Revisiting Terminal Capacity: The Impact Berth Expansion/Loss

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Presentation Agenda

• Revisiting the Concept of Terminal Capacity
• Berth Operation Simulation
• Quantifying Impact of Berth Expansion / Loss for Concession Agreements
• San Antonio Added Capacity
• St. Vicente Loss of Capacity
Capacity Calculation Methodologies

• Berth Indicators
  – Actual Data (typical)
  – $f$ (Ship Size, Number of Berths)
  – TOC 2009

• UNCTAD’s Queuing
  – Berth Productivity $\times$ Workable Time $\times$ Utilization
  – What is a berth?

• Operation Simulation
  – Utilization = $f$ (Allowed Ship Waiting)
Capacity in Concession Agreements

• San Antonio need for **Additional** Capacity
  – Adding to Berth Length
  – Arrival Pattern
  – Moves / Ship-Call and Productivity

• St. Vicente **Loss** of Capacity
  – Reducing Berth Length
  – Ship Population (LOA)
  – Comparison of Methodologies
San Antonio Ships’ Inter-Arrival Time

![Graph showing the frequency of inter-arrival times for San Antonio ships. The graph indicates a long tail with a significant number of occurrences at lower inter-arrival times.](image-url)
San Antonio Berth Productivity

Y-axis: Moves / Ship-Hour

X-axis: Moves / Ship-Call

The graph illustrates the productivity of San Antonio Berth with data points representing the number of moves per ship-hour against the number of moves per ship-call. The trend line shows an upward trajectory, indicating increased productivity over time. The ratio of 1:11 suggests a significant improvement in efficiency.
## San Antonio Capacity

<table>
<thead>
<tr>
<th>Description</th>
<th>Actual 2008</th>
<th>Capacity 2008</th>
<th>Capacity Future</th>
<th>Capacity Future Windows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berth Occupancy</td>
<td>28.3%</td>
<td>48.5%</td>
<td><strong>44.2%</strong></td>
<td><strong>49.3%</strong></td>
</tr>
<tr>
<td>Moves / Ship-Call</td>
<td>984</td>
<td>904</td>
<td>922</td>
<td>1,788</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,764</td>
</tr>
<tr>
<td>Moves / Berth-Hour</td>
<td>65.3</td>
<td><strong>79.5</strong></td>
<td>121.7</td>
<td>120.2</td>
</tr>
<tr>
<td>Average Wait</td>
<td>0.1</td>
<td>0.3</td>
<td>0.4</td>
<td>0.3</td>
</tr>
<tr>
<td>% Ships Waiting</td>
<td>3.5%</td>
<td>13.7%</td>
<td>11.8%</td>
<td>13.2%</td>
</tr>
<tr>
<td>% Ships Waiting &gt; 4 hrs</td>
<td>2.4%</td>
<td>9.0%</td>
<td>8.3%</td>
<td>8.8%</td>
</tr>
<tr>
<td>Throughput</td>
<td>550,802</td>
<td>553,948</td>
<td>1,106,371</td>
<td>1,637,291</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1,805,772</td>
</tr>
<tr>
<td>Ratio</td>
<td><strong>1.00</strong></td>
<td><strong>1.01</strong></td>
<td><strong>2.01</strong></td>
<td><strong>2.97</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>3.28</strong></td>
</tr>
</tbody>
</table>
Maersk seeks to improve terminal efficiency

Maersk Line said that by collaborating closely with terminals... The pilot project was implemented with terminals on the AE7 string between Asia and Europe (E-Class).

In many ports, the project has so far reduced total port time required by up to 15%, but is to reach 30%.

“By getting vessels out of the port earlier, we’ll be able to reduce bunker consumption,” Knudsen said. "We can also create opportunities to add extra port calls to — or even take a vessel out of — a rotation.”
St. Vicente Berth Situations

Berth 1
Berth 2
Berth 3

Container Yard

600 m 640 m
163 m
492 m
25 m

Buoy
St. Vicente Assumptions

- Damage only to Berthage (not Yard)
- Berth Productivity Unchanged
- Berthage Dictates Capacity
- Only Containers, Preferable Cargo
- Capacity = Potential (Maximum) Throughput
- Level of Service Dictated by Market Conditions
- Compare Pre to Post Earthquake Capacities
- Difference (%) = 1 – Post / Pre
## Berth-Length Comparison

<table>
<thead>
<tr>
<th>Description</th>
<th>Dock Structure</th>
<th>Dock Structure + Extension Buoys</th>
<th>Dock Structure + Extension Buoys - Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>600</td>
<td>640</td>
<td>615</td>
</tr>
<tr>
<td>Post</td>
<td>437</td>
<td>477</td>
<td>452</td>
</tr>
<tr>
<td>Post / Pre</td>
<td>72.8%</td>
<td>74.5%</td>
<td>73.5%</td>
</tr>
<tr>
<td>1 - Post / Pre</td>
<td>27.2%</td>
<td>25.5%</td>
<td>26.5%</td>
</tr>
</tbody>
</table>
3 x (0.68 – 0.58) = 0.3

3 x 0.68 – 2 x 0.58 = 0.87 (57.2%)

3 – 2 = 1.0 (33.3%)
<table>
<thead>
<tr>
<th>Description</th>
<th>Num. of Berths</th>
<th>M / E2 / n</th>
<th>E2 / E2 / n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowed Utilization</td>
<td>2</td>
<td>0.45</td>
<td>0.58</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>0.58</td>
<td>0.68</td>
</tr>
<tr>
<td>Num. of Berth Pre</td>
<td>3</td>
<td>1.74</td>
<td>2.04</td>
</tr>
<tr>
<td>Num. of Berth Post</td>
<td>2</td>
<td>0.90</td>
<td>1.17</td>
</tr>
<tr>
<td>Post / Pre</td>
<td></td>
<td>51.8%</td>
<td>57.2%</td>
</tr>
<tr>
<td>1 – Post / Pre</td>
<td></td>
<td>48.2%</td>
<td>42.8%</td>
</tr>
</tbody>
</table>

E = Earlang Distribution  
M = Markovian Distribution  
n = Number of Berths
St. Vicente Fleet Distribution

- Minimum: 170m LOA, 1,800 TEUs
- Average: 228m LOA, 3,000 TEUs
- Maximum: 300 m LOA, 6,500 TEUs
Berth Assignment Pre and Post

- 4 instead of 3 Days
- Waits 30 Hours
Assignment Rules

If \( t_2a > t_1f \)
Then \( t_2s = t_2a \)

If \( t_2a < t_1f \)
And \( L_2 < 452 - L_1 \)
Then \( t_2s = t_2a \)

If \( t_2a < t_1f \)
And \( L_2 > 452 - L_1 \)
Then \( t_2s = t_1f \)
# Capacity Reduction by Methodology

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Reduction in Berth Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berth Length</td>
<td>26.5%</td>
</tr>
<tr>
<td>UNCTAD E2 / E2 / n</td>
<td>42.8%</td>
</tr>
<tr>
<td>UNCTAD M / E2 / n</td>
<td>48.2%</td>
</tr>
<tr>
<td>Simulation with Present Fleet</td>
<td>55.3%</td>
</tr>
<tr>
<td>Simulation with Future Fleet</td>
<td>64.5%</td>
</tr>
</tbody>
</table>