 3 and 5 days for imports and exports respectively and slightly longer for transhipment, with the latter possibly reflecting behaviour of shipping lines, call frequencies, etc.

Table 5: Cargo dwell times at Sub-Saharan African ports



Source: Raballand, et.al. (2012)

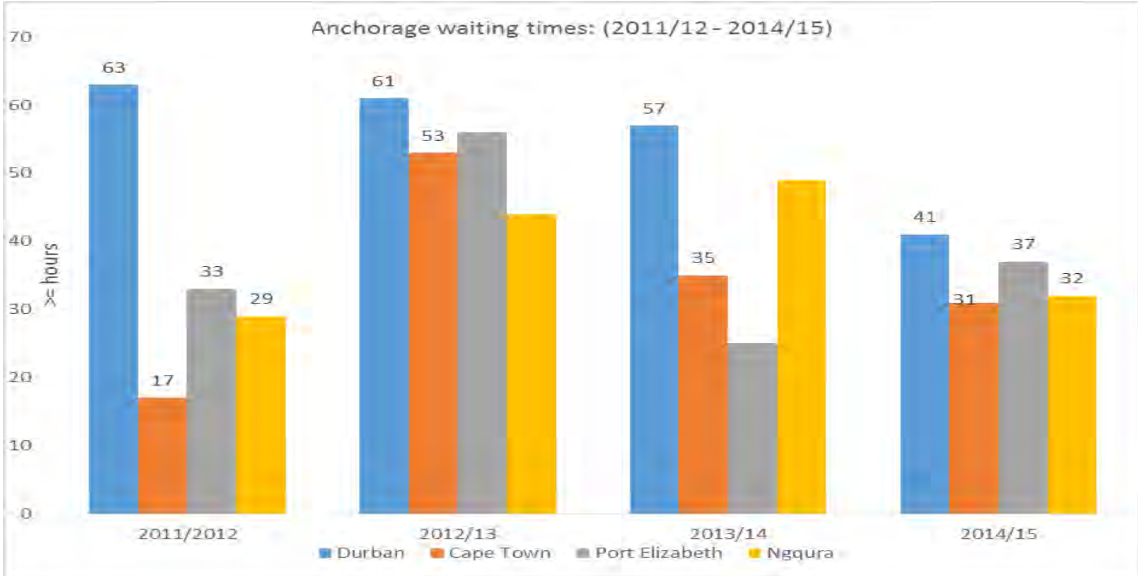
While there are a myriad of operational, transactional and storage factors (Raballand, et.al: 2012) affecting dwell times in a port, the port of Durban's Dwell time which can be categorised into

Dwell times in most European ports is reported to be three to four days which makes South Africa's performance on par with the global trends.

2.6. Time spent at anchorage

There is not much comparable data for time spent at anchorage which reflects all instances where ships are waiting for a berthing slot to be available .This is difficult to measure since it is not always attributed to the ports, as it can be related to scheduling issues, missing booked time window, etc. Long waiting time at anchorage are a result of lacking berthing slots able to accommodate specific ship classes (draft and cargo type) as well as terminal productivity issues. As reported by the Authority, the average number of hours that vessels have had to wait at anchorage due to berthing or marine services i.e. excluding weather and any other factors that are not under the control of the Authority in the four container terminals in the past 4 years (2012 – 2015) are reflected in Figure 13.

Figure 13: Time spent at anchorage



In 2011/12 vessels were spending up to two and a half day waiting at anchorage before they could enter the Durban port precinct from berthing and discharging/loading. This is reported to have reduced by almost a day to forty-one hours in 2014/15.

A total of 1 807 vessels spent on average 44.05 hours each at anchorage between March and September 2015 with causes for delays covering factors within and outside the Authority's control (see table below). Significantly, the most of the delays are in the control and management of the Authority i.e. provision of pilots, berth allocation and terminal availability which collectively account for 1 439 vessels spending over a day and a half (39 hours) at anchorage.

