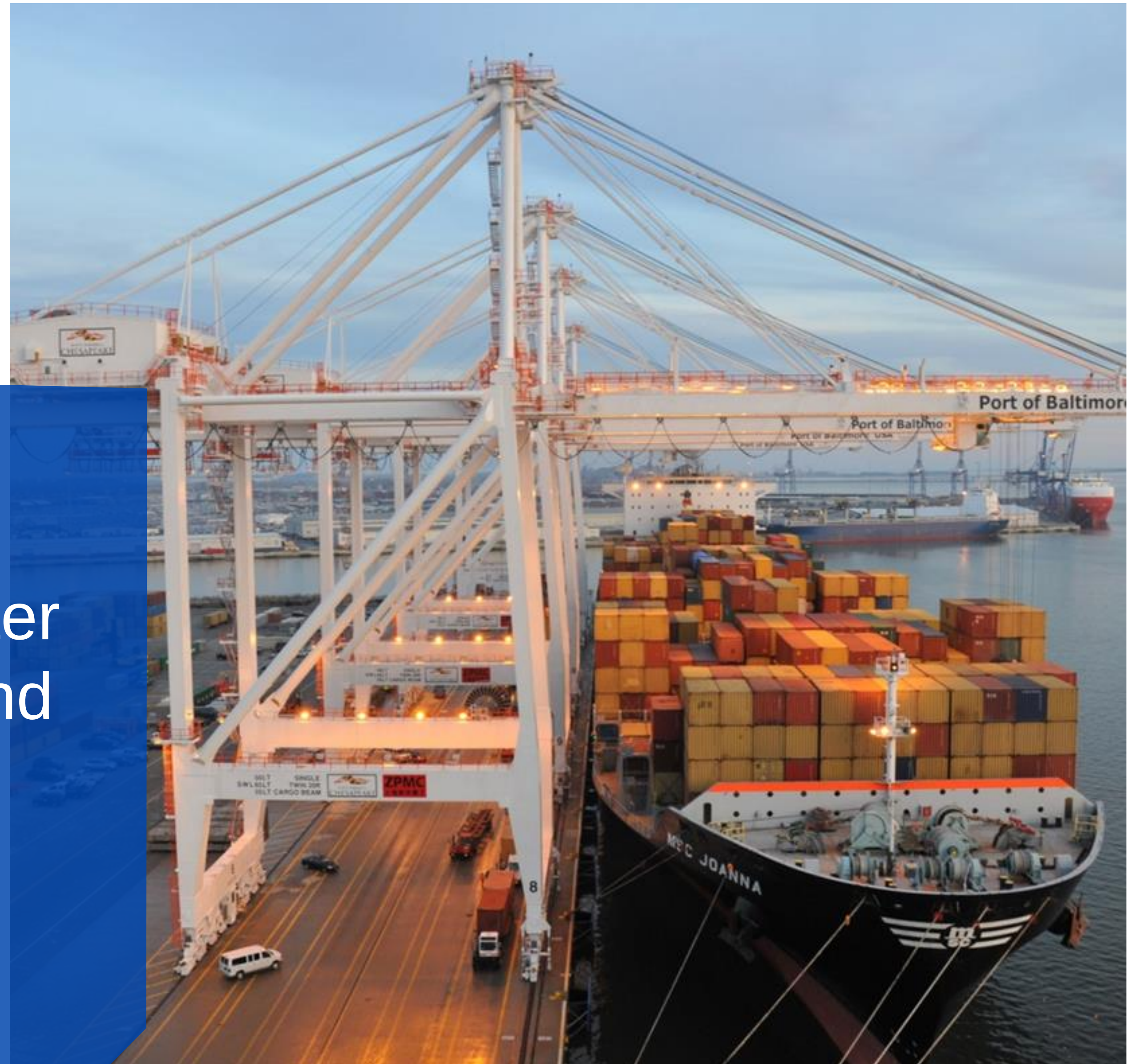

Best Practices in Master Planning, Research and Technology Tools

American Association of Port Authorities
Tampa, Florida

Thomas Ward, PE, D.PE
Senior Maritime Planner

January 27, 2017

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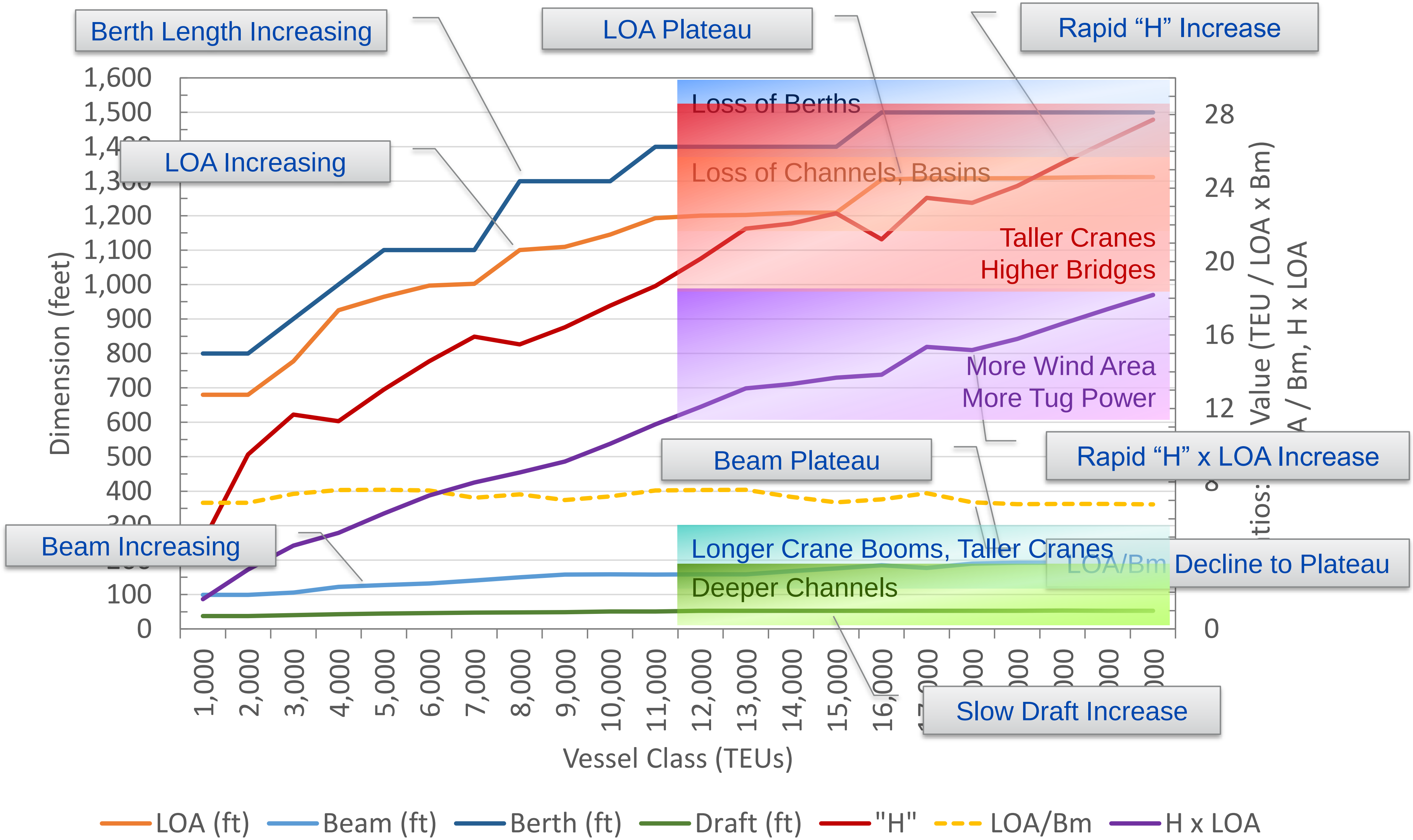
OVERVIEW

