

ANALYSIS OF THE RELATIONSHIP BETWEEN VESSEL CALLS AND PORT PIER CAPACITY IN THE PORT OF DURBAN IN SOUTH AFRICA

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- Introduction
- Background
- Objectives
- Current condition
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INTRODUCTION

- Durban is the premier trade gateway port to landlocked countries
- Occupies a focal point in transport and logistics chain
- Plays an important role as the main contributor to the economy of South Africa
- Contributes more than 60% of the combined revenue of the 8 ports

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INTRODUCTION

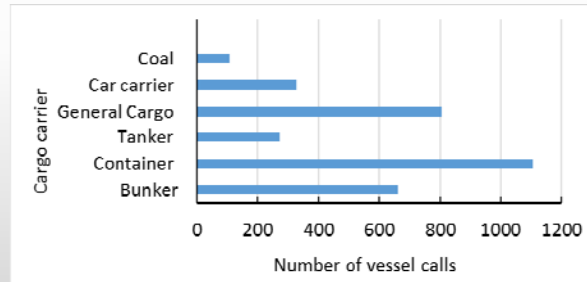
- Receives \pm 4000 vessels annually
- Handles 2.6 million TEU's and 3.3 million of break-bulk annually
- \pm 86 million tonnes of cargo is moving through the port
- Trading with America, Europe, Asia and Middle East and
- Considered as a good benchmark for sub-Saharan ports as the 4th largest container port in Southern Hemisphere

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BACKGROUND

- Mostly receives containers, bunkers, general cargo, vehicle, product tankers, LPG tankers and other types of cargo's annually

Type of vessel	Vessel calls
Bunker	661
Container	1106
Tanker	272
General Cargo	805
Car carrier	327
Coal	105



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BACKGROUND

- The port is close to reaching its capacity
- There are capacity constraints on containers and dry bulk as the volumes grow rapidly particularly for containers
- Consequences are congestion at anchorage and on terminals
- Improvements require additional capacity to ease congestion and improve on efficiency and port performance

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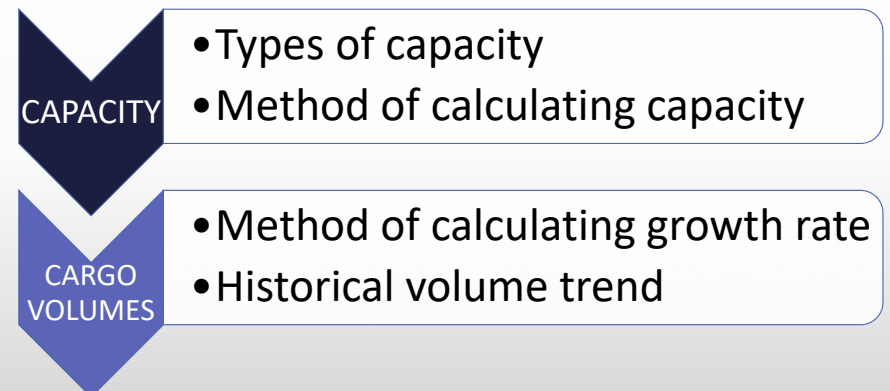
OBJECTIVES

The aim of the research is to find an approach for the port to meet capacity demand by analysing current port capacity and vessel calls and movements within port limits with an objective to

- Establish required capacity for all cargo types to meet future demand

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CURRENT CONDITION



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CURRENT CONDITION

VESSEL CALLS

- Historical trend
- Behavior

VESSEL PORT TIME

- Anchorage time
- Ship turnaround time
- Port time

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CURRENT CONDITION

CAPACITY

- The port is close to reaching its capacity with containers and dry bulk commodity found to have no latent capacity usable whereas for other commodities, a significant latent capacity was reached using the formula :

$$Lc = \frac{Ci}{Cd}$$

Lc = Latent capacity/ annum (usable)

Ci = Installed capacity/annum

Cd = Design capacity/annum

Cargo type	Design Capacity per	Installed Capacity per	Latent Capacity
Container (TEU'S)	3,020,000	3,020,000	0.0%
Dry Bulk (Tonns)	11,000,000	11,000,000	0.0%
Break Bulk (Tonns)	4,000,000	3,800,000	5.0%
Liquid Bulk (Kl)	21,000,000	11,000,000	47.6%
Ro-ro (Units)	520,000	480,000	7.7%

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CURRENT CONDITION

CARGO VOLUMES

- A 12 year period annual cargo volume growth was defined to demonstrate cargo volume trends using the Compound Annual Growth Rate (CAGR) using the formula:

