Terminal Master Planning: A Key Planning Process Before Design Begins

Present At
AAPA Marine Terminal Management Training Program
September 15, 2015
> Founded in 1945
> A strong reputation throughout our domestic and international operations
> *Engineering News Records* Top Firms Lists
>   > #23 Top 500 Design Firms
>   > #32 Top 200 Environmental Firms
> > A Dedicated staff that specializes in port/terminal planning and design:
>   > Port and Terminal Master Plans
>   > Bulk Terminal Planning and Material Handling Studies and Design
>   > Container Terminal Designs
>   > Equipment Studies and Specifications
>   > Cost Estimating
>   > Vessel Maneuvering and Hydrodynamic Modeling
>   > Dredged Material Management and Navigational Studies
>   > Sustainability and Energy Planning
Terminal Master Planning Is An Important Step in The Design Process

> Terminal Master Planning or “Program Planning” is **Not** the same as preliminary design;

> Master Planning is more the “programmatic” phase of a project

> Master Planning a terminal before design starts will allow the Owner to:
  > Identifying problems and solutions early in the process
  > Determine project requirements
  > Finalize the design program and schedule;
Project Team:

**DANNENBAUM**
- Prime Program Management Consultant

Cardno
- Lead Terminal Planners
- (now CH2MIll) - Wharf Concepts

Halcrow
- Automation Concepts

CargoVelocity

Project Owner:
Port of Houston Authority
Existing Barbours Cut Terminal (BCT) Attributes

> 175 Acre Terminal
> 5,000 LF Wharf / 5 Berths (PHA only)
  (A 6th Berth was operated by APMT, but now back to POHA)
> Existing STS Cranes – 50’ Gage
> CY a combination of RTGs and wheeled storage
> Empties stored offsite
Landside Interface - Existing Condition - 50 Gage

> Amenities Building mixed in A-Row
Port of Houston Authority (PHA)
Stated Operational Goals For The Program

> Retrofit wharf for 100-gage Quay Cranes (22-Wide) – **Can not change existing berth-line!**
> Construct minimum 1,000 FT of new wharf by 2014
> Densify yard to handle + 2.0 million TEU/yr
  > RTGs
  > RMGs
  > Automated system
> Return empty depot operations to on-site within BCT
Wharf Operations Studies Early In the Program

- Berthing Concept Study
- Berth Capacity Model Results
- Wharf Face Operation Study
- Crane Rail Position Study
- Impact of 100 Gage Crane on Yard
- Amenities Building Location Study
Berth Capacity

> Berth capacity model set up to assess multiple berth segments and number of cranes per berth

> Some enhancements were considered to improve productivity in the future

> Evaluate unit berth capacity under various crane options and apply to the number of berths available
Berth Capacity Based on Crane and Berth Count

<table>
<thead>
<tr>
<th>BCT Berth Capacity (future crane count)</th>
<th>2.0</th>
<th>2.5</th>
<th>3.0</th>
<th>3.5</th>
<th>4.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berth Capacity - 4 Berths (Lifts/year)</td>
<td>993,651</td>
<td>1,213,242</td>
<td>1,422,874</td>
<td>1,623,208</td>
<td>1,814,850</td>
</tr>
<tr>
<td>Per Berth Capacity - 4 Berths (TEUs/year)</td>
<td>1,649,460</td>
<td>2,013,982</td>
<td>2,361,970</td>
<td>2,694,525</td>
<td>3,012,651</td>
</tr>
<tr>
<td>Total Cranes - 4 Berths</td>
<td>8</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>Berth Capacity - 5 Berths (Lifts/year)</td>
<td>1,242,064</td>
<td>1,516,553</td>
<td>1,778,592</td>
<td>2,029,010</td>
<td>2,268,562</td>
</tr>
<tr>
<td>Per Berth Capacity - 5 Berths (TEUs/year)</td>
<td>2,061,825</td>
<td>2,517,477</td>
<td>2,952,463</td>
<td>3,368,156</td>
<td>3,765,813</td>
</tr>
<tr>
<td>Total Cranes - 5 Berths</td>
<td>10</td>
<td>13</td>
<td>15</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>Berth Capacity - 6 Berths (Lifts/year)</td>
<td>1,490,476</td>
<td>1,819,863</td>
<td>2,134,310</td>
<td>2,434,812</td>
<td>2,722,275</td>
</tr>
<tr>
<td>Per Berth Capacity - 6 Berths (TEUs/year)</td>
<td>2,474,191</td>
<td>3,020,973</td>
<td>3,542,955</td>
<td>4,041,788</td>
<td>4,518,976</td>
</tr>
<tr>
<td>Total Cranes - 6 Berths</td>
<td>12</td>
<td>15</td>
<td>18</td>
<td>21</td>
<td>24</td>
</tr>
</tbody>
</table>