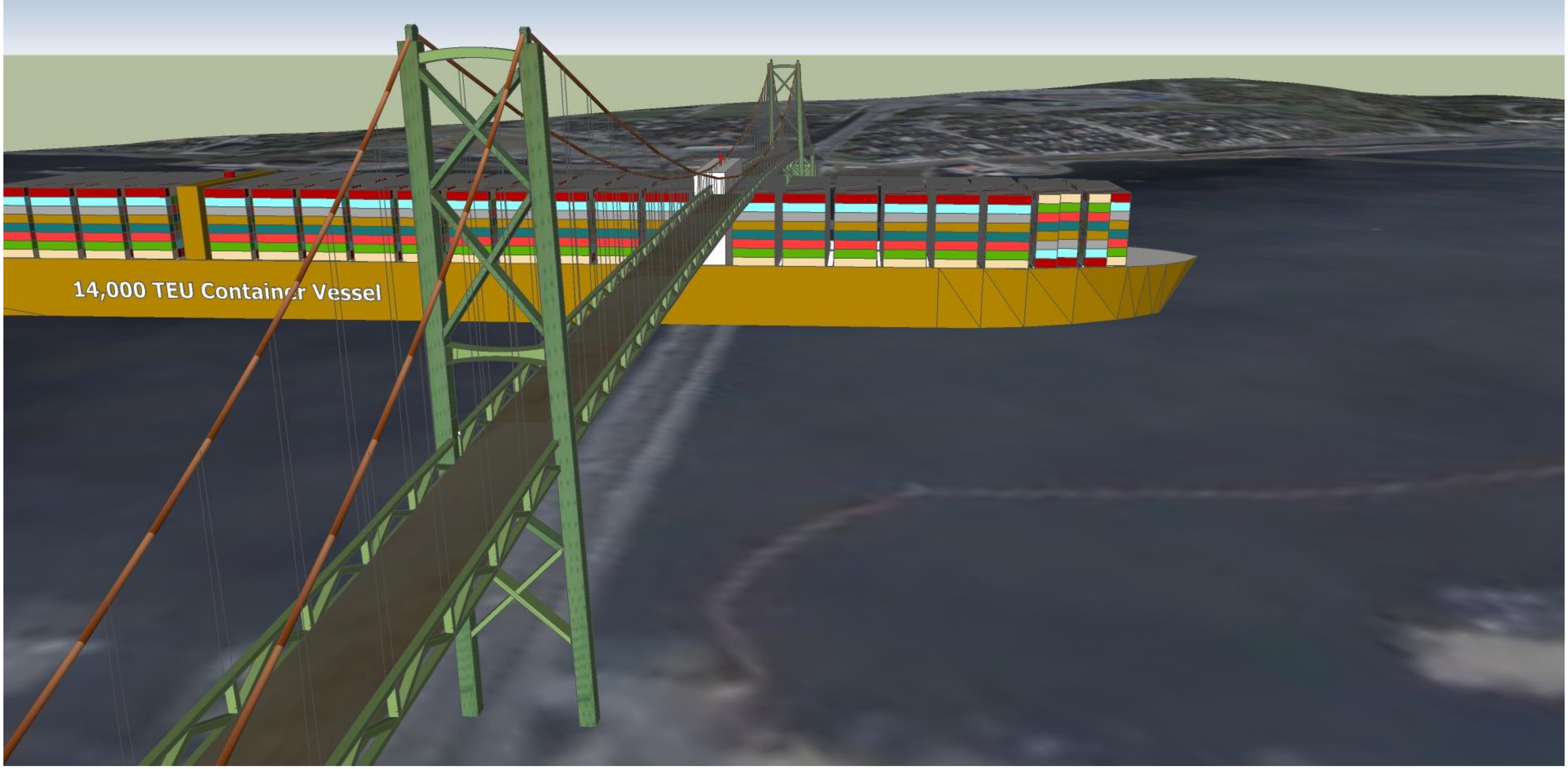
- → **Problems of Dimension**
- → **Problems of Volume**
  - Analytical Example
- → **Problems of Commerce**
- → **Problems of Finance**

- → **Planning Response**
- → **Future Progress**

PROBLEMS OF DIMENSION



A PROBLEM OF DIMENSION



PROBLEMS OF VOLUME: ANALYTICAL EXAMPLE

- **Using <u>T</u>erminal <u>S</u>imulation <u>D</u>emand <u>M</u>odel** **(© 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**
  - <u>Same</u> 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

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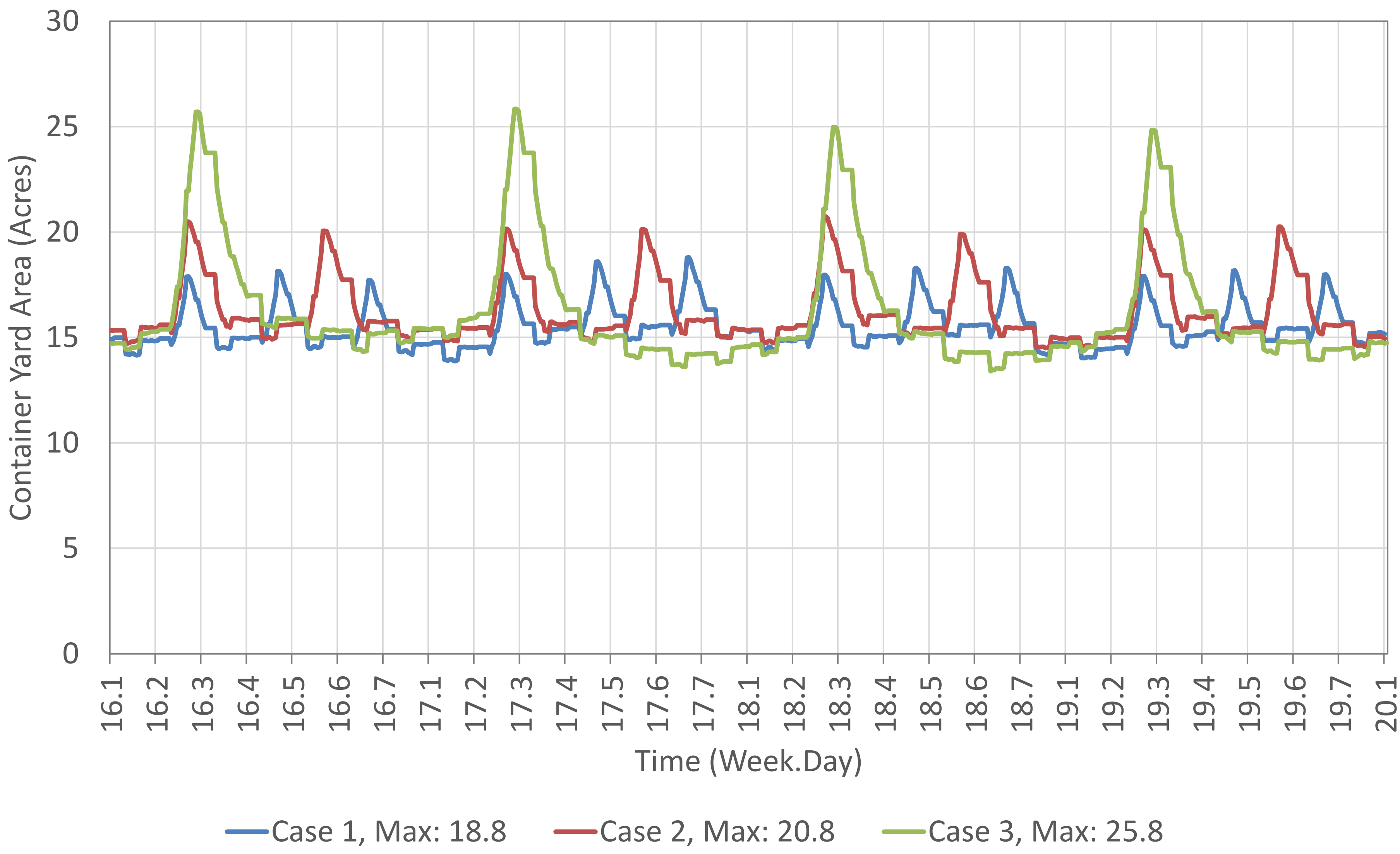
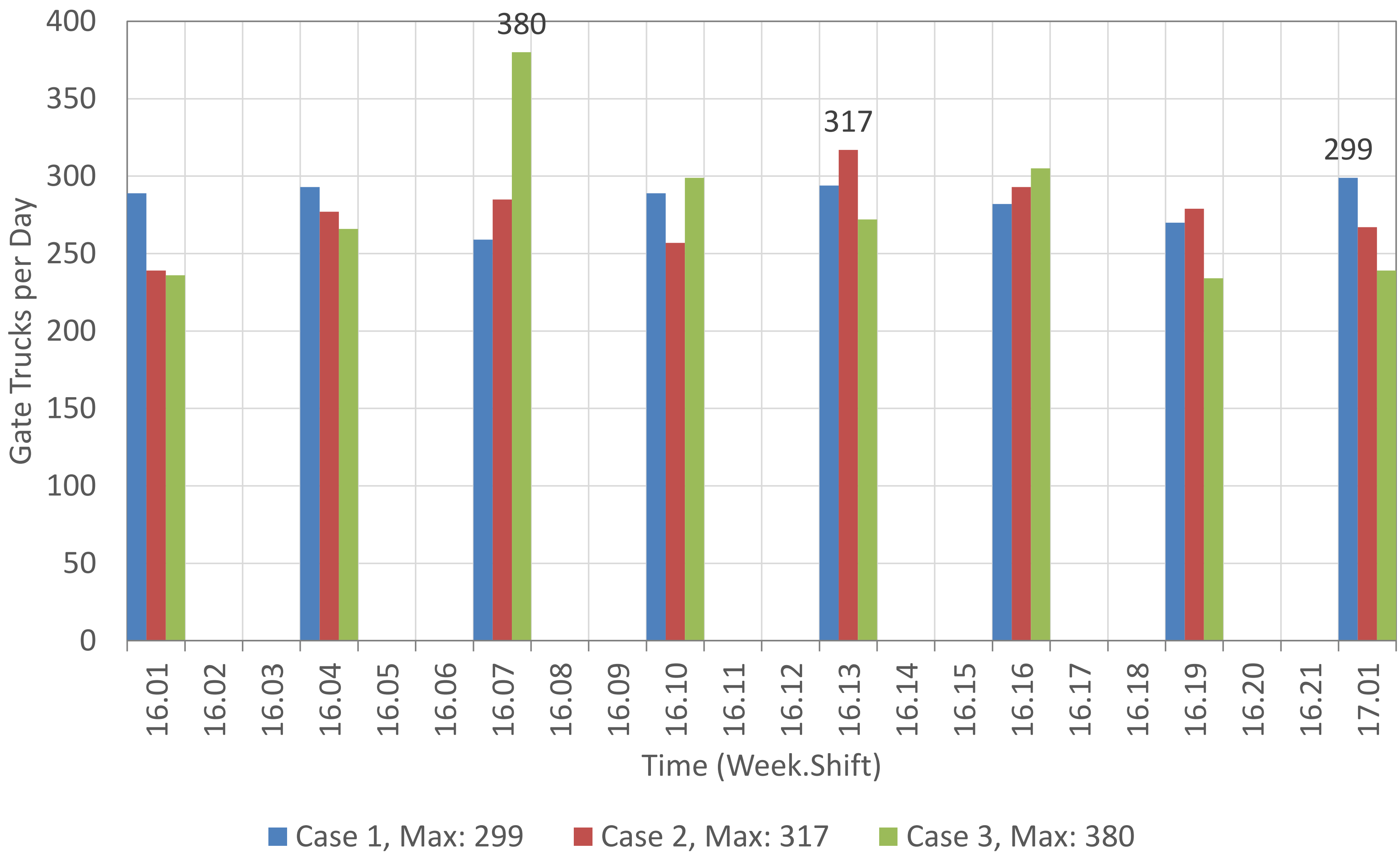
ANALYSIS: YARD AREA



