Title: Envisioning Tomorrow’s Terminal: Improving Cargo Flow from Ship to Gate

Presented By: Mark Sisson, P.E., AECOM
Terminal Best Practice for IT

• 100% appointments
• Pre-advisement of status to minimize trucker trouble
• Advance rehandling of containers to minimize trucker wait time (much easier to do with automation)
• Efficient stacking, and encouragement of large import blocks (Peel offs)
• Automated data collection for trucks at gate (no people in lanes)
• Automated inventory control (no lost boxes)
• Automated container handling with remote control of equipment as needed
Typical Container Terminal Flow

Wharf (Quay Cranes) ➔ Terminal equipment ➔ Container Yard ➔ Terminal equipment ➔ Intermodal Yard (Rail) ➔ Street trucks ➔ Gate
Example RTG Block
All traffic shares a single load lane
Top Picks are Used Where Selectivity is Not Needed
Why Automate a Terminal?

• Operating cost (labor) savings
• Insurance against labor shortages, strikes, slowdowns
• Ability to run closer to 24/7, especially for housekeeping moves
• Reduction in lost time for personnel changes (lunch, end of shift, etc.)
• Increased safety
• More pleasant working environment for operators
• Improved street truck service time
• Improved vessel productivity?
• Emissions reduction?
• Increased capacity?
An Example of Unreliable Labor

source: PMA 2014 Annual Report

LA/Long Beach: Absent Crane Operators
Total Shifts for Qualified Crane Operators – 7-day Moving Average

On 11/3/14, ILWU suddenly began refusing to dispatch qualified crane operators.

After the 2/20/15 contract agreement, dispatch returned to normal.
Example ASC Terminal – APMT Norfolk
TraPac, POLA, Combines ASCs and Autostads
Long Beach Container Terminal
Example ASC Operator Room
Any driver can control any crane
LBCT Gate Congestion Management Zone
ASC blocks have only 4-5 truck spots each
LBCT Street Truck Loading Zone

Driver exits the cab and waits in booth for ASC to complete the move.
Chart of ASC Terminals Worldwide by Start Year
US Unions and Automation

• **ILWU:** Contract states that any position can be automated. Individual terminals may have unique agreements on staffing.

• **ILA:** Contract states that “full automation” meaning robotic transport is prohibited. Semi-automation meaning remotely operated cranes such as ASCs are OK.
# Highlights of US Automation Projects

<table>
<thead>
<tr>
<th></th>
<th>APMT VA</th>
<th>Global NJ</th>
<th>TraPac, POLA</th>
<th>LBCT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year opened</td>
<td>2007</td>
<td>2014</td>
<td>2015</td>
<td>2016</td>
</tr>
<tr>
<td>STS to CY</td>
<td>Manual shuttle (diesel)</td>
<td>Manual shuttle (diesel)</td>
<td>Autostrad (diesel)</td>
<td>AGV (electric)</td>
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<tr>
<td>CY storage</td>
<td>ASC (1-over-5)</td>
<td>ASC (1-over-5)</td>
<td>ASC (1-over-5)</td>
<td>ASC (1-over-6)</td>
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<tr>
<td>Street truck service</td>
<td>ASC interface</td>
<td>ASC interface</td>
<td>ASC interface</td>
<td>ASC interface</td>
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<tr>
<td>IY Crane</td>
<td>RTG (diesel)</td>
<td>RMG off-site</td>
<td>Automated RMG</td>
<td>Manual RMG</td>
</tr>
</tbody>
</table>
Electrification is a Priority for Equipment Makers
https://www.youtube.com/watch?v=BTgk6oOy6_4

• “... reachstackers, terminal tractors ... our strategy is very easy and simple ... we want to have zero emission operations ... it means electric or electric battery operations”

• From TOC Europe Conference 2017
Electric Power is now Standard for AGVs
Autostrads are all Diesel Today, but Electric Prototypes are Being Tested

Kalmar FastCharge™ charging set-up
But Automated Terminals are Less Productive than Manual Terminals, Right?
“Yes, excessive automation at Tesla was a mistake,... Humans are underrated.”

