Equipment, Automation & Operation
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Basic Question

How will new technologies and business processes impact the planning and design of new and existing marine container terminals?
The West Coast Problem

- Southern California ports are processing over 7,500 TEUs per net CY acre per year, and are not adding land
- The annual growth rate ranges from 8% to 10%
- If 50% of annual growth is diverted to other WC ports, they will reach capacity in four to six years
- We must do more with what we have
- At current growth rates, and with a lot of diversion, density in SoCal will increase by 800 TEUs/net acre/year EVERY YEAR for the foreseeable future
- The operators have taken steps to adapt, and are planning further steps
- These steps will impact DESIGN everywhere
Density Growth

- The impact of current 9.7% AGR in SoCal
Overview

– Advanced Data Systems
– Gate Automation
– Gate Appointment Systems
– Night Gates
– Yard and Vessel Coordination
– Yard Inventory Automation
– Electric Yard Cranes
– Automated Container Operations
– Tandem/Quad Cranes
Advanced Data Systems

- Optical Character Recognition (OCR)
- Differential Global Positioning Systems (DGPS)
- Radio Frequency Identification (RFID)
- Advanced Container Scanning
- Electronic Seals
- Electronic Data Interchange (EDI)
- Mobile Data Terminals (MDTs)
Impact

- All these systems automate data transfer between equipment and the Terminal Operating System (TOS)
- All these systems reduce the need for human data collection in the terminal
- All these systems increase the empowerment of the TOS to optimize equipment performance
- All these systems, when properly combined, reduce the cost of container handling
- These systems contribute to reducing the cost of grounded operations
Gate Automation

- OCR currently can read 95% to 98% of container and chassis numbers
- OCR can read license plates, but poorly
- Automatic penetrative scanning can check the contents of containers
- E-seals and smart boxes are a good idea, but not yet a reality
- Weigh-in-motion scales are good enough for checking weight against bills of lading, but not for road certificates
- Electronic demurrage payment
- Electronic EIRs
- Pre-lodging of transaction data, including TWIC
Impact

- Entry Gate Queue, Trapac LA, 09:40 Monday, January 9
- Old gates are too big
- New gates don’t need humans on the ground, except security
Gate Appointment Systems

- Identify trucker and transaction to be completed within a given time slot
- Time slots can be quite narrow – one hour is not uncommon
- Allow some control of truck flow variability
- Provide advance warning to TOS about near-term transaction volumes and characteristics
- Integration of Transportation Workers’ Identity Credential (TWIC)
Impact

- Improve transaction quality
- Allow improved integration between trucker and terminal
- Reduce waste moves in grounded operations
- Allow selectivity in densification
- Increase the productivity of grounded storage equipment
- Reduce the cost of grounded storage and retrieval
Night Gates

- Shift gate transactions from weekday days to weekday nights and/or weekend days or nights
- Integrated with appointment systems
- Congestion pricing
Impact

– SoCal PierPass Off-Hours Program

– Shift from weekday days to off-peak periods:
  • Import containers through out-gate 40.3%
  • Export containers through in-gate 42.5%
  • Weighted average all cargo-bearing containers: 40.8%
Yard & Vessel Coordination

- OCR at the vessel capturing all container IDs
- RFID on transport tractors, matching tractor to container number
- RFID reader at yard crane, matching transport, and thus container number, to tractor
- Tracking equipment at yard crane, matching container number to storage slot
- Automatic vessel stow plan record
- Integrate with TOS to automate instructions to tractor driver, based on container identity, via MDT
Impact

– Reduced clerks on the ground at the cranes
– Seamless integration between vessel and yard
– Huge data bandwidth required: wifi, fiberoptic, etc.
Yard Inventory Automation

- DGPS and/or other navigation equipment on yard cranes
- RFID on yard tractors, and possibly street tractors
- Automatic container position detection
- Automatic update of inventory
Impact

- Eliminate on-the-ground clerical control of yard cranes
- Allow centralized coordination of yard crane activities
- Reduce waste-move rehandles
- Increase yard crane productivity
- Reduce truck queuing
- Reduce emissions
- Increase safety
- Reduce the cost of grounded operations
Grounded Economics

- Trapac Los Angeles – RTGs at the waterfront
- Trapac observes that new technologies increase RTG productivity by 40%
Grounded Economics

- Pier A Long Beach
Grounded Economics

- Pier T Long Beach
Grounded Economics

– Pier J Long Beach
Grounded Economics

- West Basin Terminals, Los Angeles
Electric Yard Cranes

- Kalmar Electric-Cable RTGs in Oslo
Electric Yard Cranes

- ZPMC Cordless Capacitor/Hybrid Cranes
Impact

- Lower emissions – zero on-site emissions
- Lower energy cost – regeneration is mature
- Reduced crane deployment flexibility
Automated Container Operations

- ZPMC Altenwerder
Impact

- Workerless container handling and transport
- Slightly higher storage density and capacity
- Low emissions
- Rapid truck service
- Decent vessel productivity
- Reduced lighting
- Greatly increased safety
Tandem/Quad Cranes

- Two 40s, or four 20s, or two 20s + one 40
Tandem Operations

- Low-res video, Dubai, May 2005
- 2.5-minute cycle times to two trailers
Impact

- Potentially much higher vessel productivity
  - First generation cranes are very good, but not perfectly reliable
- Wharf traffic congestion will be an issue
- Coning / de-coning is an issue
  - Upstream / downstream or on-crane coning may be required
- Cranes are very heavy
- 100-foot standard crane gage is probably too narrow
- Recommended design for Jebel Ali New Container Terminal has 42 m (138 ft) gage
Dubai Tandem-Crane Wharf

**Legend**
- 1. ELEVATED BPC CHECKER CAB
- 2. TRANSIT/LOAD
- 3. VESSEL
- 4. VESSEL SERVICE
- 5. HATCH COVER L
- 6. FENDER
- 7. CURB
- 8. BOLLARD
- 9. 3" LIST GEAR C
- 10. WATERSIDE CRANE
t- 11. POWER CABLE T
- 12. FENCE TO SEPA OPERATIONS FG OPERATIONS
- 13. VESSEL GANGWAY
- 14. QUAY AREA SEP
- 15. VESSEL SERVICE
- 16. THIS SPACE USE PAGING LINE AND GANGWAY
- 17. QUAY CRANE
- 18. SHUTTLE CARRIERS
- 19. CONTAINER ON PLATFORM

**Tandem Lift - Shuttle Carriers in Independent Lanes**
- 42.0M GAGE CRANES
- 6 WORKING LANES
- 1ST AND 4TH CRANE SHARE LANES WHEN WORKING TANDEM 40'S
- CONING ON PLATFORM
What is Important?

- Survey of three major operating company’s management

![Normalized Score Chart]

- High Safety
- Low Overall Cost per Lift
- High Vessel Productivity
- Low Environmental Impact
- Rapid Street Truck Service
- Flexibility for Expansion
- High Intermodal Rail Velocity
- Labor Acceptance Risk
- Suitability for Robotization
- High Storage Capacity
- Phaseability
- Low Complexity/Risk
- Security
Conclusion

This isn’t your grandma’s marine terminal:

It is:
- Denser
- Faster
- Safer
- Greener
- Smarter

More Expensive to Build
Cheaper to Operate