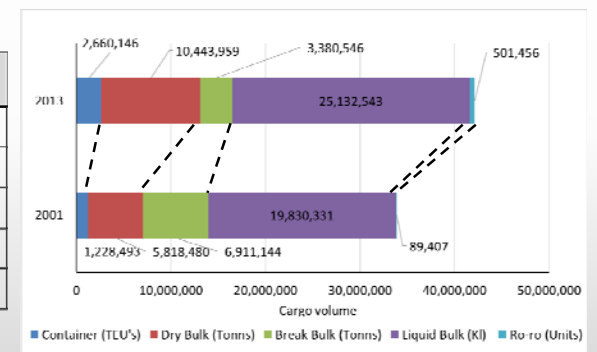
$$CAGR = \left(\frac{\text{Ending value}}{\text{Beginning Value}} \right)^{\frac{1}{\text{Number of years}}} - 1$$

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CURRENT CONDITION

CARGO VOLUMES

Cargo type	2001 Throughput	2013 Throughput	CAGR (2001-2013)
Container (TEU's)	1,228,493	2,660,146	6.65%
Dry Bulk (Tonns)	5,818,480	10,443,959	5.00%
Break Bulk (Tonns)	6,911,144	3,380,546	-5.79%
Liquid Bulk (Kl)	19,830,331	25,132,543	1.99%
Ro-ro (Units)	89,407	501,456	15.45%

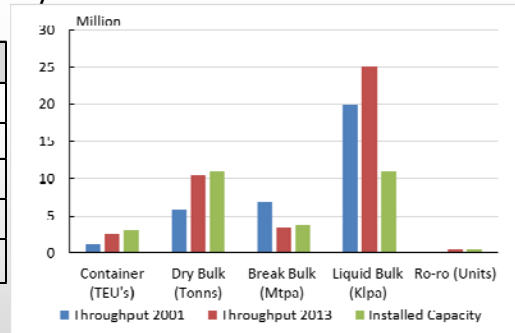


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CURRENT CONDITION

• Throughput and installed capacity

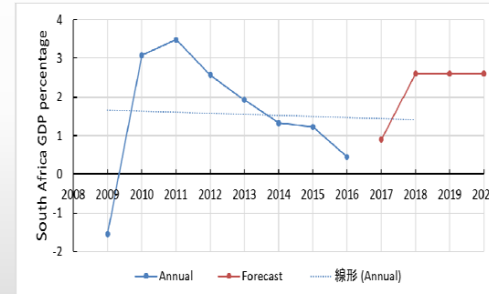
Cargo	Throughput 2001	Throughput 2013	Installed Capacity
Container (TEU's)	1,228,493	2,660,146	3,020,000
Dry Bulk (Tonns)	5,818,480	10,443,959	11,000,000
Break Bulk (Mtpa)	6,911,144	3,380,546	3,800,000
Liquid Bulk (Klpa)	19,830,331	25,132,543	11,000,000
Ro-ro (Units)	89,407	501,456	480,000



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CURRENT CONDITION

VESSEL CALLS



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CURRENT CONDITION

VESSEL CALLS

- Vessel calls historical trends and the economy
- Transformation of larger vessels
- The effect of transformed larger vessels to cargo volumes and port capacity
- Concerns in transformation

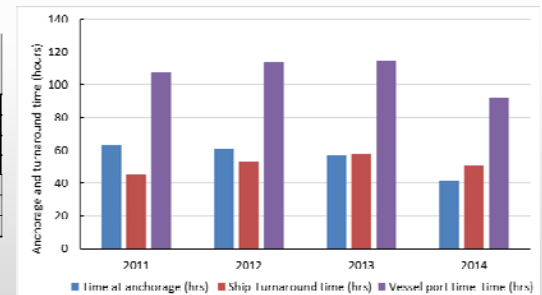
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CURRENT CONDITION

CONTAINER VESSEL PORT TIME

- Areas of improvement and concerns

Year	Time at anchorage (hrs)	Ship Turnaround time (hrs)	Vessel port time (hrs)	Vessel movements
2011	63	45	108	2907
2012	61	53	114	2308
2013	57	58	115	2329
2014	41	51	92	2416
Average	55.5	51.8	107.3	
Average in days	2	2	4	
Increase/decrease	22	6	16	491



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DATA

- Vessel movements: Arrivals and shifts
- Forecasted cargo volumes
- Forecasted capacity demand

