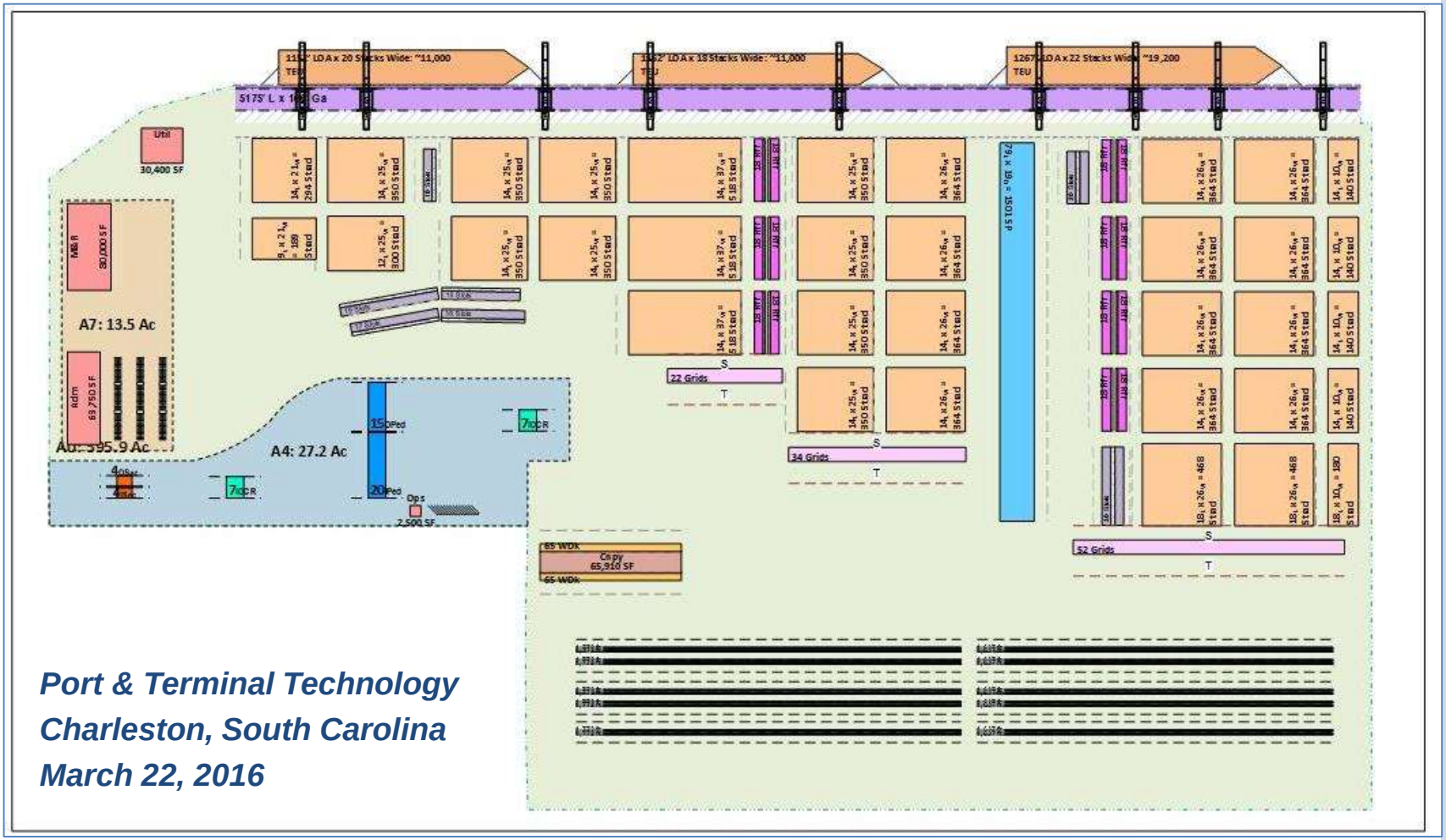
The Benefits of an Integrated Approach



Port & Terminal Technology
Charleston, South Carolina
March 22, 2016

WSP | PARSONS BRINCKERHOFF
PORT&TERMINAL Technology

The Challenge

- Taking a decision on port development is complex
- Many factors drive a “go” or “no-go” decision
  Capacity, Demand, Impact, Capital Expense, Operating Expense, Cash Flow, Labor, Flexibility, Technology
- Complexity manifests in a mix of plans and analyses that are very *poorly integrated*
- Complexity *narrows the range* of options to be considered, in full, in a short time frame

