Process for Port Master Planning

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Moffatt & Nichol

- Founded in 1945 in southern California to serve the evolving Naval, Port and Maritime Industries
- 550+ employees; 27 offices (North America, Europe, Latin America, Middle East, Pacific Rim)
- A recognized leader in marine terminal planning, analysis, design, and goods movement economics
- Marine terminal specialists made up of Planners, Engineers, and Economists
Process for Port Master Planning

• Understanding the Influences:
  – Demand
  – Land
  – Environmental
  – Access
  – Operations
Process for Port Master Planning

• Process will include:
  – Economic, market, & financial analysis
  – Port use definition
  – Project financing options
  – Environmental studies
    • Site evaluation
  – Facility planning
Economic, Market, & Financial Analysis

- Market forecast
- Market share analysis
- Pricing analysis
- Competition analysis
  - Least Cost Market Area (LCMA)
Market Forecast

- Container, RoRo, and bulk cargo forecasts
  - Long term global economic trends
  - Structural economic changes
  - Supply chain analysis

![Graph showing TEU Volumes and Real GDP over time from 2000 to 2030E.](image)
Example of Containerized Cargo Forecast

Mexico is the largest economy in Central America and second largest in Latin America, trailing only Brazil

- Mexico gateway (import and export) volume is driven by demand from growing manufacturing and consumer sectors
- Transhipment volumes are driven by ports on the Pacific Coast of Central America who continue to rely on hub-and-spoke transshipment services.
- The recent energy reform being enacted could provide significant stimulus to the economy and trade
Example of Containerized Cargo Forecast

- Historical & Projected GDP & TEU Growth
Market Share Analysis

Share of Mexico’s container volume by state

[Map showing container volume share by state, with different shades indicating volume ranges.]
Pricing Analysis

Cost Segments of Import Logistics Route

<table>
<thead>
<tr>
<th>Transport Costs (USD)</th>
<th>Ocean Voyage</th>
<th>THC 1</th>
<th>Demurrage</th>
<th>Local Drayage</th>
<th>One Way Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1,500</td>
<td>250</td>
<td>200</td>
<td>450</td>
<td>2,400</td>
</tr>
</tbody>
</table>

- **International Segment**
  - Ocean Voyage costs
  - Terminal Handling Charge
  - Storage Costs

- **Domestic Segment**
  - Local drayage or long-haul trucking to DC or factory
  - Factory, crossdock or DC – value-added services performed

Illustrative cost structure for truck moves

1,500 250 200 450 2,400
Competition Analysis

Cost differential for LZC over MZO
Project Financing

• Public source
• Private source
• Combination of public & private sources
Project Financing

• Success of a port is influenced by port authority, private port operators, and shipping lines:
  – Public Port Authorities
    • Investment in ports and transportation infrastructure (road & rail systems)
    • Transparent institutional duties and responsibilities
    • Non restrictive and stable import and export rules
Reliable Transportation Infrastructure Example

Alameda Corridor
Project Financing

– Private Port Operators
  • Availability of capital to develop or improve a project
  • Improve capacity by optimizing all terminal systems

– Shipping Lines
  • Continue to demand for improvement in vessel productivity
  • Demand in predictability of vessel productivity
Port Development Roles

- Port Type
  - Common use port (owner/operator)
  - Landlord port

Diagram:

- Owner/Operator
  - Responsible for ALL Development
  - Lease the Terminal for 20-30 Years

- Port Authority & Landlord
  - Responsible for:
    - Planning
    - Design
    - Construction
    - Infrastructure
    - Buildings

- Operator
  - Responsible for:
    - Planning
    - Design
    - Construction
    - Infrastructure
    - Buildings

- Shipping Lines
  - Responsible for:
    - Equipment
    - IT systems
    - O & M
Environmental Studies

• Key Site Evaluations include:
  – Geotechnical Investigation
  – Coastal & Navigational Studies
  – Environmental Permitting
  – Environmental Risk Analysis
  – Constructability Analysis
  – Construction material availability analysis
Environmental Studies