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DATA

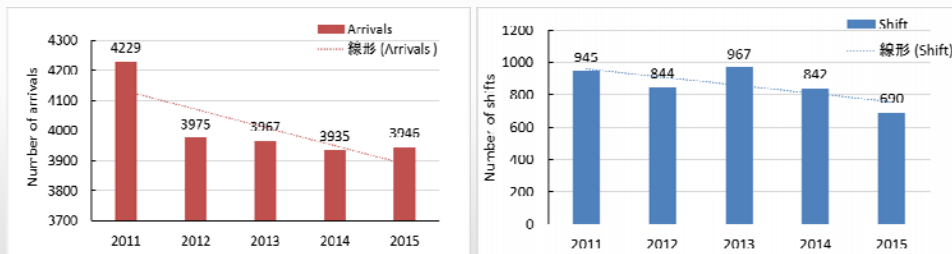
- Vessel movement data : Descriptive

	2011	2012	2013	2014	2015				
Mean	789	Mean	735	Mean	745	Mean	728	Mean	718
Standard Err	13	Standard Error	14	Standard Error	13	Standard Error	12	Standard Error	28
Median	793	Median	754	Median	754	Median	740	Median	706
Mode	#N/A	Mode	#N/A	Mode	732	Mode	#N/A	Mode	740
Standard Deviation	44	Standard Deviation	47	Standard Deviation	46	Standard Deviation	41	Standard Deviation	95
Sample Variance	1978	Sample Variance	2230	Sample Variance	2145	Sample Variance	1661	Sample Variance	9091
Kurtosis	1	Kurtosis	0	Kurtosis	0	Kurtosis	-1	Kurtosis	8
Skewness	-1	Skewness	-1	Skewness	-1	Skewness	0	Skewness	3
Range	168	Range	158	Range	149	Range	139	Range	354
Minimum	693	Minimum	640	Minimum	653	Minimum	656	Minimum	644
Maximum	861	Maximum	798	Maximum	802	Maximum	795	Maximum	998
Sum	9463	Sum	8819	Sum	8945	Sum	8741	Sum	8610
Count	12	Count	12	Count	12	Count	12	Count	12

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DATA ANALYSIS

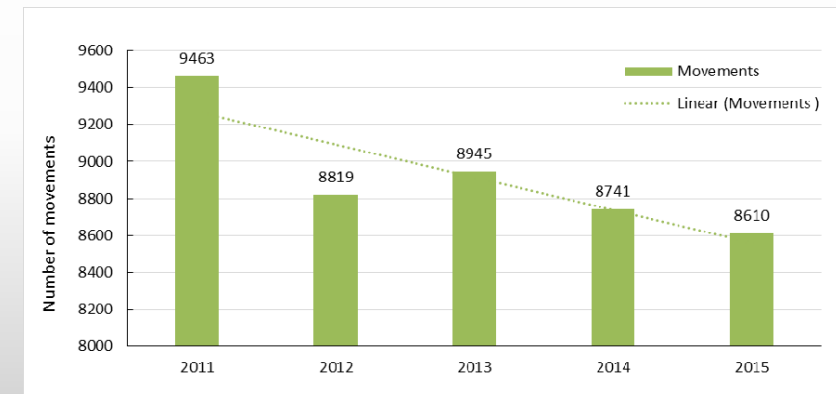
Vessel arrivals and shifts trend



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DATA ANALYSIS

Vessel movements trend

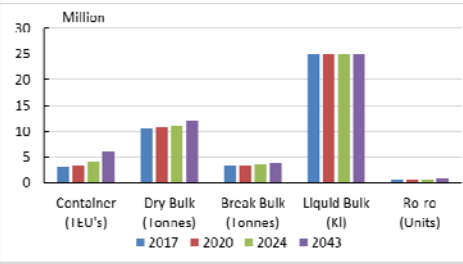


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DATA ANALYSIS

- Forecasted cargo volumes growth trend
- Liquid bulk growth is dependent on upcoming external projects

Cargo type	Estimated volume growth Rate	Year			
		2017	2020	2024	2043
Container (TEU's)	4.20%	3,107,050	3,498,538	4,088,293	6,123,856
Dry Bulk (Tonnes)	0.50%	10,652,838	10,814,680	11,030,953	12,082,772
Break Bulk (Tonnes)	0.40%	3,434,834	3,475,850	3,531,483	3,799,734
Liquid Bulk (Kl)	N/A	25,132,543	25,132,543	25,132,543	25,132,543
Ro-ro (Units)	2.80%	557,819	604,459	672,158	938,720