Increased storage area for same volume:
Case 2: +11%, Case 3: +37%

ANALYSIS: GATE FLOW



<u>Increased boundary flow for same volume</u>:
Case 2: +6%, Case 3: +27%

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PROBLEMS OF VOLUME

For the <u>same</u> 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 <u>duration</u>,
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

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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**

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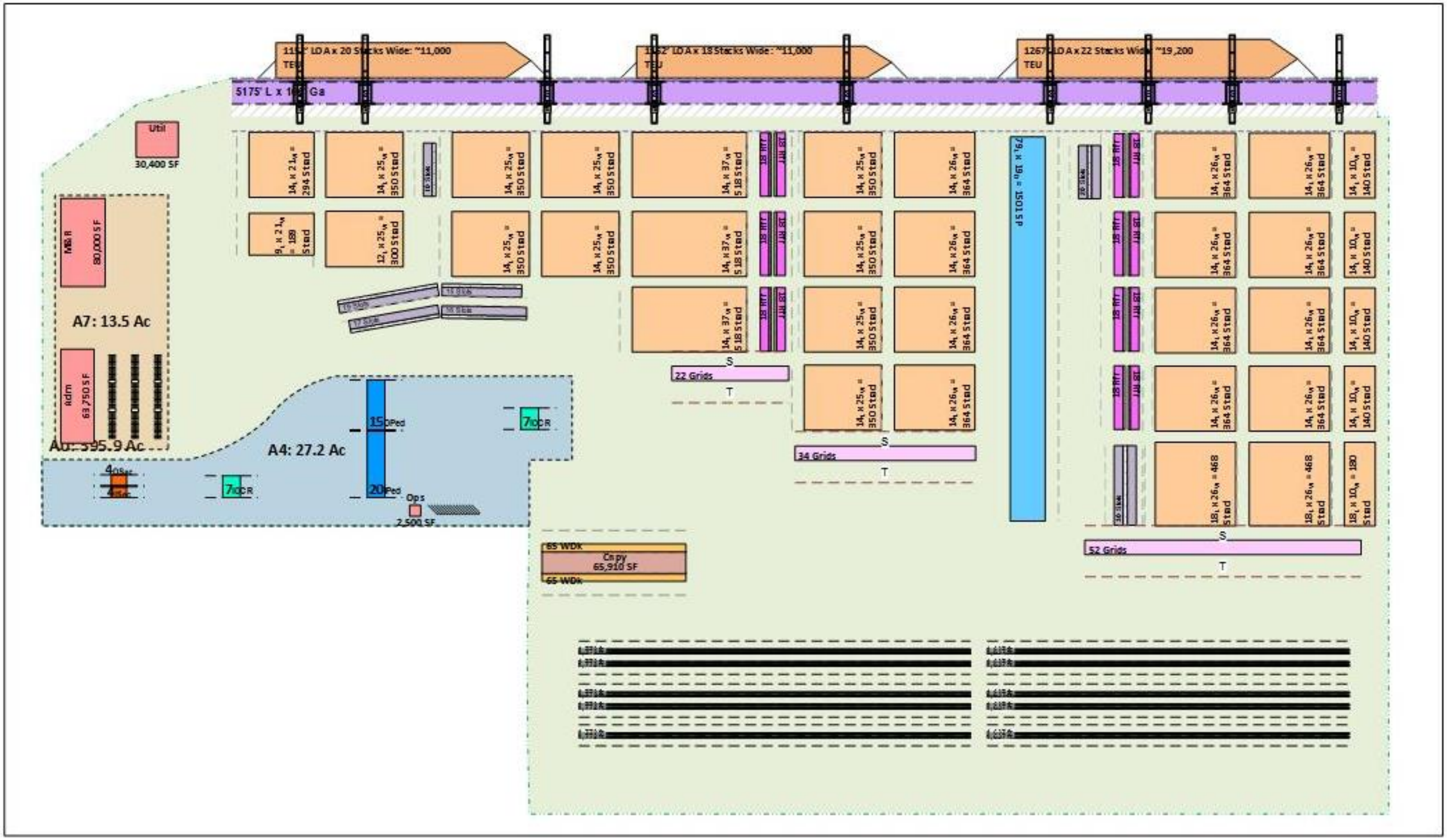
PLANNING RESPONSE