Table 6: Reasons and number of vessels delayed at Anchorage

Reason for delay	No of Vessels delayed	Total anchorage time (Hours)
Tugs	-	-
Pilot	2	3.4
Repairs	4	807.85
Weather	53	769.23
Orders	290	20 861.97
Cargo	21	1 170.62
Berth	780	33 623.04
Terminal	657	22 361.77
Total	**1 807**	**79 597.87**

Source: NPA Quarterly reporting to the Regulator (2015)

A significant number of vessels affected by berthing delays were bulk carriers (420) followed by container vessels (134) and tankers (114). Delays with terminal readiness affected mainly bulk carriers (398), container vessels (231) and 20 tankers. These measures are now being reported to the Regulator on a quarterly basis and will be monitored to identify where bottlenecks are.

Prior to the establishment of the Terminal Operators Performance Standards and Marine Operator Standards processes where the Authority has systematically started monitoring performance of terminals against consulted and agreed measures, there had not been significant strides in measuring the performance of SA terminals. The next section looks at scale efficiency and how SA terminals have fared relative to other ports on this measure.

3. Overall efficiency container, oil and bulk cargoes

There is limited comparable information on the bulks to allow proper comparisons. The Regulator is considering the possibility of commissioning a dedicated study to determine efficiency frontiers for the four cargo handling types. The recent study by Merk and Dang holds potential as it links efficiency to port infrastructure utilisation.

Merk and Dang (2012) undertook work to determine port efficiencies not only in container but also bulk cargos which most literature does not cover. Using the Data Envelopment Analysis (DEA) method, they determine overall efficiencies in container, crude oil, iron ore, coal and grain terminals, from which they determine the difference between overall and technical efficiency. The results of the research ranks ports according to their efficiency scores. This is but one of different approaches to benchmarking port efficiency with the advantage that it includes performance of bulk cargo.

The work by Merk and Dang (2012) on which this analysis has been based, assists in linking terminal efficiencies to productive use of infrastructure and will be useful future assessments of port efficiency, especially from an infrastructure perspective. The study sample and input parameters were as follows:

Table 7: Merk and Dang's efficiency outputs, inputs and sample parameters

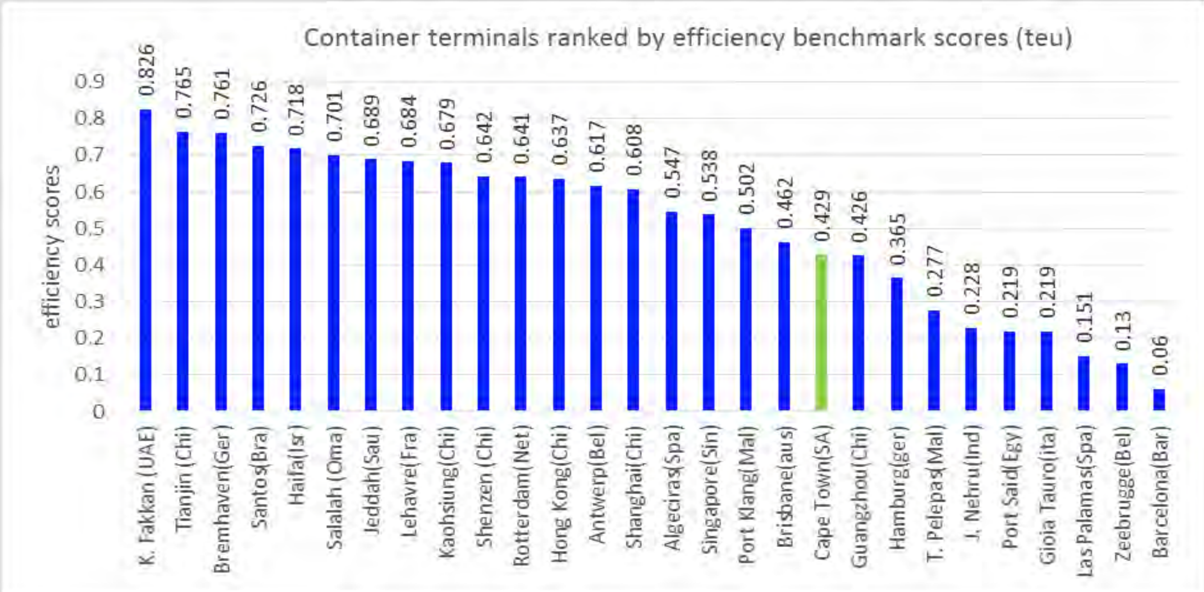
Terminals	Output	Input	Sample: number of terminals
Container	Deadweight tons of calling vessels + TEUs, Dwt only	Quay length, surface terminal, reefer points, quay cranes and yard cranes	62
Crude oil	Deadweight tons of vessels calling at each of sample ports	quay length, maximum depth, loading/unloading arm capacity (tons/hour), storage capacity (tonnes)	71
Iron Ore			11
Coal		quay length, storage capacity (tonnes), loading/unloading capacity (total capacity per hectare)	34
Grains			41

Below is a discussion of the findings with South African terminals that were included in the overall sample.