Elon Musk, April 2018
Terminal Storage Density by Mode

- Wheeled 1-ov-2
- Strad 1-ov-3
- Loose 6w RTG
- Tight 6w RTG
- Tight 7w RTG
- Small FEL export
- Big FEL export
- Small empty
- Big Empty
- ASC

Static Capacity (TEU per Acre)
Example High Density Empty Storage
Typical Range of STS Crane Productivity
(Lifts per hour)

• US manual terminals: 25-35
• Fully automated terminals Year 1 of ops: 15-25
• Fully automated terminals Year 5+: 25-35
• Do you care more about per-hour or per day productivity?
  • 16hr*30mv/hr = 480 moves per crane-day
  • 21hr*25mv/hr = 525 moves per crane-day
SoCal Automated Terminals have Excellent Truck Turn Time
Source HTA/JOC (Sept 2019 data)
Fewer Workers = Fewer Injuries?

Source: PMA 2018 Annual Report p20

Most Injured Longshore Occupations

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Incidence Rate</th>
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<tbody>
<tr>
<td>Semi-Tractor</td>
<td>93</td>
</tr>
<tr>
<td>Lasher</td>
<td>71</td>
</tr>
<tr>
<td>Mechanic, ILWU</td>
<td>70</td>
</tr>
<tr>
<td>Holdman</td>
<td>43</td>
</tr>
<tr>
<td>Dockman</td>
<td>31</td>
</tr>
<tr>
<td>Top Handler/Side Pick</td>
<td>18</td>
</tr>
<tr>
<td>Crane, Cont Gantry</td>
<td>14</td>
</tr>
<tr>
<td>Auto Driver</td>
<td>13</td>
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<tr>
<td>Linesman</td>
<td>11</td>
</tr>
<tr>
<td>Gearman</td>
<td>6</td>
</tr>
</tbody>
</table>
What Else Can be Automated?

- **Vessel mooring via vacuum pads.** Less appealing as vessel size increases and cost of mooring per move declines.

- **STS crane operation.** Remote cranes are in operation in a handful of terminals worldwide, but not yet in US.

- **IBC Handling.** Robotic prototypes in use in China. If successful this will both reduce cost and increase STS productivity!

- **RTG operation.** Remote RTG cranes are in operation in a handful of terminals worldwide, but not yet in US.

- **Terminal tractors.** Some prototypes in operations in Asia today. A great deal is being invested in street truck automation that can also be applied here.
Prototype IBC Robot at QQCTN, China

Source: https://www.youtube.com/watch?v=E--R0r4RBEs
Volvo’s Vera Automated Truck
Prototype Operating in Gothenberg
Westwell Automated Terminal Tractor
Prototype testing at Zhuhai China

https://www.youtube.com/watch?v=PxtPAseopko
What Jobs Will be Left with Maximum Automation? (i.e. a “Fully Automated” terminal)

• Lashing gangs on vessel
• Remote drivers for pick/set activity and safety supervision
• Remote clerks for exception handling
• Rail IBC (coning) crews
• Top-pick/side pick operators (high density empty piles especially)
• Maintenance technicians
• Vessel and rail planners
• IT support staff, cybersecurity specialists, etc.
• Management
Final Thoughts

• IT and software systems are key to performance of automated terminals

• Technical progress only goes in one direction - technical risk of automation declines every year

• Automation is likely to get ever more popular worldwide, but change will be gradual due to high cost and hassle of remodel projects

• Automation and electrification are not related
  • Every autostrad is diesel in 2019
  • Many manual RTGs are electric in 2019

• Automation style will vary a great deal from place to place

• Many factors influence the appeal of automation on a given terminal – each project is unique and merits a good deal of study before committing to large investments
Thank You

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