- → **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**

PRIME | TERMINAL



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**

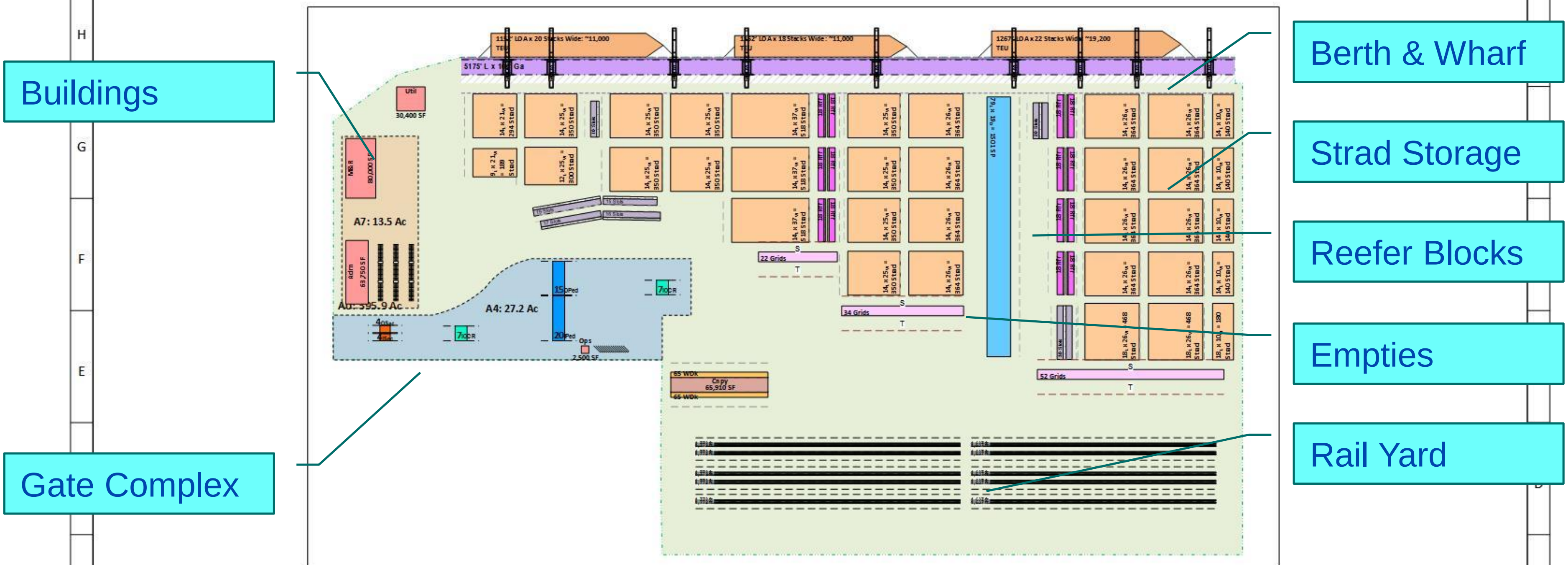
PRIME GENERAL ARCHITECTURE

- → **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



Block Type:	Capacity	
Side Pick / ECH:	1,501	TGS
Straddle Carrier:	11,531	TGS
Reefer Rack:	252	FGS
In Gate Sec:	4	Lanes
In Gate OCR:	14	Lanes
In Gate Pedestal:	20	Lanes
Out Gate Pedestal:	15	Lanes
Out Gate Sec:	4	Lanes

Variable	Units	Plan Value
Berth Length	Feet	5,175
Storage Capacity	TEUs	29,182
Rail Yard Working Track	Feet	34,090
Berth Constrained Capacity	L/Yr	1,109,000
	TEU/Yr	1,923,000
Berth Velocity	L/Ft/Yr	214
Yard Constrained Capacity	L/Yr	832,000
	TEU/Yr	1,442,000
Yard Velocity	TEU/TEU/Yr	49
Rail Yard Capacity	L/Yr	348,000
	TEU/Yr	604,000
Rail Velocity	L/Ft/Yr	10
Rail Constrained Capacity	L/Yr	2,903,000
	TEU/Yr	5,034,000
Capacity	L/Yr	832,000
	TEU/Yr	1,442,000
Quay Cranes	#	9

- Wharf Deck Between Rails
- Automated Stacking Crane (ASC) Storage
- Straddle Carrier (SC) Storage
- Empty Container (ECH) Storage
- Reefer Storage | Access Racks
- Straddle / Shuttle Carrier Parking
- Automated Stacking Crane (ASC) Storage
- Gate Area
- Truck Circulating Area
- Shuttle Circulating Area
- Strad Circulating Area
- Automated Stacking Crane (ASC) Storage
- Straddle Carrier (SC) Storage
- Shuttle / ASC Interchange
- Shuttle / Truck Interchange

0 240 400 800
Scale: 1in = 600ft.

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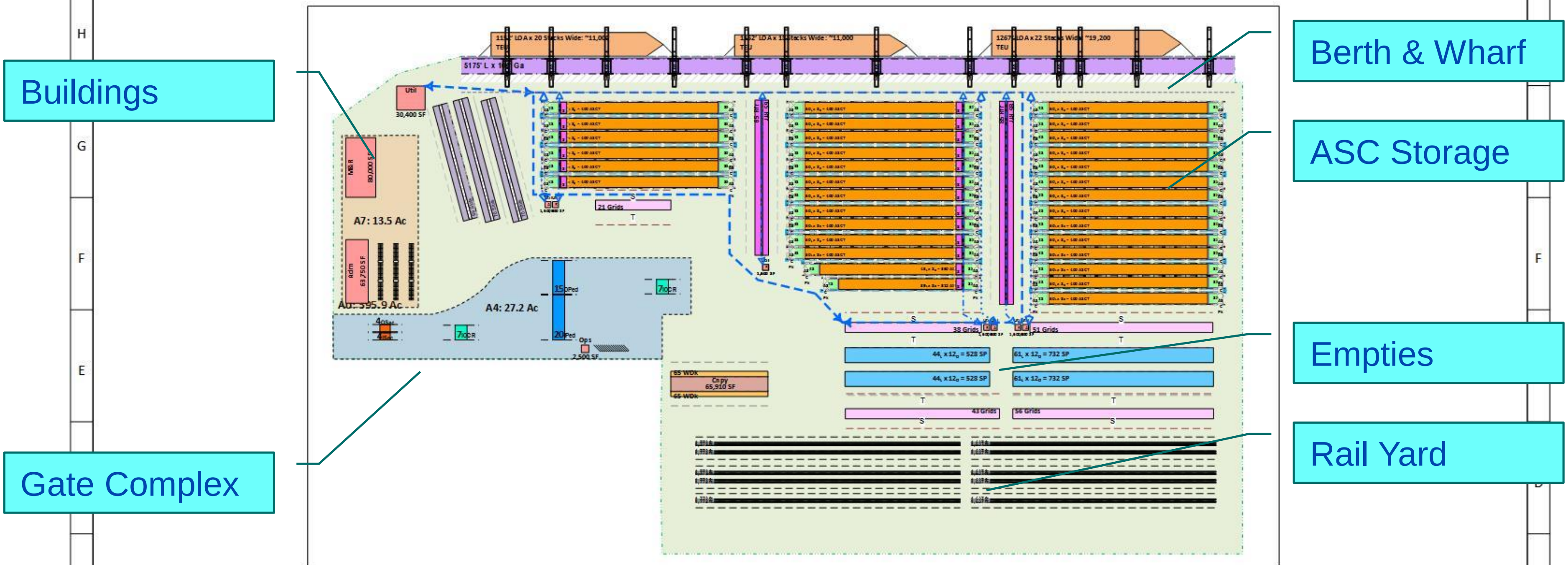
FINAL LAYOUT



Block Type:	Capacity	
Side Pick / ECH:	2,520	TGS
Auto Stacking Crane:	12,616	TGS
Reefer Rack:	452	FGS
In Gate Sec:	4	Lanes
In Gate OCR:	14	Lanes
In Gate Pedestal:	20	Lanes
Out Gate Pedestal:	15	Lanes
Out Gate Sec:	4	Lanes

Variable	Units	Plan Value
Berth Length	Feet	5,175
Storage Capacity	TEUs	63,737
Rail Yard Working Track	Feet	34,090
Berth Constrained Capacity	L/Yr	1,446,000
	TEU/Yr	2,508,000
Berth Velocity	L/Ft/Yr	279
Yard Constrained Capacity	L/Yr	2,051,000
	TEU/Yr	3,557,000
Yard Velocity	TEU/TEU/Yr	56
Rail Yard Capacity	L/Yr	388,000
	TEU/Yr	673,000
Rail Velocity	L/Ft/Yr	11
Rail Constrained Capacity	L/Yr	3,232,000
	TEU/Yr	5,606,000
Capacity	L/Yr	1,446,000
	TEU/Yr	2,508,000
Quay Cranes	#	13

- Wharf Deck Between Rails
- Automated Stacking Crane (ASC) Storage
- Straddle Carrier (SC) Storage
- Empty Container (ECH) Storage
- Reefer Storage | Access Racks
- Straddle / Shuttle Carrier Parking
- Automated Stacking Crane (ASC) Storage
- Gate Area
- Truck Circulating Area
- Shuttle Circulating Area
- Strad Circulating Area
- Automated Stacking Crane (ASC) Storage
- Straddle Carrier (SC) Storage
- Shuttle / ASC Interchange
- Shuttle / Truck Interchange

0 240 400 800
Scale: 1in = 600ft.