3.1. Container terminals

The study did not find a strong correlation between terminal or port size and efficiency of container terminals. By this reason, the port of Cape Town which is smaller in terms of volume and terminal size than the country's primary container port of Durban is included in the sample. Based on the determined efficiency scores, Cape Town's container terminal ranked higher than the bigger ports including Hamburg, Las Palamas and Zeebrugge. The other African port which made into the ranking and which performed better than a few large terminals, is Port Said in Egypt. Port Said also made it into the Top 100 Container terminals in 2015 based on increased volumes handled.

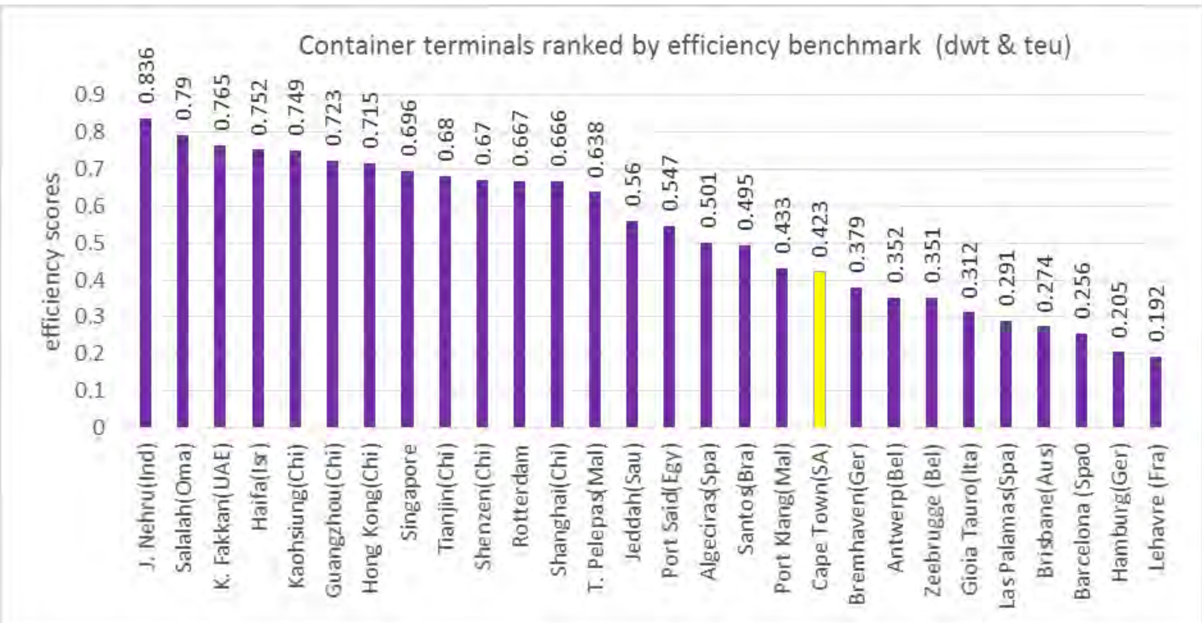
Figure 14: Container terminals ranked by efficiency benchmark scores



Source: Extracted from

The performance of the Cape Town terminal does not change much when deadweight tons and TEUs were considered. Where the score changes by only 0.006, for most other ports, a consideration of both these outputs as seen in the changed positions in the ranking above and below.