- *The “go” / “no-go” decision can end up driven by flawed analysis of poor choices*

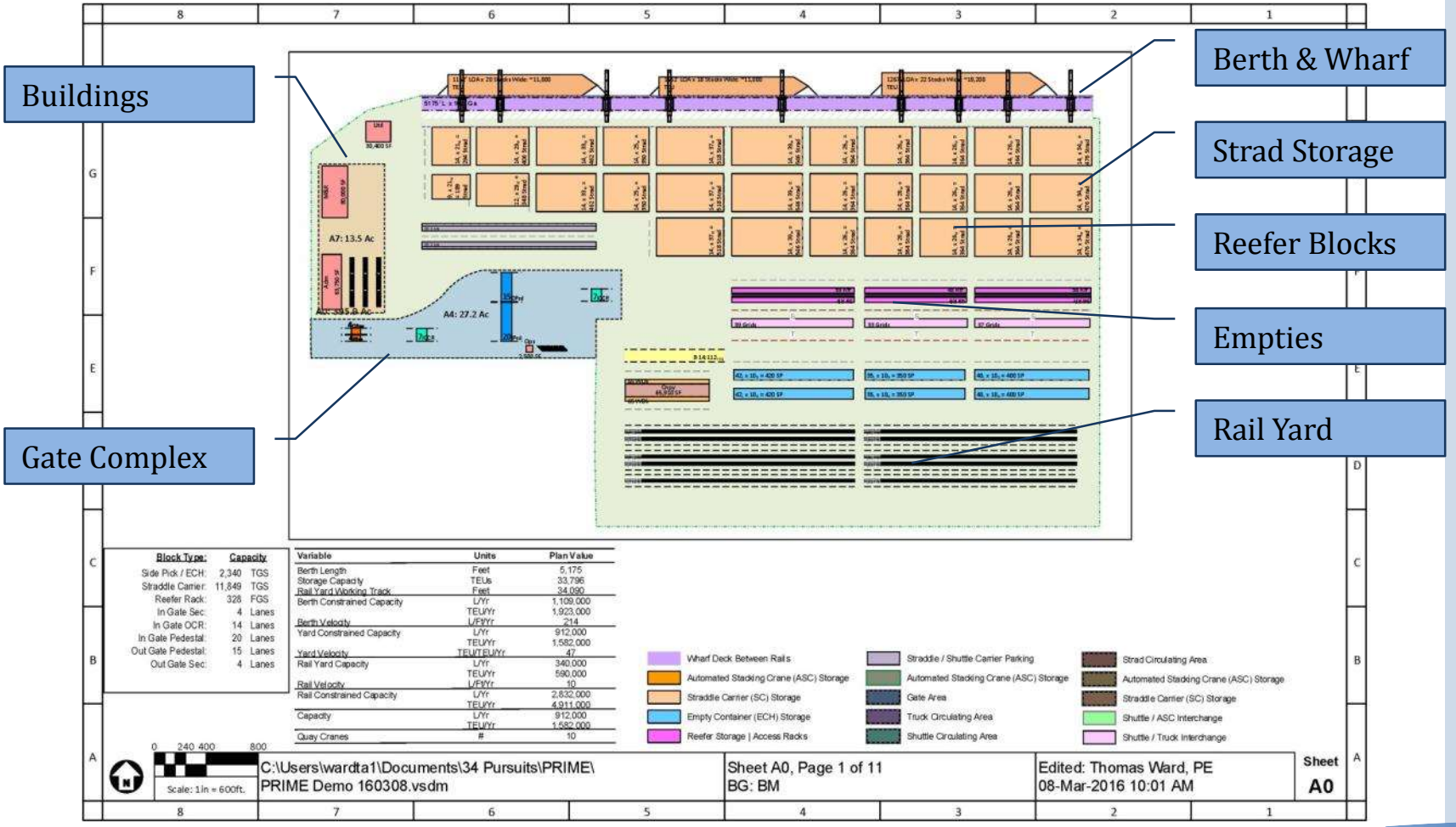
PRIME

- Port / Rail / Intermodal Modeling Environment
- 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
- Site planning in Microsoft Visio
- Operational model in Microsoft Excel
- Tight, direct integration between plans and model