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Sheet A5b, Page 11 of 11
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Sheet
A5b

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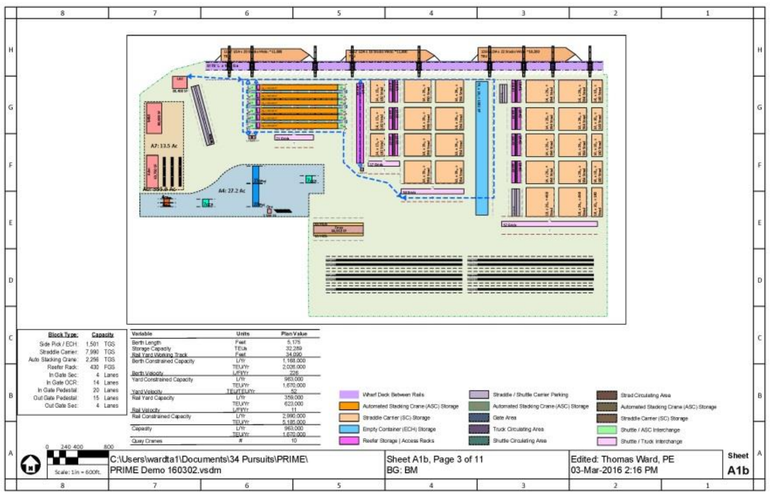
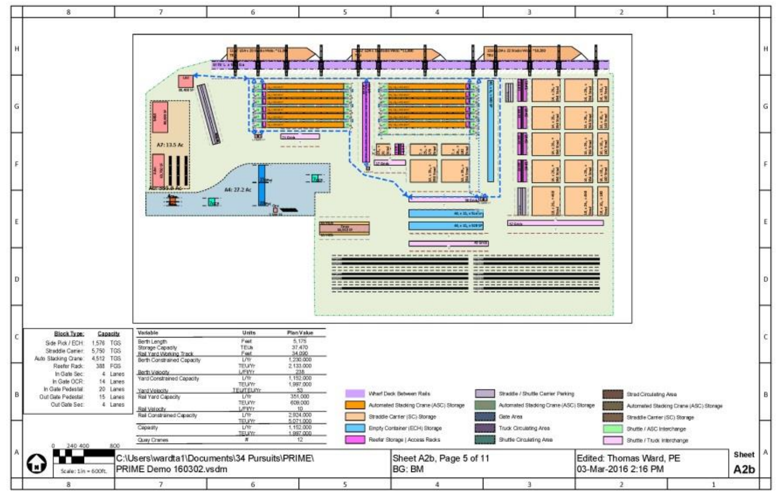
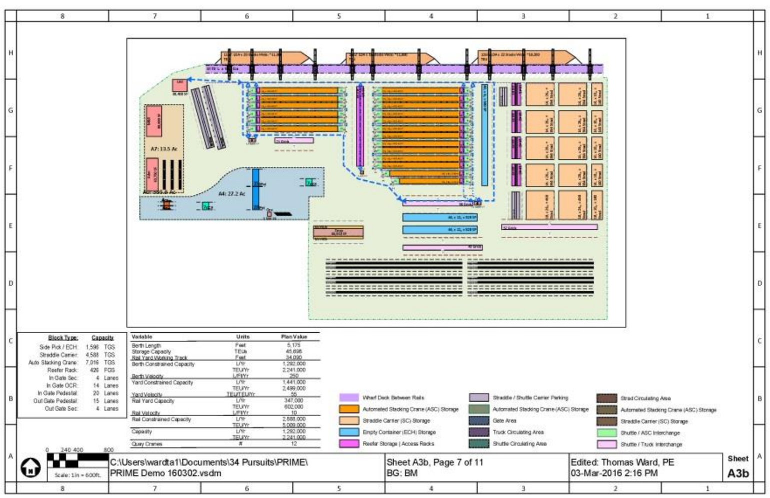
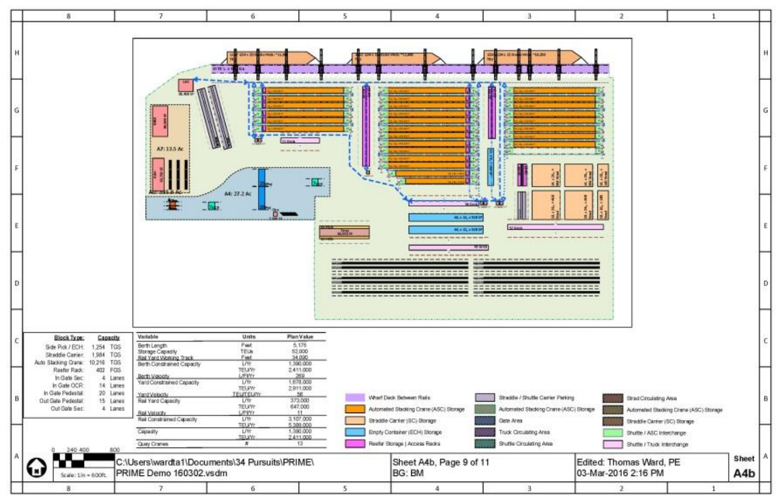
PHASED DEVELOPMENT









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STATISTICS TRANSFERRED TO PRIME MODEL

	Ground Slots in Visio Layout: PRIME Demo 160302.vsdm on 3/2/2016 at 17:02:21										
Block Name	**A0**	**A1a**	**A1b**	**A2a**	**A2b**	**A3a**	**A3b**	**A4a**	**A4b**	**A5a**	**A5b**
RfRk ASC	0	0	96	96	192	192	304	304	304	304	304
RfRk Strad	504	504	764	584	584	548	548	332	500	428	600
SP	1,501	1,501	1,501	1,576	1,576	1,576	1,596	1,146	1,254	1,056	2,520
SP Taper	0	0	0	0	0	0	0	0	0	0	0
Strad	11,531	7,990	7,990	5,750	5,750	4,588	4,588	1,984	1,984	806	0
Strad Taper	0	0	0	0	0	0	0	0	0	0	0
RMG	0	0	0	0	0	0	0	0	0	0	0
ASC/MS	0	0	2,400	2,400	4,800	4,800	7,472	7,472	10,672	10,672	13,072
ASCS	0	0	-144	-144	-288	-288	-456	-456	-456	-456	-456

→ **Storage capacities as 20-foot ground slots**

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ANALYSIS MODEL CHARACTERISTICS

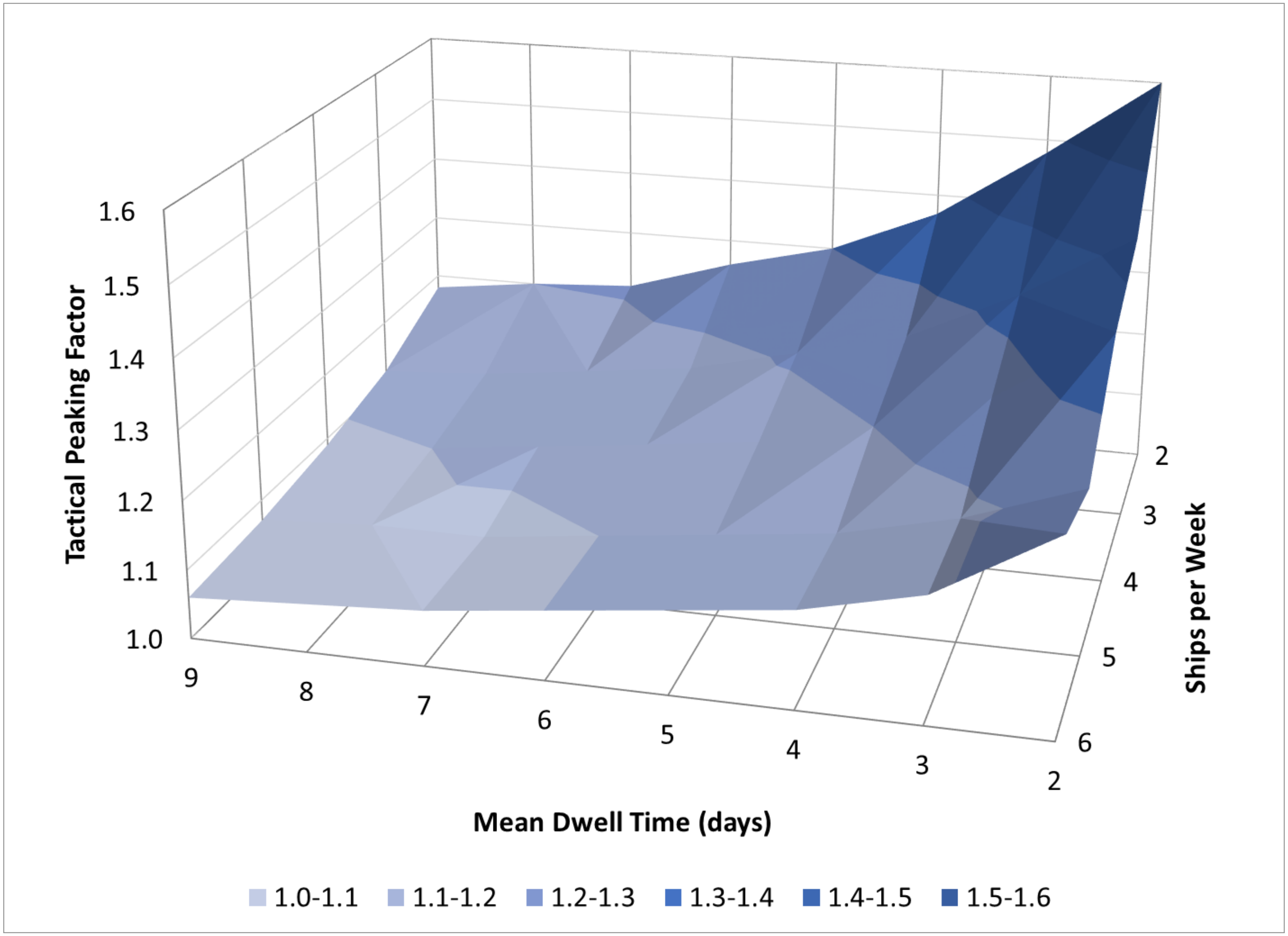
- → **Excel-based static model**
- → **Tied to plan via direct bilateral data transfer**
  - Using COM Add-Ins for Visio & Excel
- → **Single spreadsheet deals with all aspects of analysis**
  - Demand and Capacity
  - Equipment fleets, utilization, manning, costs
  - Infrastructure sizing, timing, impact, 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**