Figure 15: Container terminals ranked by efficiency scores (DWT & TEU)

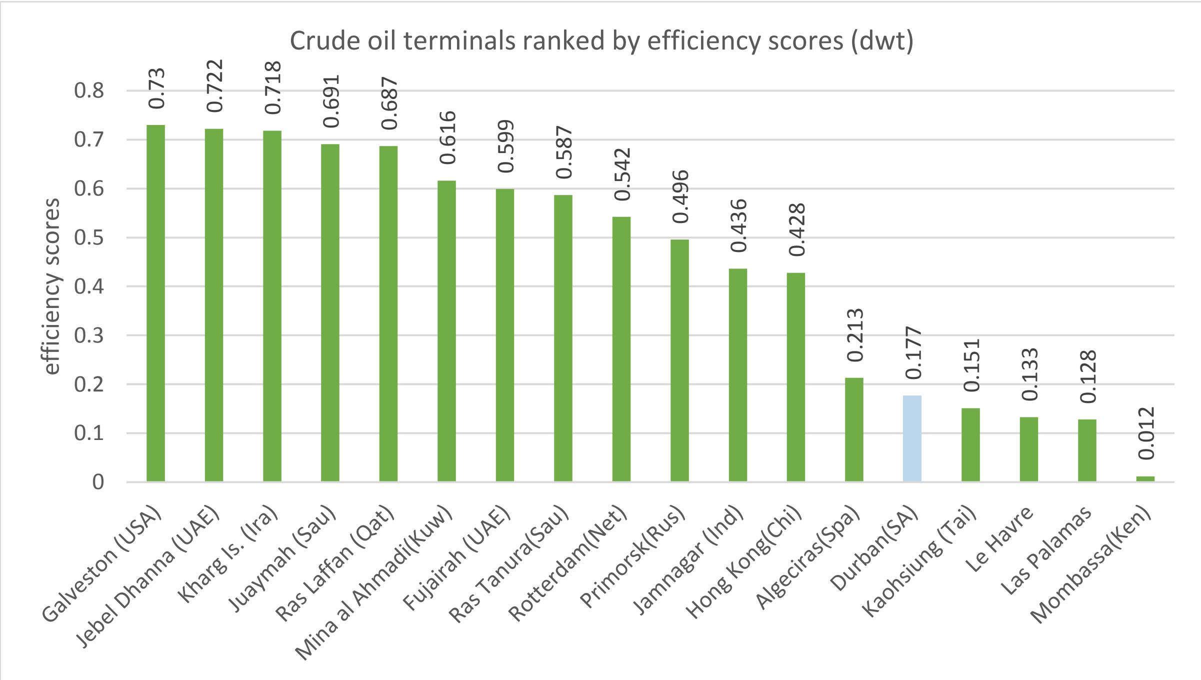


Reportedly, Cape Town's efficiency is higher than Bremerhaven, Antwerp and Le Havre where both factors are considered. Nonetheless, implied by ones position in graph is the extent to which more can be done to improve optimal performance and edge closer to the leaders and a score of one. This applies across all the terminals. Accordingly it should be noted that even the most efficient terminals have room to improve with the highest score achieved by the leading terminals less than one.

3.2. Liquid bulk terminals

Analysis of a sample of 71 major oil terminals (crude oil, petroleum and liquid gas) across the World by Merk and Dang (2012), showed that efficiencies in these terminals is *strongly and significantly* associated with oil traffic volumes, such that the bigger the terminals the more likely they are to be efficient, thus for oil terminals, size does matter. Accordingly efficient ports, excluding Galveston and Rotterdam, are mostly located in the Gulf Region. Notwithstanding, on average the most efficient terminal could still improve by about 30% from gains in production given their existing infrastructure i.e. even though they are efficient, they use up only 60% to 70% of their infrastructure or production capability.

Figure 16: Crude oil terminals ranked by efficiency scores (DWT)