- 4 Berths adequate for 2 million TEU range
- 5 Berth scenario for 3 million TEU range
- Some flexibility in crane count / berth
- Yard capacity will drive berth demand
Berth Face Operations Study – Key to setting W/S Rail Location

- Existing berth-line/wharf face location needed to be maintained
- Need to determine future wharf face activities
  - Crane power system
  - Accommodation ladders
  - Bollards
  - Future cold iron vaults
  - Service truck access
Berth Face Operations Study – Studied Various Options
Fill vs No-Fill Alternatives
Adds a 6th Berth
Fill vs. No-Fill
Capacity Analysis (TEUs)

<table>
<thead>
<tr>
<th>RTG Layout</th>
<th>Yard Capacity</th>
<th>Berth Capacity</th>
<th>Limiting Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Fill</td>
<td>3,293,202</td>
<td>2,619,696</td>
<td>Berth</td>
</tr>
<tr>
<td>Fill</td>
<td>3,445,387</td>
<td>3,274,620</td>
<td>Berth</td>
</tr>
</tbody>
</table>

- “No Fill” option  4 berths
- “Fill” option     5 berths
- Assumes 4 cranes/berth
- Some additional capacity by adding cranes
- Roughly +150,000 TEU/yr gained by adding fill and 5th berth

- It was determined that the Project Goals could be met with the No-Fill Option and the area behind the “fill section” could be better used for storage of break-bulk/project cargo.
Landside Interface: Existing Layout - 100 Gage

> Retain existing RTG pad layout
> Impacts A-Row & Amenities Building
> 101’ from LS crane rail to B-Row
Landside Interface – Options
RTGs Back to Back - 100 Gage

> Back to Back layout
> 121 ′ from LS crane rail to B-Row
Considerations:

> Width/Requirements of Amenity Strip
> RTG Pad location and operation (One Way or Back-to-Back)
> RTG Pad distance from L/S Rail
> Width of Passing Lanes
> Light Pole and Camera Locations
Narrow Amenities Strip

- Separate buildings from RTG pad
- 134 FT wharf apron
- 40 FT amenities strip
- Allows area for:
  - Substations
  - Electrical Equip
  - Misc Truck/equip. parking
  - Boneyard
Yard Layout Alternatives

- Three alternatives considered:
  - RTG Dense operations
  - ASC Perpendicular to the wharf
  - ASC Parallel to the wharf
- General layouts provided for discussion
- Blocks provided for major terminal elements
- Further detailed layouts required
Camera Pole Study Goals

> Place camera pole at each RTG pad to view operations
> Avoid conflicts with yard circulation and RTGs
> Minimize impacts on terminal footprint
> Investigate using 80 FT high pole at each bypass lane for cameras
> Investigate placing wireless cameras on RTG’s
E-RTG Concept Study Evaluated Cost and Capacity of E-RTGs vs. Diesel RTGs

> **Benefits:**
>  > 30% lower maintenance costs
>  > 80% lower fuel costs
>  > 60 – 80 % emissions reduction

> **Constraints:**
>  > Fixed runway positions
>  > Increased civil costs for power delivery and substations
E-RTG Concepts, cont.

- Power Delivery Methods
  - Motorized cable reel
  - Conductor bar
Projected Return on Investment

- Estimated Capital Costs $ 33,503,433
- Operating Cost Savings $ 2,923,000/yr
- Projected Capital Cost Recovery +11 years
- POHA decided to stay with Diesel RTGs because of similarities with other PHA Terminals (Bayport)
PHA Yard Layout Wish List

- Maximize RTG storage area
- Approx 50 acres for empty containers
- Approx 50 Ag Ramp slots
- 100 to 300 wheeled slots
- Wheeled reefer slots initially
- Dedicated area for VACIS inspections
Further Plan Refinement, cont.