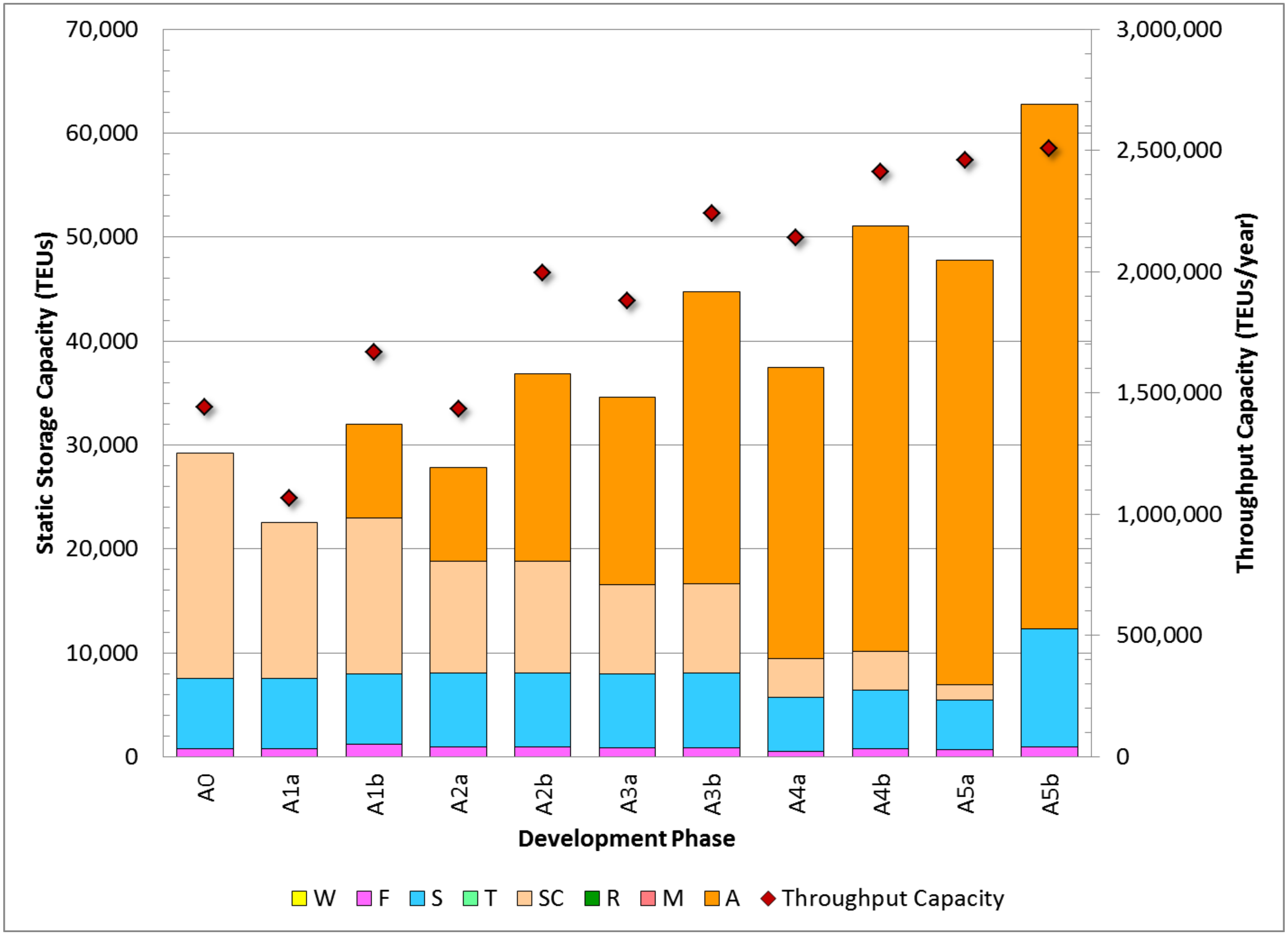
- → **All integrated and cross-referencing**

BERTH AND YARD CAPACITY LINKAGE

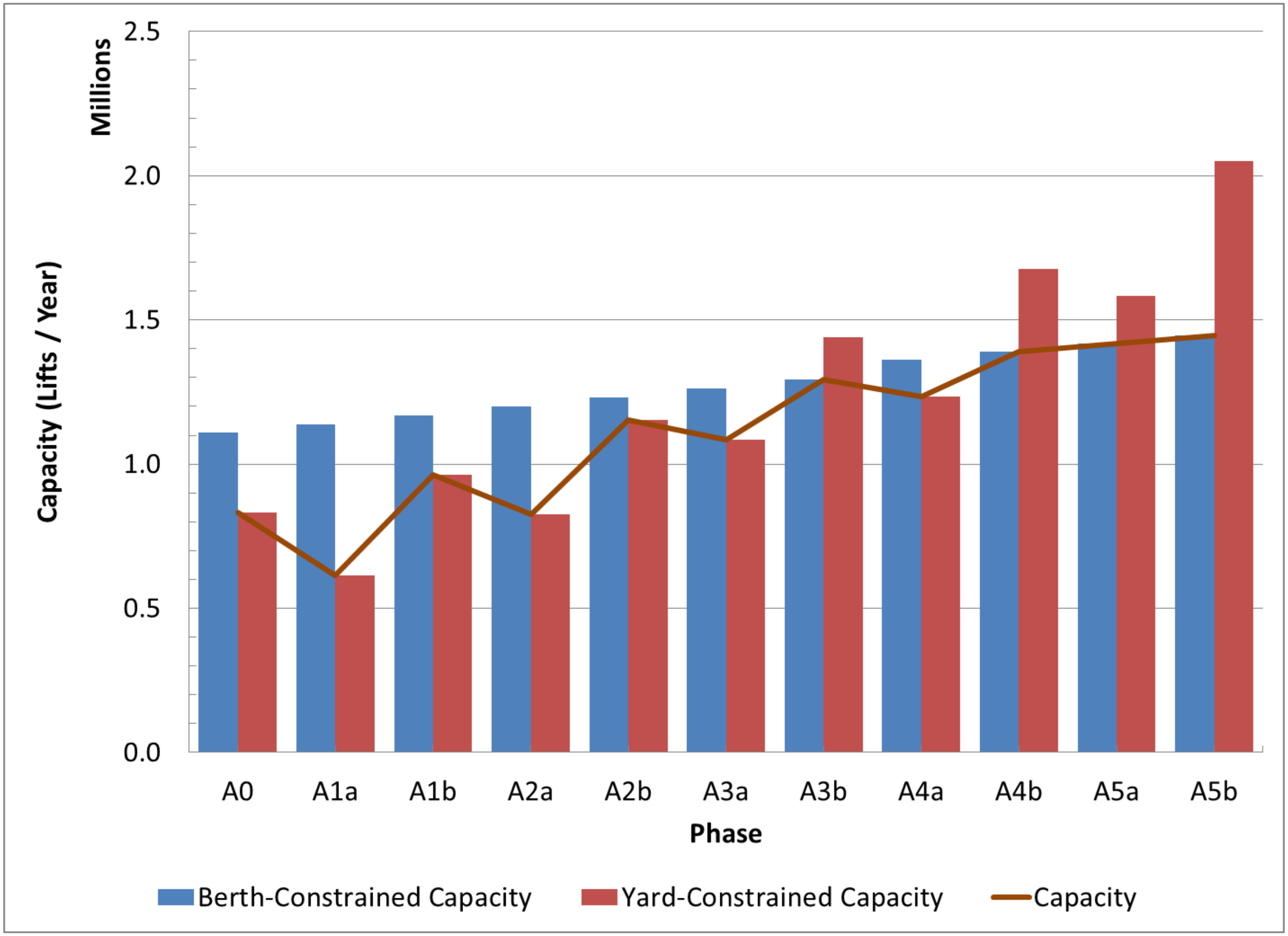


Fewer ships means more storage demand, more so for freight with short dwell times

