Marine Terminal Automation Today and Tomorrow
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Overview

• Current State in terminal automation
• APMT Norfolk – first North America ASC installation
• PAG Oakland – first West coast ASC Terminal?
• When to do something different and or why would you make a change?
• Factors to consider when converting to an automated terminal
• Use of Emulation
Automation on Marine Terminals

- Container handling: Focus of this Presentation
  - Yard Transport
  - Yard Cranes
- Other Areas
  - Gate process
  - Vessel mooring
Altenverder, Hamburg
Nested ASCs that can Pass are Unique to Altenverder
With end loaded CY systems, trucks back up to the landside end of the CY stacks and are served by remote operators. With no need to creep forward, trucks can shut off engines while waiting for service.
Console for Remote Yard Crane Operations for Gate Service in Hamburg

A camera on each corner of the spreader shows an image here

This joystick controls the electric crane
# ASC Implementation at different Automated Terminals

<table>
<thead>
<tr>
<th>Location</th>
<th>Cranes per block</th>
<th>Stack width (boxes)</th>
<th>Waterside transport</th>
<th>Landside transport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thamesport</td>
<td>2 on same rails</td>
<td>9/7</td>
<td>Trucks drive to side of ASC</td>
<td>Trucks back-in to landside of ASC row</td>
</tr>
<tr>
<td>ECT Rotterdam</td>
<td>1</td>
<td>6</td>
<td>AGVs to end of ASC</td>
<td>Trucks served via strad interface</td>
</tr>
<tr>
<td>CTA Hamburg</td>
<td>2 on separate rails</td>
<td>10</td>
<td>AGVs to end of ASC</td>
<td>Trucks back-in to landside of ASC row</td>
</tr>
<tr>
<td>APMT Norfolk</td>
<td>2 on same rails</td>
<td>8</td>
<td>Manned shuttles at end of ASC</td>
<td>Trucks back-in to landside of ASC row</td>
</tr>
<tr>
<td>Euromax Rotterdam</td>
<td>2 on same rails</td>
<td>10</td>
<td>AGVs to end of ASC</td>
<td>Trucks back-in to landside of ASC row</td>
</tr>
<tr>
<td>DPW Antwerp</td>
<td>2 on same rails</td>
<td>10</td>
<td>Manned shuttles at end of ASC</td>
<td>Trucks back-in to landside of ASC row</td>
</tr>
<tr>
<td>CTB Hamburg</td>
<td>3, on two sets of rails</td>
<td>10</td>
<td>Manned shuttles at end of ASC</td>
<td>Trucks back-in to landside of ASC row</td>
</tr>
<tr>
<td>NYCT New York</td>
<td>2 on same rails</td>
<td>11/9</td>
<td>Trucks drive to side of ASC</td>
<td>Trucks back-in to landside of ASC row</td>
</tr>
<tr>
<td>PAG Oakland</td>
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</tr>
</tbody>
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Common factors in Automated Terminals to Date

- ASC runs normally perpendicular to the wharf
- Trucks back into transfer zones (or slots) on the Gate side end
- Most of the terminals other than Hamburg prefer two cranes on same rails
- ASC stack width range from 8 to 10 wide and 4 to 5 high
Why Would you Make a Change?

- **Transhipment terminals**
  - Need more ASCs to service the stevedoring
  - Gate ASCs not heavily utilized in case of two ASCs on same rails

- **Rail**
  - Rail side operations have not been automated as of yet
  - Higher rail fraction terminals would prefer automating the rail operations

- **Terminal shape**
  - Depth of the terminal does not allow perpendicular ASC runs

- **Phasing with a truck environment (NYCT)**
Transhipment Options

- Use separate rails (CTA) to allow both cranes to work waterside
- Rotate 90 deg to get buffers on both ends
Rail Service

- Direct wharf-rail access
- Automated end transfer
An Option for Direct AGV/IY Access
Bridge Crane System for CY to IY Transfer
Options for Narrow Terminals

**ADVANTAGES:**
- Very high storage density on small footprint
- Ability to use different number of landside and waterside RMGs
- High buffer capacity
- Horizontal transfer ability within stacks
- Narrow machines allow more RMG density

**DISADVANTAGES:**
- Unique TOS
- Higher cost per RMG than portal RMGs
- Landside RMGs not available for vessel work
- Difficult to manage more than two parallel rows
- Difficult to phase construction
Big Nested RMGs are Already In Use in the US
BNSF Memphis
Phasing With Trucks

**ADVANTAGES:**

- The operation can be phased into an automated mode of operation without changing the physical infrastructure on the ground
- Easy addition to an existing terminal with terminal tractors. For e.g. a RTG terminal with terminal tractors

**DISADVANTAGES:**

- Less yard density in comparison to perpendicular ASC systems due to the circulation aisles used for the waterside terminal tractors
Phasing with a Truck Environment (NYCT)
Factors to consider when moving to Automated Terminal

• Yard geometry relative to berth
• Cost and availability of labor vs. expected throughput
• Terminal Operating System Risks
Thank You
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Appendix
Glossary

• ASC = Automatic Stacking Crane, an end loaded RMG without a driver on the crane. Controlled remotely as needed
• RMG = Rail Mounted Gantry Crane
• DCRMG = Dual Cantilever Rail Mounted Gantry Crane
• AGV = Automated Guided Vehicle. Robotic transporters used for container transport
• Shuttle Carrier = A short (1-over-1) straddle carrier used only for transport, not for stacking
• AutoStrad = a robotic unmanned straddle carrier
• DGPS = Differential Global Positioning System, a very precise location technology that combines satellite navigation (GPS) with local reference points