- Modify CY terminal aisles to increase velocity
  - 20 FT truck bypass lanes
  - Dedicated RTG shuttle lane on entry gate aisle (114 FT)
  - N-S Aisles at 80 FT
  - Intra-terminal 4-lane road at 60 FT
Summary of Final RTG Composite Plan

> TGS Count
  > RTG Loads 11,664
  > Reefer Racks 108
  > Empties 7,346
  > Wheeled Reefers 118
  > Misc Wheeled 249

> Empty container storage +32 acres
> Ag Ramp slots 50 slots
Automated Staking Crane (ASC) Alternative

- An Option For Future ASC Operation Was Studied;
- Would allow for the future conversion of the CY to ASC
- Buildings and other facilities were located so as to not be impacted by a future conversion
- A Phasing Plan was developed so the terminal could be converted to ASC by phases
ASC Composite Plan
PHA Phasing Plan Preferences

- Focus redevelopment on wheeled areas first
- Maximize development of break bulk terminal
- Accelerate relocation of empty handling op’s to BCT
- Redevelop waterfront RTG pads last
- Prefer working minimum three pads adjacent with same aisle alignment
RTG Phasing Plan
RTG Phasing Plan

1. Lose two RTG Pads

1. Area Impacted by Wharf Project

2. Relocate Road (Entire Terminal)

2. Lose one RTG Pad

Use Overflow Pads & Break Bulk Area for Replacement Capacity

TRANSITION RTG LAYOUT
SCALE 1' - 50'

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RTG Phasing Plan

3. Redevelop Waterside RTG Pads

4. Redevelop Landside RTG Pads

PROPOSED RTG LAYOUT
SCALE: 1" = 50'

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Near Term Construction Phasing
Project 1 - Phase 1 (June 2013)

Terminal C5 yard construction (11.7 AC)

Phase addition: +936 TGS
Phase removal: -720 TGS
Phase Net: +216 TGS
Cumulative through project: +216 TGS
Near Term Construction Phasing
Project 1 - Phase 2 (April 2014)

Terminal C5 operational
during Rehab Wharf 1
No change in TGS count
(Still +216 TGS)
Near Term Construction Phasing
Project 2 - Phase 1 (June 2014)

Phase addition: + 984 TGS
Phase removal: -102 TGS
Phase net: + 882 TGS
Cumulative: +1098 TGS
Near Term Construction Phasing
Project 2 - Phase 2 (October 2015)

No change in TGS count

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Near Term Construction Phasing
Project 4 - Phase 1 (5-7 Year Plan)

Project addition: + 1056 TGS
Project removal: -264 TGS
Net: + 792 TGS
Cumulative through project: + 3546 TGS
Phase addition: + 2952 TGS
Phase removal: - 2454 TGS
Phase net: + 498 TGS
Cumulative through project: + 4044 TGS
Near-Term Construction Phasing

- Project 1 – Rehab Wharf 1 and C-5 Yard (0-3 Year Plan)
- Project 2 – Rehab Wharf 2 and C-4 Yard (0-4 Year Plan)
- Project 3 – Break Bulk Area (3-6 Year Plan)
- Project 4 – C-3 Yard (5-7 Year Plan)
- Project 5 – C-1/C-3 Waterfront (6-10 Year Plan)
Near Term Construction Phasing
TGS Count by Project

- Each project adds more TGS than it removes
- After project is completed, the CY will have 4,044 more TGS than when construction began

<table>
<thead>
<tr>
<th>Projects</th>
<th>Project 1</th>
<th>Project 2</th>
<th>Project 3</th>
<th>Project 4</th>
<th>Project 5</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>TGS Constructed</td>
<td>936</td>
<td>984</td>
<td>1656</td>
<td>1056</td>
<td>2952</td>
<td>7584</td>
</tr>
<tr>
<td>TGS Removed</td>
<td>-720</td>
<td>-102</td>
<td>0</td>
<td>-264</td>
<td>-2454</td>
<td>-3540</td>
</tr>
<tr>
<td>Project Net</td>
<td>216</td>
<td>882</td>
<td>1656</td>
<td>792</td>
<td>498</td>
<td>4044</td>
</tr>
<tr>
<td><strong>Project Cumulative Gain</strong></td>
<td><strong>216</strong></td>
<td><strong>1098</strong></td>
<td><strong>2754</strong></td>
<td><strong>3546</strong></td>
<td><strong>4044</strong></td>
<td><strong>4044</strong></td>
</tr>
</tbody>
</table>

**TGS Removed and Constructed**

- TGS Removed
- TGS Constructed
- Project Cumulative Gain

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Another Critical Item Is Laydown Areas and Haul Routes During Construction
Wharf 1 Project Completed Fall 2014
Wharf 2 Advertised For Bid Fall 2015

- Berth 1 Completed;
- 4 New Post-Panama Cranes Delivered;
- Terminal areas 4 & 5 improvements completed
- Berth 2 project currently out for bid
Conclusion

> Program Planning (Master Planning) is a critical element to any terminal development project;
> There are many “small” items that have to be considered during this planning process;
> Successful Program Master Planning ensures successful design and construction programs.

> For More Information:
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   Principal Port Planner
   Email: james.hunt@cardno-gs.com