STATIC STORAGE & THROUGHPUT CAPACITY



BERTH- AND YARD-CONSTRAINED CAPACITY



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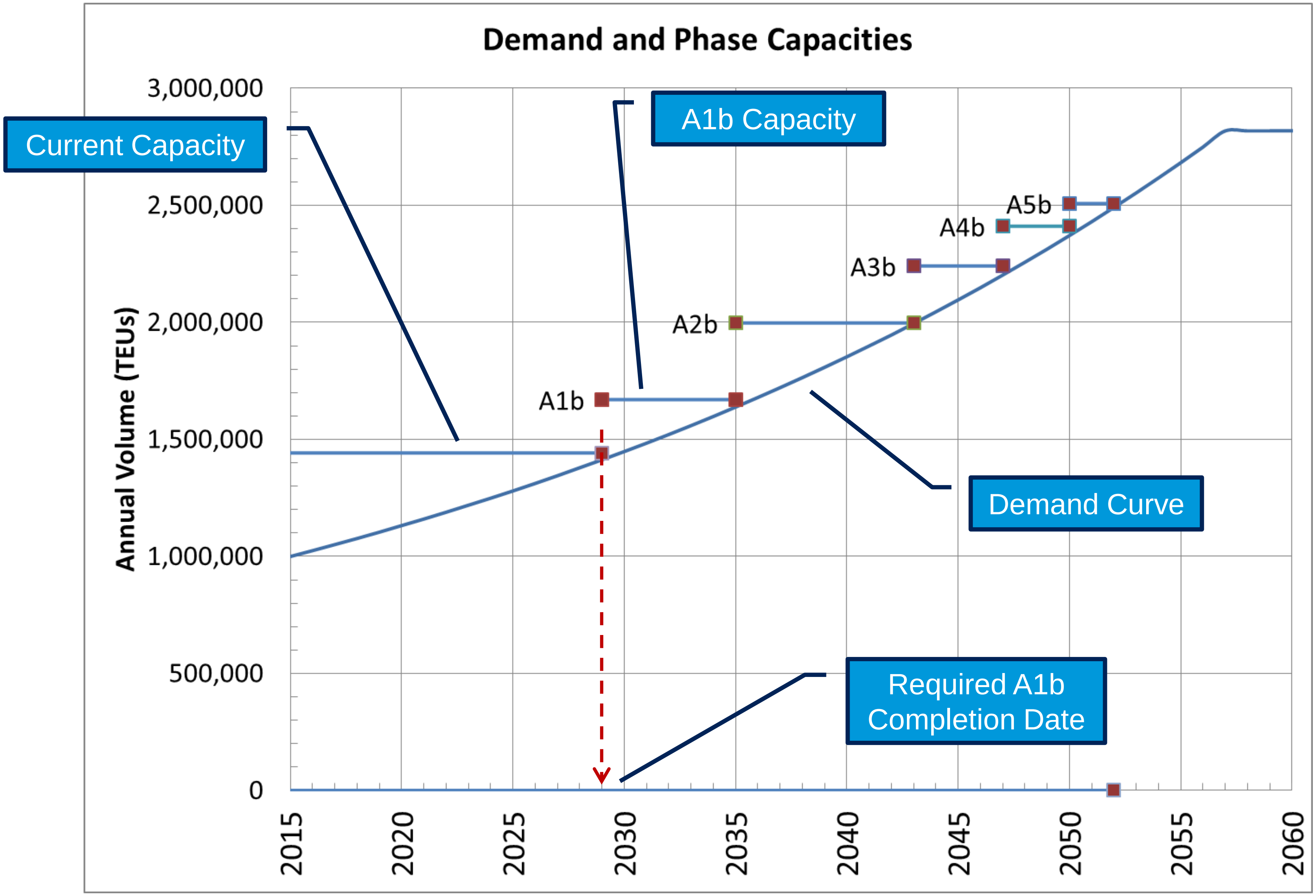
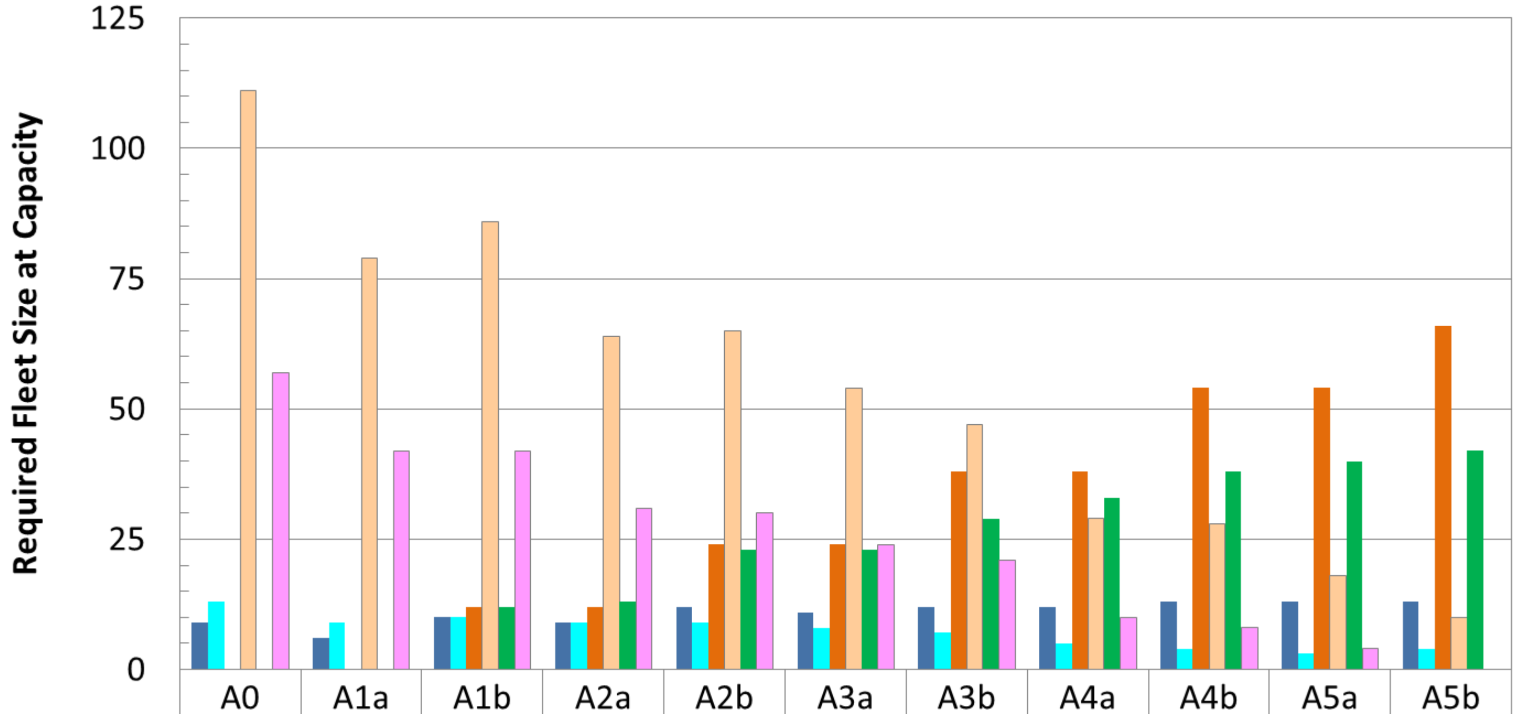
PHASE TIMING VS. DEMAND