• Geotechnical Investigation
  – Establish site design condition
  – Initial studies to evaluate site geology and seismicity
  – Subsurface investigations to determine
    • Depths of varying soil conditions (loose soil, rock, sand, clay) with respect to soil stability and load bearing capacity.
  – Landfill recommendations
Environmental Studies

- Coastal & Navigational Studies
  - Wave climate modeling
  - Develop alternative harbor layouts
  - Investigate alongshore sediment transport
  - Hydrology, hydraulics, and sedimentation studies
  - Navigational channel, berth dredging, and land reclamation plan
  - Develop breakwater conceptual design
Wave Climate Modeling Example

- POLA Pier 400
Environmental Studies

• Identify permit requirements, approval process, and schedule

• Risk Assessment
  – Hazardous materials and cleanup requirements
  – Environmental impact to local area
    • Especially from operational pollution.
  – Any requirements for project mitigations particularly from the creation of landfill
  – Wildlife Habitat Mitigation
  – Water Quality
  – Storm Water Management
Environmental Studies

- Site Access
  - Vessel, Road, Rail
Environmental Studies

• Utility Availability/Reliability
  – Electrical Power
  – Water
  – Sanitary Sewer System
  – Other Utilities
Facility Planning

• Purpose to Balance
  – Berth
  – Container Yard
  – Gate
  – Rail Yard

• To Provide
  – Adequate capacity
  – Required productivity
  – Predictable cost / opex
  – Weekly reliability
Terminal Business Case is to Receive/Deliver Cargo from/to Vessel, Train, & Truck; and Manage Cargo in the Storage Yard.

**Vessel**
- Up to 14,000 ctr per call
- Regular schedule with some variation
- Demand for short port stay time

**Train**
- "Call size" 600 or less
- Tight and regular schedule

**Truck**
- "Call size" normally 1 to 2 ctr
- Almost random appearance
- Demand for short turn time

**Container terminal**
- to handle
- to store
- to sort and consolidate
Use of Simulation in Developing proven Master Plan

- Simulation FlexTerm **FXT** to develop proven master plan
Conclusion

• The Port Master Planning Process
  – The application of
    • Economic analysis
    • Environmental studies
    • Planning tools
  – To understand the port project influences
    • That are aligned with your development responsibility
Muchas Gracias
Port Master Planning

• Panama Canal expansion may be a Game Changer for some ports
  – The PC expansion will result in larger vessels transiting the canal
  – New Panamax vessel capacity = 250% of Panamax vessel capacity
  – Initially, there will be fewer vessels
  – Cargo will concentrate in a fewer ports and will cause pressure on logistic chain
Port Master Planning

13 Containers
32m

19 Containers
49m

9 + 5 = 14 HC
 Containers
39m

11 + 8 = 19 HC
 Containers
57m

135 containers per bay
/ Quay Crane
9 hours Disch + Load

320 containers per bay
/ Quay Crane
20 hours Disch + Load
Port Master Planning

Global Fleet Composition by Capacity

- Panamax
- New Panamax
- New Post-Panamax (Suez / Trans-Pacific)

Fleet Order Book

- "Panamax"
- "Post-Panamax"

Capacity Bands:
- < 2K
- 2K - 4K
- 4K - 5.1K
- 5.1K - 7.5K
- 7.5K - 10K
- 10K - 13.3K
- > 13.3K

Fleet Composition:

- < 2K: 0%
- 2K - 4K: 5%
- 4K - 5.1K: 10%
- 5.1K - 7.5K: 15%
- 7.5K - 10K: 20%
- 10K - 13.3K: 25%
- > 13.3K: 30%
Port Master Planning

Limitation to vessel sizes

- **New Panamax**
  - Panama Canal length: 366m
  - beam: 49m
  - draft: 15.2m
  - capacity: 13,000 TEU
  - tonnage: 120,000 DWT

- **Suezmax**
  - Suez Canal length: n/a
  - beam: 77.5m
  - draft: 20m
  - capacity: >18,000 TEU
  - tonnage: 200,000 DWT

- **Malaccamax**
  - Malacca Strait length: 400m
  - beam: 60m
  - draft: 21m
  - capacity: >18,000 TEU
  - tonnage: 240,000 DWT