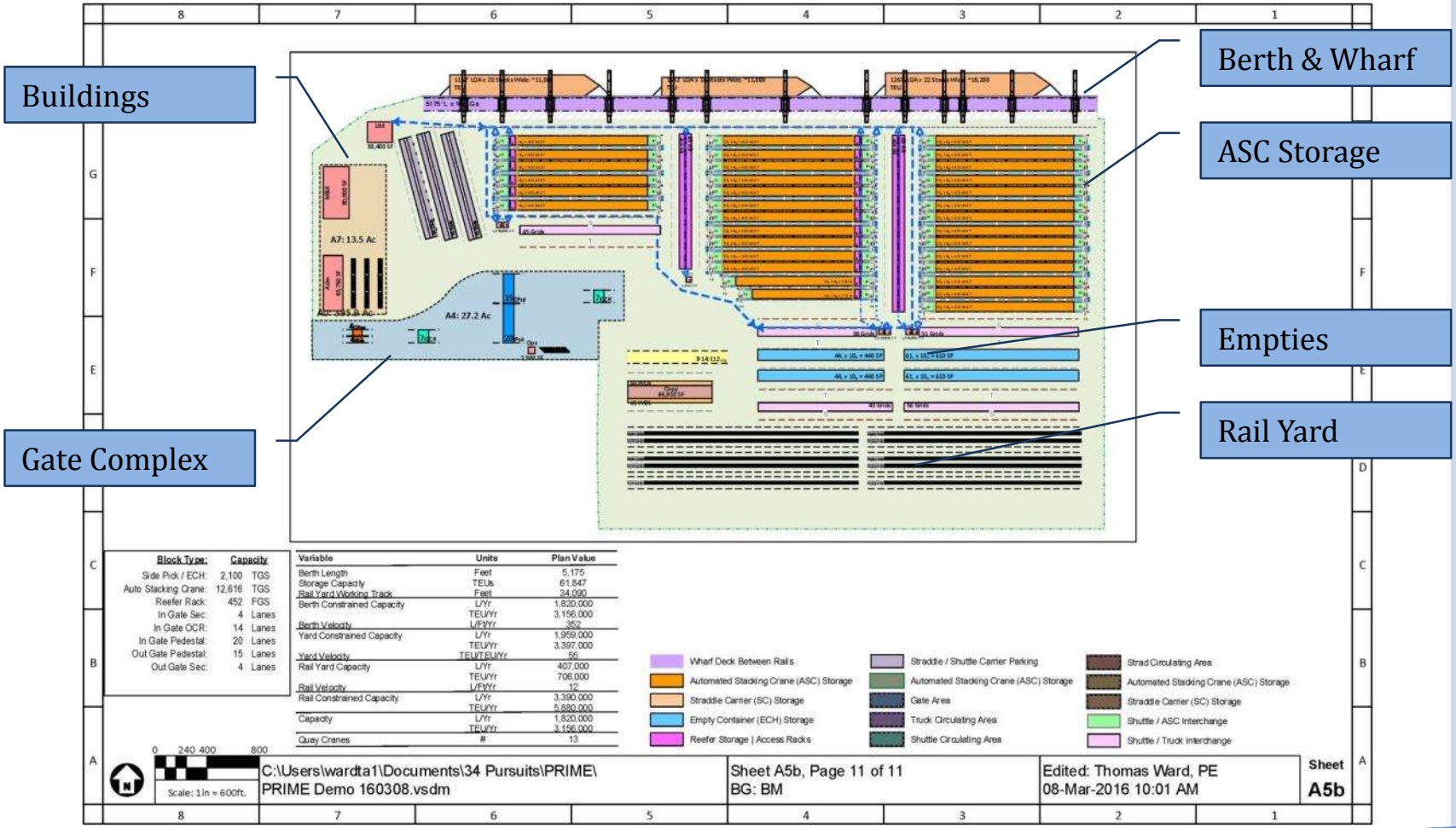
Example

- 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

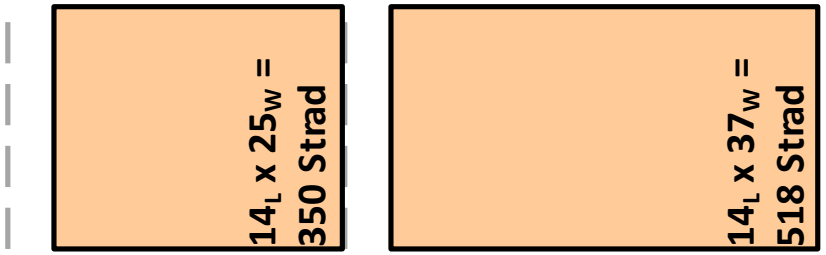
Initial Layout



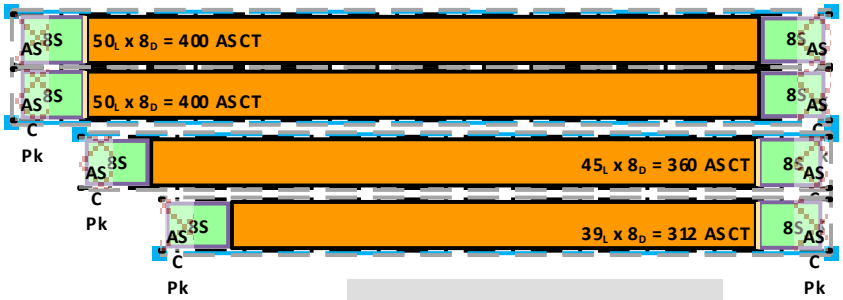
“Parallel ASC” Option



Yard Components



- Straddle Carrier-based storage
- Container gaps specified by planner
- Clearance gaps indicated
- Slot counts automatically calculated by the shape



- Stacking crane-based storage
- Crane, rail, end zone, clearance dimensions fixed
- Storage area stretches with shape
- Slot counts automatically calculated

Shape Data - ...

Bay Gap	40.00 cm.
Stack Gap	40.00 cm.
Block Type	ASCT
Rail Gap	4.00 ft.
Cable Gap	4.00 ft.
Side Gap	3.00 ft.
AST Buf Depth	2
Number of Stacks	8

