Best Practices in Master Planning, Research and Technology Tools

American Association of Port Authorities
Tampa, Florida

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OVERVIEW

→ Problems of Dimension
→ Problems of Volume
  ▪ Analytical Example
→ Problems of Commerce
→ Problems of Finance

→ Planning Response
→ Future Progress
PROBLEMS OF DIMENSION

- LOA Increasing
- Beam Increasing
- Berth Length Increasing
- LOA Plateau
- Beam Plateau
- Long LOA / Beam
- Rapid "H" Increase
- Rapid "H" x LOA Increase
- Decline to Plateau
- Slow Draft Increase
- Loss of Channels, Basins
- Loss of Berths
- Taller Cranes
- Higher Bridges
- More Wind Area
- More Tug Power
- Deeper Channels
- Longer Crane Booms, Taller Cranes
A PROBLEM OF DIMENSION
PROBLEMS OF VOLUME: ANALYTICAL EXAMPLE

➔ Using **Terminal Simulation Demand Model** (© WSP|PB)
  ▪ Robust, reliable, detailed modeling of flow and inventory

➔ **Three Cases:**
  ▪ Three ships per week, 1,000 lifts per call, Days 2, 4 and 6
  ▪ Two bigger ships per week, 1,500 lifts per call, Days 2 and 5
  ▪ One big ship per week, 3,000 lifts per call, Day 2

➔ **Common elements**
  ▪ **Same** annual volume: 156,000 lifts per year
  ▪ Maximum call duration is two working days
  ▪ 7-day gate operations
  ▪ US West Coast values
    – Empty/Full, Import/Export, Gate/Rail
    – Storage modes and densities
    – Dwell times and distributions
ANALYSIS: YARD AREA

*Increased storage area for same volume:*
Case 2: +11%, Case 3: +37%
ANALYSIS: GATE FLOW

Increased boundary flow for same volume:
Case 2: +6%, Case 3: +27%
PROBLEMS OF VOLUME

For the same volume, consolidation into fewer calls:

→ Increases storage demand
→ Increases storage area required
  ▪ More land required
→ Increases boundary flow rates – gate and rail
  ▪ Larger equipment fleets required
  ▪ Heavier peak impacts on hinterland transport networks

→ To keep the same call duration, supporting the same vessel deployment pattern:
  ▪ Case 1 required 2 ship-to-shore (STS) cranes
  ▪ Case 2 required 3 STS cranes
  ▪ Case 3 required 4 STS cranes
  ▪ Each STS crane is supported by a fleet of yard equipment, so more yard equipment and labor are needed
PROBLEMS OF COMMERCE

➔ **Shift to liner alliances sharing terminals**
  - Terminal looks like a public terminal, rather than dedicated
  - Terminal manages liner contracts with different T&C, performance, pricing
  - Terminal may serve multiple rail operators, rather than one
  - More “sorts” of containers reduce permissible yard density
  - More inter-terminal shifts to accommodate variable berthing

➔ **Shift to fewer liners in fewer alliances**
  - Terminal contracts with liner, not with alliance
  - Alliance has authority, but no collective responsibility
  - Shifts power from port to liner: ports cannot collude
  - Shifts power from terminal operator to liner: operators cannot collude
PROBLEMS OF FINANCE: COST

- More container storage area
- More, and bigger, STS cranes
- Stronger wharves
- Longer wharves
- More supporting equipment
- Remodeled STS cranes
- Higher densities: higher operating costs
- Dredged channels – wider and deeper
- Expanded turning basins
- Taller bridges
- More, and more powerful, tugs
- Higher traffic impacts in the hinterland
- Some of these are “hard constraints”
PROBLEMS OF FINANCE POLICY

→ Bigger ships mean higher terminal costs and poorer terminal service, *for the same volume*

→ Serving bigger ships requires substantial *investment* in equipment and terminal space, *for the same revenue*

→ Ports choke on bigger ships because investment in servicing them generates *negative return*

→ Poor finance structure greatly deters private investment, putting pressure on *public sources* of funding

