Port Capacity Analysis in Long Beach

Matt Plezia, POLB and Vaibhav Govil, AECOM
TRB Irvine, CA June 29, 2010
About the Port of Long Beach

- Second busiest container port in N. America
- 7 container terminals covering 1,350 acres
- 2009 throughput of 5 million TEU
- 2007 peak throughput of 7.4 million TEU
Why does POLB Care about Terminal Capacity?

– Build efficient terminals
– Plan for projected cargo growth and inform terminal development decisions
– Build efficient support infrastructure: road+rail
– Understand environmental impacts and need for mitigation
Recent History of Capacity Analysis at POLB

- Early 2000s and before: projects analyzed on a case by case basis with little comparison or detailed explanation of assumptions
- Pier J South EIR scuttled in fall of 2004
- Environmental QA/QC process involving third-party review of methodologies
- Develop a general methodology for terminal capacity estimation which provides:
  - Consistent analysis for all Port terminals and proposed projects
  - Reasonable but conservative estimate of overall terminal capacity
  - Terminal specific throughput estimates over time
  - Terminal specific vessel activity
Related Studies

  - Expected cargo volumes
  - Expected mode splits (i.e., local vs. intermodal)

- **Mercator Vessel Forecast (2006)**
  - Number of weekly services calling at SPB
  - Expected range of vessel sizes
  - Number of box-moves for each vessel category
  - Air emissions factors for each vessel category
Overall POLB Capacity Analysis Procedure

- Identify future terminal layout
- Calculate container yard (CY) capacity with spreadsheets
- Develop an example vessel schedule based on Mercator distribution with volume similar to CY capacity
- Analyze vessel schedule with Bertha statistical model
  - If less than 5% queuing, terminal will be limited by CY capacity
  - If more than 5% queuing, remove one vessel and re-analyze, repeat until vessel queuing is under 5% threshold – terminal will be berth constrained
- Report overall capacity as lesser of CY or berth capacity
Long Term Trends in POLB Operations

- Larger ships with more cranes assigned
- Longer working hours when terminals are busy (21 vs. 16 hr)
- Shorter container dwell times
- Fewer containers stored on wheels (prior to recent downturn)
- Use of taller equipment to enable higher mean stack heights
Container Yard Capacity: Spreadsheet Analysis

- Area available for CY operations
- Cargo handling equipment (e.g., RTG vs. RMG)
- Mix of container types and dwell times
- Base operating assumptions reflect modest change from current operations.
  - Continue RTG operations at most terminals
  - Reduced wheeled storage
  - Higher density from higher stacking (e.g., 1/5 RTG)
  - Modest decrease in expected dwell times (vs. 2005)
- Resulting density reaches 10,000+ TEU per gross terminal acre per year at capacity.
Berth Capacity Assumptions

- Terminal specific vessel allocations
- Vessel discharge rates (moves per vessel call)
- Increase crane productivity, up to 33 moves per hour
- Use up to 7 cranes on largest vessels
- Vessel activity more evenly distributed through the week
- Capacity determined by expected delay/vessel queuing (simulation of vessel arrivals and dwell times)
Why can’t berths run at 100% Occupancy

– Tradeoff with service – vessels get off schedule primarily due to weather

– Big ships that call POLB are very expensive to delay

– Berths must run relatively light to ensure no delay

– 5% max queuing during peak season set as POLB target

– Different at Transshipment hubs like Singapore where small barges will queue for any open space
Historical Arrival Reliability at San Pedro Terminals

- Probability
- Cumulative Probability

Hours Late:
- 0
- 8
- 24
- 48

Probability:
- 0%
- 20%
- 40%
- 50%
- 60%
- 80%
- 100%
- 120%

Cumulative Probability:
- 0%
- 20%
- 40%
- 60%
- 80%
- 100%
- 120%
BERTHA - Statistical Model of Berth Utilization

- **INPUT:**
  - Vessel call schedule
  - Vessel arrival variability
  - Vessel length
  - Dock crane assignment

- **OUTPUT**
  - Probabilistic data on Wharf and dock crane demand over time
  - Likelihood that a certain value will be exceeded
Vessel Inputs / Mercator Results
Schedules for specific terminals were selected from port-wide Mercator distribution

<table>
<thead>
<tr>
<th>Vessel Category</th>
<th>Mercator Weekly SPB Services</th>
<th>Total Lifts per Call</th>
<th>Terminal Projected Weekly Services</th>
<th>Annual Throughput at Capacity (TEU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000-1999</td>
<td>1</td>
<td>600</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2000-2999</td>
<td>9</td>
<td>1,450</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3000-3999</td>
<td>10</td>
<td>2,200</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4000-4999</td>
<td>23</td>
<td>1,800</td>
<td>2</td>
<td>346,320</td>
</tr>
<tr>
<td>5000-5999</td>
<td>16</td>
<td>4,000</td>
<td>1</td>
<td>384,800</td>
</tr>
<tr>
<td>6000-6999</td>
<td>15</td>
<td>5,300</td>
<td>1</td>
<td>509,860</td>
</tr>
<tr>
<td>7000-7999</td>
<td>12</td>
<td>6,200</td>
<td>1</td>
<td>596,440</td>
</tr>
<tr>
<td>8000-9999</td>
<td>11</td>
<td>6,820</td>
<td>1</td>
<td>656,084</td>
</tr>
<tr>
<td>10000-11999</td>
<td>11</td>
<td>8,550</td>
<td>1</td>
<td>822,510</td>
</tr>
<tr>
<td>Total</td>
<td>108</td>
<td>7</td>
<td>3,316,014</td>
<td></td>
</tr>
</tbody>
</table>
Mercator Estimate of Vessel Calls at POLB

<table>
<thead>
<tr>
<th>Mean Vessel Size (TEU)</th>
<th>No. of Vessels / Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,500</td>
<td>1</td>
</tr>
<tr>
<td>2,500</td>
<td>9</td>
</tr>
<tr>
<td>3,500</td>
<td>10</td>
</tr>
<tr>
<td>4,500</td>
<td>23</td>
</tr>
<tr>
<td>5,500</td>
<td>16</td>
</tr>
<tr>
<td>6,500</td>
<td>15</td>
</tr>
<tr>
<td>7,500</td>
<td>12</td>
</tr>
<tr>
<td>9,000</td>
<td>11</td>
</tr>
<tr>
<td>11,000</td>
<td>11</td>
</tr>
</tbody>
</table>
Total Length vs. Mean Vessel Size
A vessel with length overall (LOA) of 1000’ and Beam of 100’ will occupy 1100’ of berth.
Example Terminal Weekly Schedule - Ten Vessels

Vessel LOA + Gap

Call Duration  Possible Delay
Berth Length vs. % of Time w Vessels Queued w Ten Vessels

Vessels will be queued 4% of the time w ten vessels
Conclusions

- Robust, easily explainable capacity analyses are a big advantage in EIRs and in other planning efforts
- Analysis is an iterative process
- Revisions need to keep up with new technology and new projects
  - Revised vessel forecasts
  - Revised dwell time data
  - On-terminal rail
  - Automated RMG systems
  - Dedicated zero-emission transport systems between POLB and nearby railyards
Contact Information

– Matt Plezia
  The Port of Long Beach
  925 Harbor Plaza
  Long Beach CA, 90802
  Phone: 562-590-4158
  Email: Plezia@polb.com
  Web: www.polb.com

– Vaibhav Govil
  AECOM
  2101 Webster St.
  Oakland CA, 94612
  Phone: 510-844-0561
  Email: vaibhav.govil@aecom.com
  Web: www.aecom.com