- **Chinamax**
  - Port Terminals length: 360m
  - beam: 65m
  - draft: 24m
  - capacity: n/a
  - tonnage: 400,000 DWT

Sources: Carnel, Lloyd’s Register, Maritime Connector, Ranger

* also referred to as Valemax
Port Master Planning

Limitation to vessel sizes

Arcticmax

Kara Strait
length: n/a
beam: ~30m†
draft: ~18m
capacity: ~4,500 TEU
tonnage: ~100,000 DWT
†maximum when ice-breaker escort required

Laptev Strait
length: n/a
beam: ~30m†
draft: ~10m
capacity: ~2,500 TEU
tonnage: ~50,000 DWT
Vessel / Service Forecast

<table>
<thead>
<tr>
<th></th>
<th>Panamax</th>
<th>Post-Panamax</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capacity:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Containers (TEUs)</td>
<td>4,500</td>
<td>12,000</td>
</tr>
<tr>
<td><strong>Dimensions:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beam</td>
<td>32m (106')</td>
<td>49m (160')</td>
</tr>
<tr>
<td>Length</td>
<td>294m (965')</td>
<td>366m (1,200')</td>
</tr>
<tr>
<td>Draft</td>
<td>12m (39.5')</td>
<td>15m (50')</td>
</tr>
</tbody>
</table>

Source: ACP 35
Panamax vs New Panamax STS Cranes

Panamax

Single Trolley
Twin 20’ Spreader

35m

New Panamax

Single Trolley
Twin 20’ / Tandem 40’ Spreader?

47m

135 Containers per bay

320 Containers per bay
STS Crane Dimensions

Outreach and Lift Height

<table>
<thead>
<tr>
<th>Vessel Size</th>
<th>Required Outreach incl 2.0M overrun</th>
<th>Recommended Lift Height Above Rails</th>
</tr>
</thead>
<tbody>
<tr>
<td>8,200</td>
<td>158</td>
<td>136</td>
</tr>
<tr>
<td>13,000</td>
<td>201</td>
<td>155</td>
</tr>
<tr>
<td>18,000</td>
<td>218</td>
<td>166</td>
</tr>
<tr>
<td>22,000</td>
<td>226</td>
<td>185</td>
</tr>
</tbody>
</table>
“Terminal of the Future”
Singapore – MN Next Generation Container Port Competition

- 20M TEU per year
- 80% Transshipment

- 200,000 slots
- 78 STS cranes
- 200 Yard cranes
- 27 Landside transfer cranes
- Recessed terminal “AGV” railway
If automation is an option

- None automated well optimized terminal may be a solution for many terminals
New Generation of STS Cranes
New Generation of STS Cranes

Driver Assist or Automated

Manual

Tandem / Twin / Quad
25-30 cycles per hr

Single
40-50 cycles per hr
New Generation of Horizontal Transport

• Detailed gathering and distributing tasks to/from storage
  – Move any box, from any location to any location at any time
• Must be rubber-tired
  – AGV (battery operated)
  – AShC (hybrid diesel)
New Generation of ASC

- End-loaded stacking/retrieval cranes
- Side-loaded stacking/retrieval with landside transfer cranes
Automated Straddle Carriers & RTGS
Flexible Terminal Master Plan

- Develop a master plan with a provision to change from one mode of cargo to another with minimal investment
  - Start with RoRo, bulk, or break bulk
  - If the economic trend changes to containerized cargo, make the required changes when needed

- Develop a master plan for container terminals with provision to convert from non-automated to automated
Phased Terminal Development is a Challenge

• To minimize the impact of the first phase
  – Offsite satellite terminal
  – Build expansion area first
  – Increase the density
  – Lose some of the business

• Capacity ahead of demand for subsequent phases

Phased Development is a major challenge and requires a well-coordinated plan.
Phased Terminal Development is a Challenge

Project X
Storage Capacity during Construction Phases

Total Static Capacity

- Phased Total Storage Capacity
- Baseline Total Storage Capacity

Storage Capacity (Containers)

Start, During Phase 1, After Phase 1, During Phase 2, After Phase 2, During Phase 3, After Phase 3, During Phase 4, After Phase 4, During Phase 5, After Phase 5