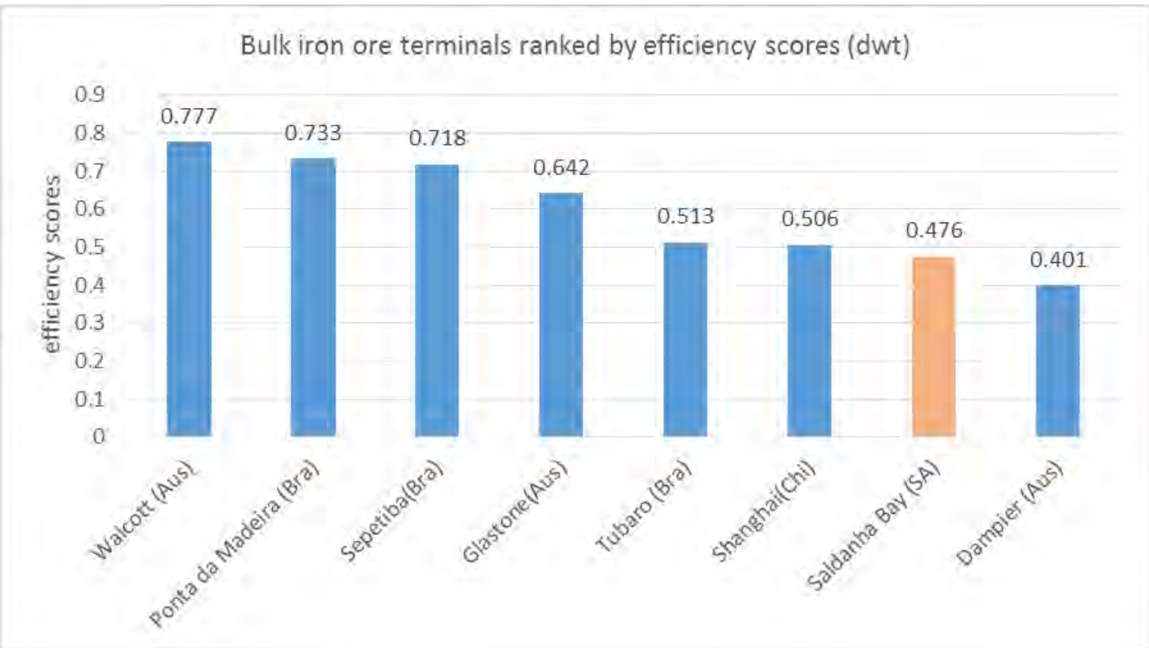


The Port of Durban, the only South African terminal that featured in the sample, registered very low on the efficiency scale and is ranked as a follower performing below benchmark ports (that include the Port Fujairah which is on the same vessel route as SA terminals). In accordance with the findings by Merk and Dang (2012), South African terminals would also suffer from production scale inefficiencies due to the volumes they handle relative to the other terminals.

3.3. Iron ore terminals

Iron ore terminals are large and are dominated by ports from the South where the leading ports, from a volume/deadweight ton perspective, are all ports in the southern hemisphere. Brazilian ports hold the first (port of Ponta da Madeira), second (port of Tubarao) and fifth (port of Sepetiba) place. The Australian ports of Walcott, Dampier and Gladstone take third, fourth and seventh place respectively, with the port of Saldanha in South Africa taking sixth place. In terms of efficiencies, the findings from the iron ore terminals is similar to crude oil in that the best performing terminals are about 30% shy of the optimal efficiency score of 1. The Port of Saldanha was found to be operating at under 50% which implies much room for improvement.

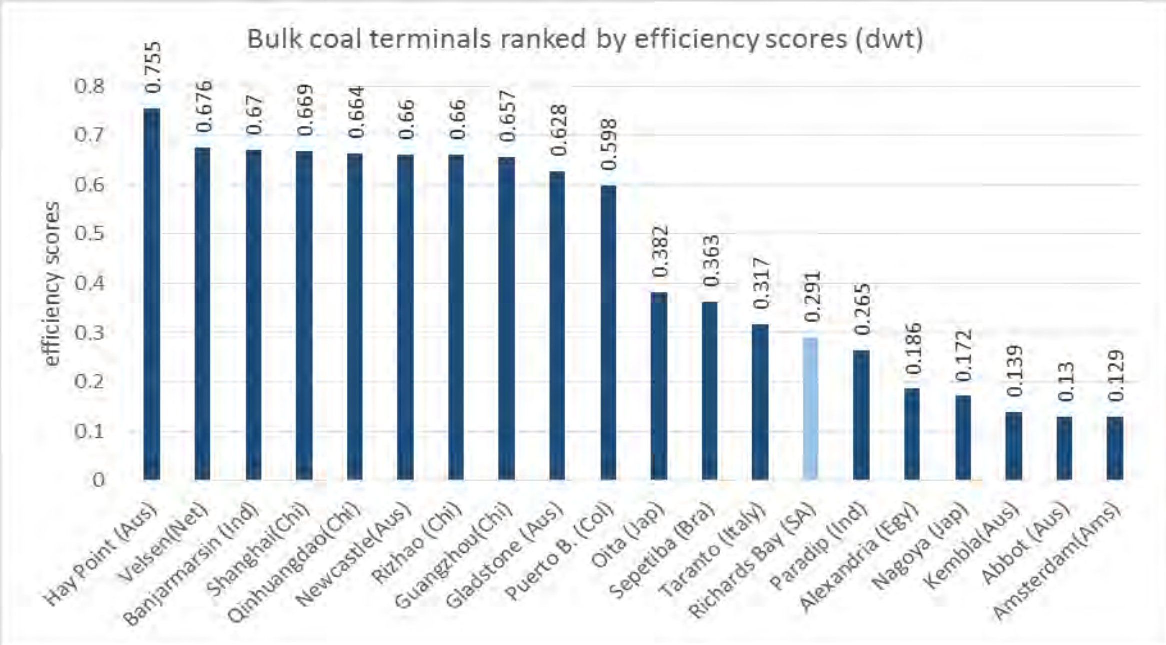
Figure 17: Bulk iron ore terminals ranked by efficiency scores