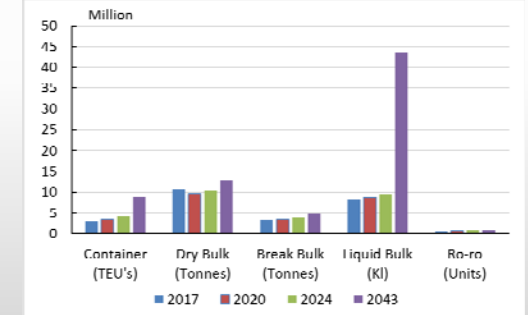


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DATA ANALYSIS

- Forecaster capacity demand
- Forecast for liquid bulk excludes potential capital projects scenarios

Cargo type	Year			
	2017	2020	2024	2043
Container (TEU's)	2,981,321	3,434,675	4,091,637	8,803,080
Dry Bulk (Tonnes)	10,780,618	9,620,644	10,332,873	12,826,294
Break Bulk (Tonnes)	3,178,208	3,422,882	3,780,742	4,916,608
Liquid Bulk (Kl)	8,105,675	8,719,295	9,432,147	43,531,729
Ro-ro (Units)	537,977	578,279	639,975	718,611



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DATA ANALYSIS

- Additional capacity is required for all commodities
- Capacity required is presented in number of terminals per commodity
- Capacity calculations are based on forecasted volumes for the next 27 years in line with forecasted demand ending 2043
- Terminal capacity required per cargo type was calculated using a formula, Capacity (No of terminals) = Future cargo volumes per year / current installed capacity per year : $Nc = \frac{V_f}{C_i}$

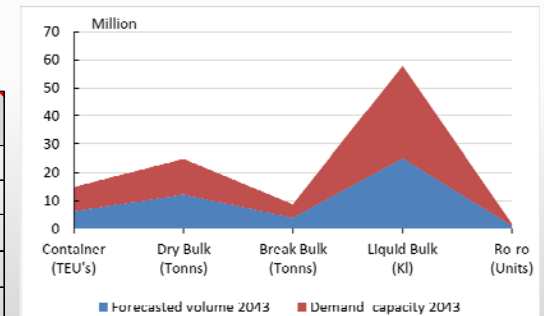
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RESULTS

- Required number of terminals

$$Nc = \frac{6\,123\,656\text{ teu's per annum}}{3\,020\,000\text{ teu's per annum}}$$

Cargo type	Forecasted volume 2043	Demand capacity 2043	Installed Capacity	No. of terminals
Container (TEU's)	6,123,656	8,803,080	3,020,000	2
Dry Bulk (Tonnes)	12,082,772	12,826,294	11,000,000	1
Break Bulk (Tonnes)	3,799,734	4,916,608	4,000,000	1
Liquid Bulk (Kl)	25,132,543	32,719,258	21,000,000	2
Ro-ro (Units)	938,720	718,611	520,000	2

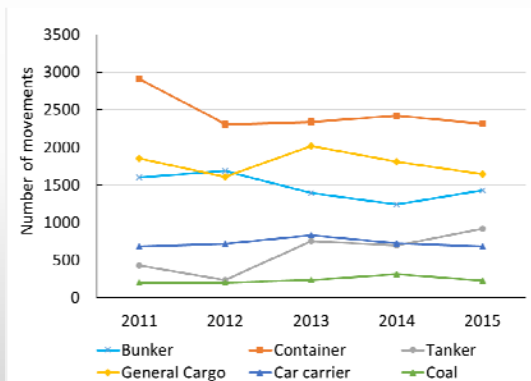


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RESULTS

• Vessel movements

Reason	Year				
	2011	2012	2013	2014	2015
Bunker	1601	1688	1392	1240	1428
Container	2907	2308	2335	2416	2320
Tanker	429	229	752	691	916
General Cargo	1858	1608	2020	1813	1648
Car carrier	681	718	833	720	681
Coal	196	194	236	314	228



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CONCLUSION

- The measured terminals required will be adequate for the future demand capacity based on predicted cargo volumes and future demand capacity. Demand capacity can be met and port time can be reduced
- The capacity expansion will promote efficiency and enhance port performance. Liquid bulk volumes are depended on potential major projects although volumes are expected to grow whether the proposed projects materialize
- The next generation of vessels being larger in size are concluded to have a significant effect on decreasing number of vessels destined for the port, particularly for containers and break bulk cargo due to the transformation

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CONCLUSION

- With the knowledge that vessels calling for the port are driven by the port capacity and its developments, trade primarily relies on the economy of the country in line with market demand and on well progression of the ports main attributes
- As containerization of breakbulk cargo is expected to grow, we can conclude that volumes can decrease over time and would be encountered in container volumes. With the rapid growth experienced in containers, this transformation will create excessive volume growth
- Adding or expanding capacity insures good hinterland connections and efficient terminal operation easing the port congestion while improving on efficiency and port performance

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THANK YOU

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