→ The public doesn’t understand why this is *their* problem
PLANNING RESPONSE

→ Tactical Peaking Factor impacts peak storage demand
→ Terminal plans must reflect peak demand
→ Terminal planning must be closely tied to capacity model that combines:
  ▪ Estimated berth capacity based on possible ship calls
  ▪ Impact of ship call pattern on storage demand
  ▪ Relationship between storage map and storage capacity

→ As problems become tougher, our tools must advance in sophistication

→ Port | Rail | Intermodal Modelling Environment (© WSP|PB)
PRIME USES

→ Integrated platform that allows rapid, robust planning and operational analysis of goods movement terminals

→ Suitable for
  - Conceptual planning
  - Master planning
  - Phased development analysis
  - Due diligence

→ Physical plans in Microsoft Visio
→ Operational models in Microsoft Excel
→ Tight, direct integration between plans and models
PRIME GENERAL ARCHITECTURE

- MS Visio Professional used for plans
- Visio Stencils hold customized smart “shapes”
  - Shapes have a copyright that appears on “hover”
  - If copyright notice is changed in any way, tools don’t work
- MS Excel used for models
- MS Visual Studio | Visual Basic used for all working Tools
- Tools are compiled as “COM Add-Ins” for Visio and Excel
EXAMPLE: TERMINAL DENSIFICATION

➢ The example shows the staged conversion of a marine container terminal
  ▪ Three berths
  ▪ On-dock intermodal container yard for double-stack operations

➢ Initial configuration uses 1-over-2 straddle carriers for most container storage and all transport

➢ Final configuration uses 1-over-5 automated stacking cranes (ASCs) for most container storage, and manned shuttle carriers for all transport
INITIAL LAYOUT

Berth & Wharf
Strad Storage
Reefer Blocks
Empties
Rail Yard
Buildings
Gate Complex
PHASED DEVELOPMENT
STATISTICS TRANSFERRED TO PRIME MODEL

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→ Storage capacities as 20-foot ground slots
ANALYSIS MODEL CHARACTERISTICS

→ Excel-based static model
→ Tied to plan via direct bilateral data transfer
  ▪ Using COM Add-Ins for Visio & Excel
→ Single spreadsheet deals with all aspects of analysis
  ▪ Demand and Capacity
  ▪ Equipment fleets, utilization, manning, costs
  ▪ Infrastructure sizing, timing, impact, costs
→ No cross-linking of spreadsheets or links to external databases
→ Uniform, coherent use of styles to clarify the nature of each cell
ANALYSIS MODELS

→ Berth-constrained capacity
→ Yard-constrained capacity
→ Rail yard capacity
→ Gate requirements
→ Equipment requirements and utilization
→ Demand timing
→ Capital expense estimation
→ Operating expense estimation
→ Cash flow estimation

→ All integrated and cross-referencing
Fewer ships means more storage demand, more so for freight with short dwell times.
STATIC STORAGE & THROUGHPUT CAPACITY
BERTH- AND YARD-CONSTRAINED CAPACITY
PHASE TIMING VS. DEMAND

Demand and Phase Capacities

- Current Capacity
- A1b Capacity
- Demand Curve
- Required A1b Completion Date

Annual Volume (TEUs)

- 0
- 500,000
- 1,000,000
- 1,500,000
- 2,000,000
- 2,500,000
- 3,000,000

Year

2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
EQUIPMENT FLEET SIZING

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MACHINE OPERATING HOURS PER YEAR

Machine Operating Hours per Year

Thousands

- Quay Cranes
- Side Picks
- ASCs
- Straddle Carriers
- Shuttles

Years:
- 2015
- 2018
- 2021
- 2024
- 2027
- 2030
- 2033
- 2036
- 2039
- 2042
- 2045
- 2048
- 2051
- 2054
- 2057
- 2060
CAPEX CASH FLOW
FUTURE PROGRESS AND RESEARCH

→ Focus should be on mitigating impacts of ship-induced demand peaks throughout the system

→ Appointment systems
→ Integration of truck and terminal operations
→ Extended gate AND warehouse operations
→ Dray-off programs
→ “Taxi Dray” or “Uber Truck” systems
→ Rail shuttles for regional distribution
  ▪ Rail automation?

→ All efforts must respect commercial realities, and avoid theoretical treatments