3.4. Coal terminals

Coal terminals, as with iron ore, are dominated by Australian ports which have 6 out of the top 34 ports by deadweight tons, followed by China and the United States with 4 ports each in the top 34. South Africa’s Richards Bay Coal terminal and Egypt’s port of Alexandria represent African ports. The most efficient terminals are in groupings that comprise ports in Australia and China operating between 65% and 75% efficiency. The Port of Richards Bay falls within the group of ports with very low levels of efficiency at around 29%.

Figure 18: Bulk coal terminals ranked by efficiency scores

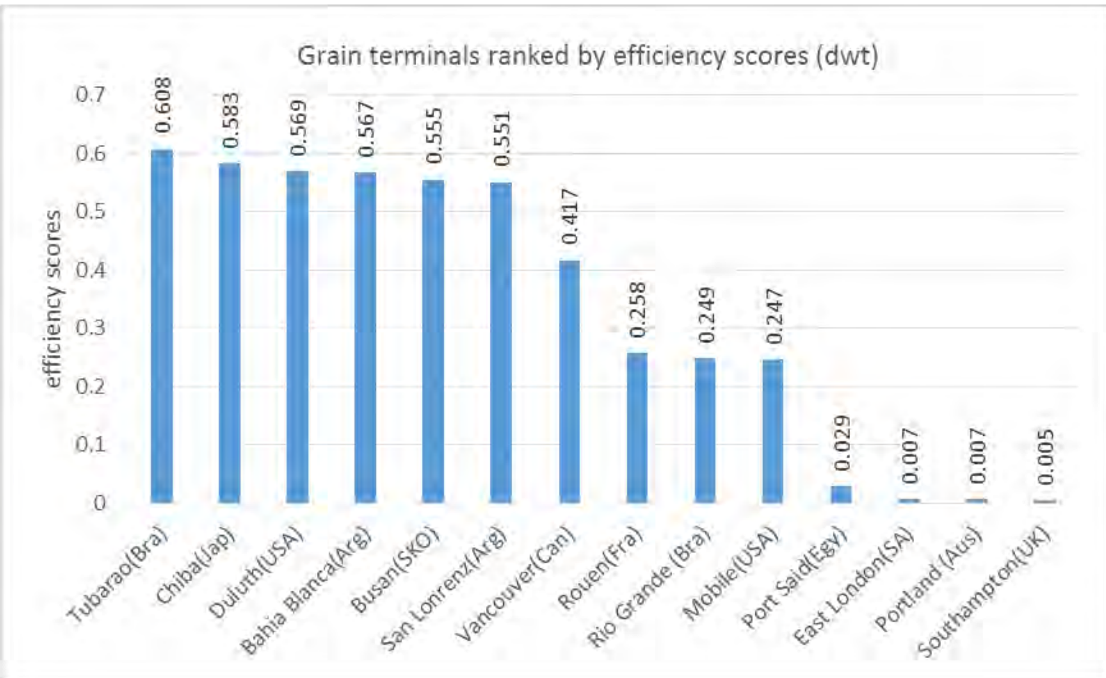


An important finding of the study was that significant efficiency gains in coal bulk sector can be achieved by improving technology and equipment. This may be true for Richards Bay in that the productive use of the facility and throughput is impacted by the capacity on the rail side, even though this may not be the only factor. The low number shows that more must be done to identify the causes of this inefficiency so that it can be systematically addressed.