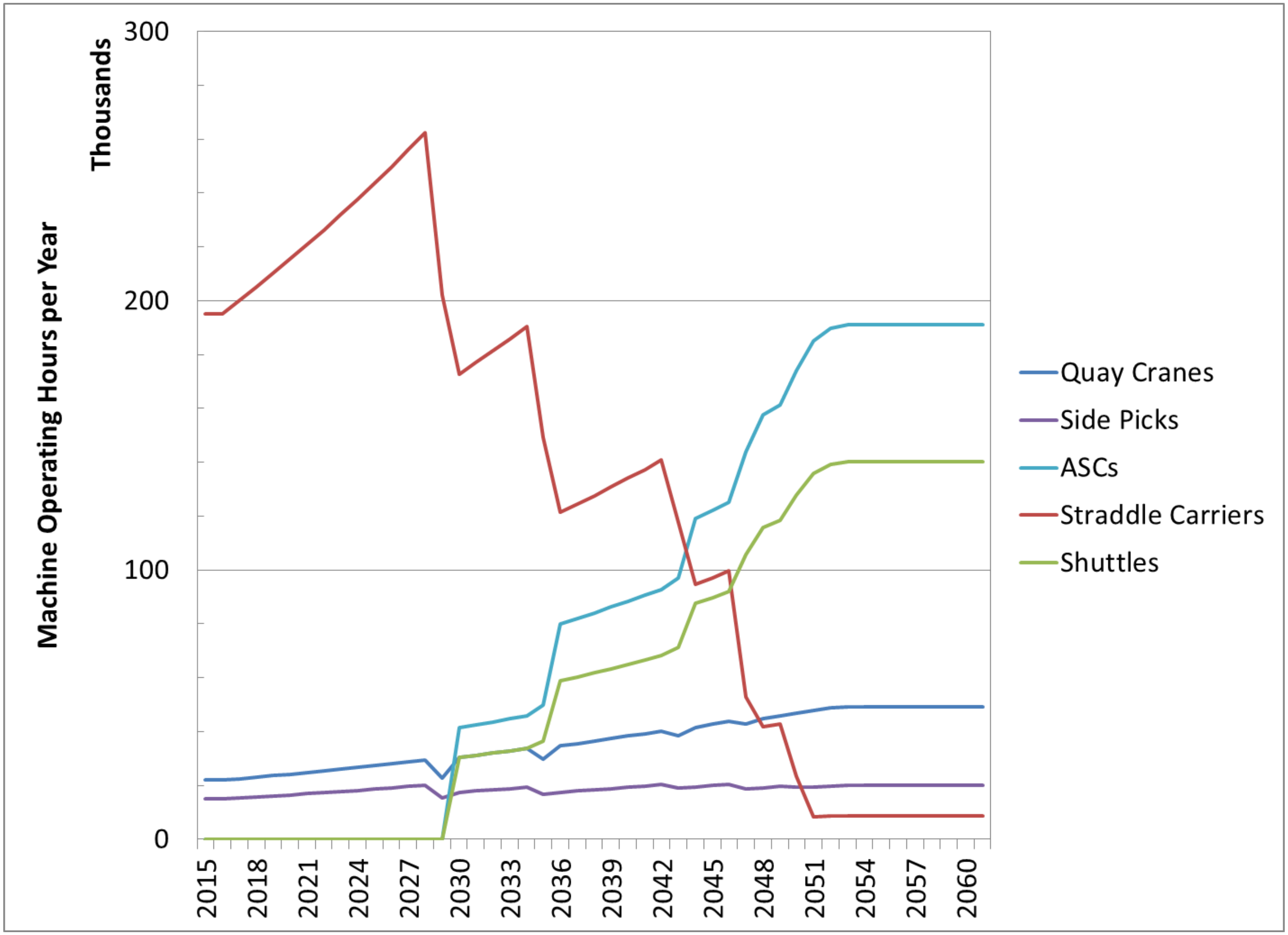
EQUIPMENT FLEET SIZING



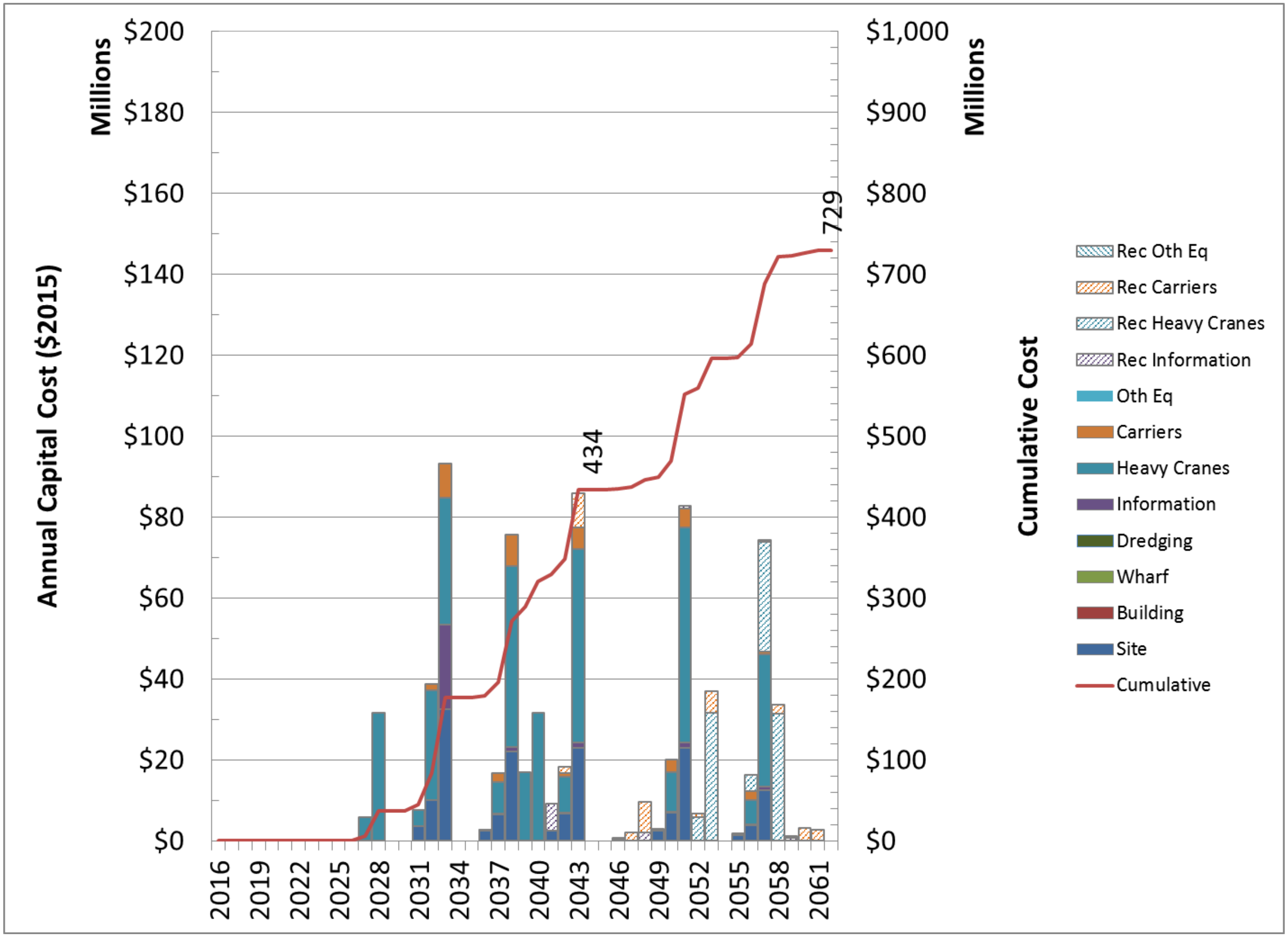
	A0	A1a	A1b	A2a	A2b	A3a	A3b	A4a	A4b	A5a	A5b
STS	9	6	10	9	12	11	12	12	13	13	13
ECHs	13	9	10	9	9	8	7	5	4	3	4
ASCs	0	0	12	12	24	24	38	38	54	54	66
Strads	111	79	86	64	65	54	47	29	28	18	10
Shuttles	0	0	12	13	23	23	29	33	38	40	42
Grids	57	42	42	31	30	24	21	10	8	4	0

Terminal Layout

MACHINE OPERATING HOURS PER YEAR



CAPEX CASH FLOW



PRIME | PORT
PORT OF LONG BEACH LAND USE STUDY

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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**