3.5. Grain bulk terminals

The main grain bulk facility in the South African system which serves not only the domestic grain industry but critically the SADC (Southern Africa Development Community) is the grain elevator in the Port of East London which has been used as part of security of food supply initiatives in times of supply shortages, including in the SADC region. In recent times the state of the grain elevator has deteriorated with lack of clarity between infrastructure owner and operator resulting in much needed rehabilitation work not being undertaken. Not surprisingly, the efficiency levels of the grain elevator could not be plotted even though it made it into the sample due to the deadweight tonnes and volumes it handles. Overall, it was found that port size matters as *most efficient terminals are amongst the top ten largest grain ports/terminals* (Merk & Dang, 2012: 26). Port of East London ranked 34 out of 41 by volume.

Figure 19: Grain terminal ranked by efficiency



Together with Port Said in Egypt and the Australian port of Portland and Southampton in the UK, East London's efficiency level are undetected pointing to a need for a serious overhaul to make this facility work optimally.

4. Conclusion

This benchmarking report looked at the performance of SA terminals against what is achieved by terminals in other parts of the world that can be considered as benchmarks as summarised as snap-shot in Table 8 .

Table 8: Port Benchmarking Summary

Indicator	Sample	SA Ports above sample average	SA Ports at or close to the sample average	SA Ports below sample average
Container Throughput 2014 (TEU)	global			Durban, Cape Town, Ngqura, PE
TEU/terminal square metre	global		Durban	Cape Town, Ngqura, PE
TEU/metre quay	global		Durban, Ngqura	Cape Town, PE
TEU/crane/year	global	Durban, Cape Town		PE, Ngqura
Crane/berth length	global		Cape Town, PE & Durban	Ngqura
Utilization of container ports	compared to North Western European terminals 2012	Durban, Cape Town, Ngqura, PE		
Port Productivity - Container Moves per Ship Working Hour	global		Durban, Cape Town, Ngqura, PE	
Berth Productivity - Container Moves per Ship Working Hour	global			Durban, Cape Town, Ngqura, PE
Ship Turnaround time	global		Cape Town, PE	Durban
Gross Crane Moves Per Hour	global			Durban, Cape Town, Ngqura, PE
Cargo Dwell Times	Sub-Saharan Ports	Durban, Cape Town, Ngqura, PE		
Merk & Dang Efficiency score- container terminal	global			Cape Town
Merk & Dang Efficiency score- crude oil terminal	global			Durban
Merk & Dang Efficiency score - coal terminal	global			Richards Bay
Merk & Dang Efficiency score -iron ore terminal	global			Saldanha
Merk & Dang Efficiency score -grain terminal	global			East London

On operational efficiency measures, South African terminals have made significant strides in reducing cargo dwell time and to a lesser extent ship turnaround times. It is imperative that more be done to ensure that as larger vessels are cascading into South Africa's trading route, the ports and terminals are able to address the resultant challenges e.g. bottlenecks in the road and rail interface, even when performance on these improves. Targets set to measure port performance must gradually reflect both what the infrastructure is capable of as designed but they must be consistent and improved on, rather than reflect previous performance. Performance on GCH is a case in point. The Port of Cape Town's performance was not only consistent but generally on the rise which might be due to targets set at a level higher than previous performance. The overall comparative efficiencies of container, crude oil, bulk iron ore, bulk coal and grains have briefly been touched on through work done by the OECD. Such frameworks could go some way in developing performance monitoring and benchmarking system for SA terminals by either or both Authority and Regulator. Lastly, the comprehensive output from the Terminal Operator Performance Standards of the Authority are awaited as input into the benchmarking process and output. The value of the potential exposure to the practical side of what is developed in academic and other literature cannot be overstated in the process of benchmarking port performance for the benefit of South Africa.

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