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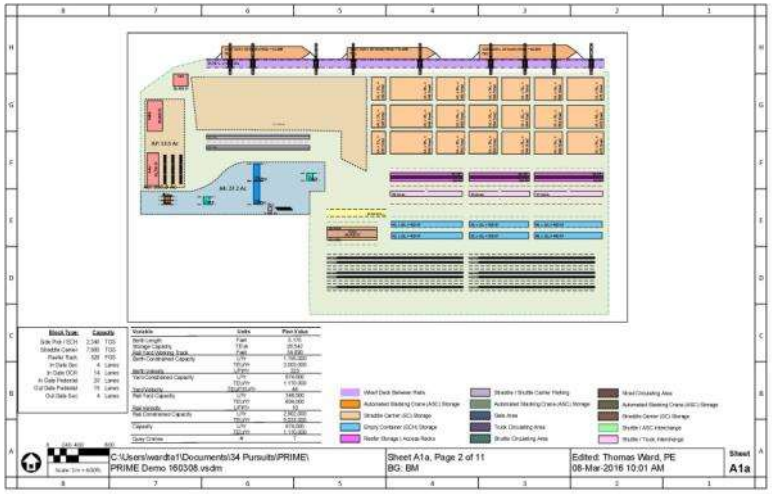
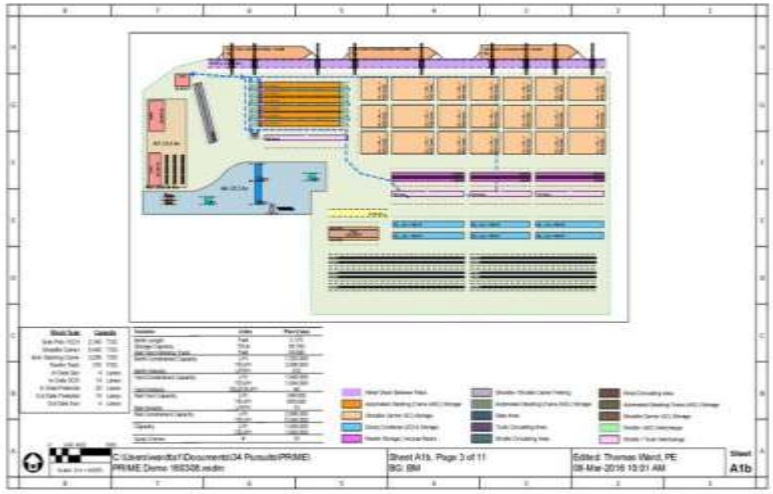
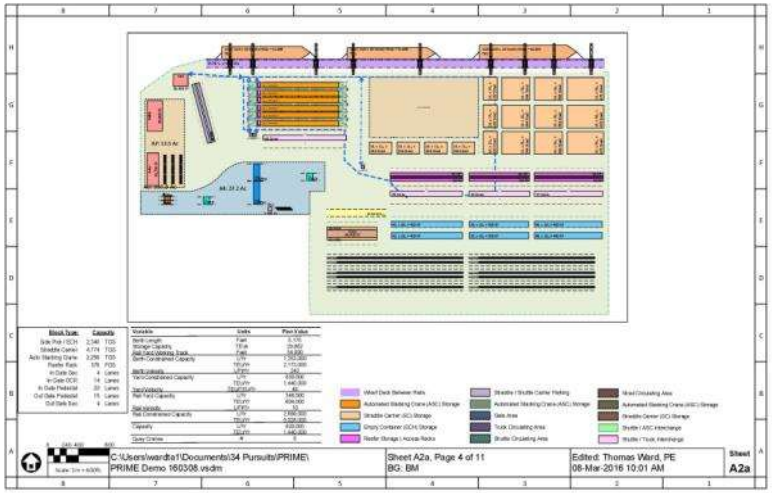
Phased Development – Phases 1, 2

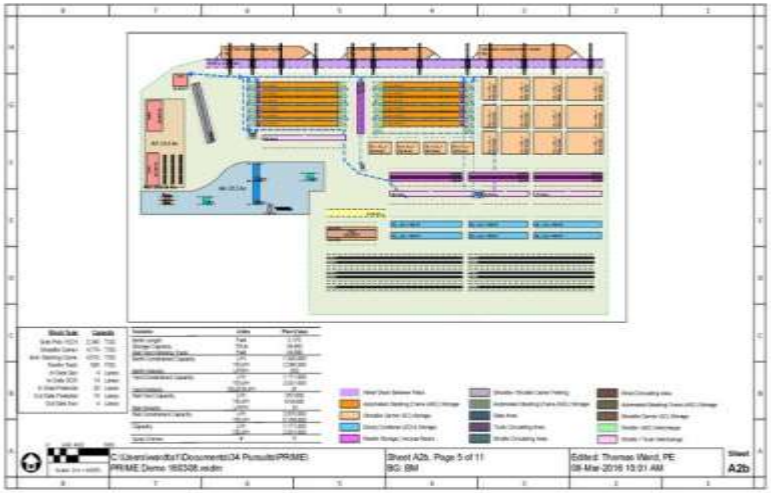
- Phases developed to allow continued safe operation during transition
- “a” phases reflect decommissioning an area for construction
- “b” phases reflect the completion of a conversion phase
- Components in each phase configured to keep the yard in balance
- Requires close coordination between plans and capacity model
- Capacity model must track both reduction and augmentation of capacity
- Capacity model must deal with operational costs and performance at each phase

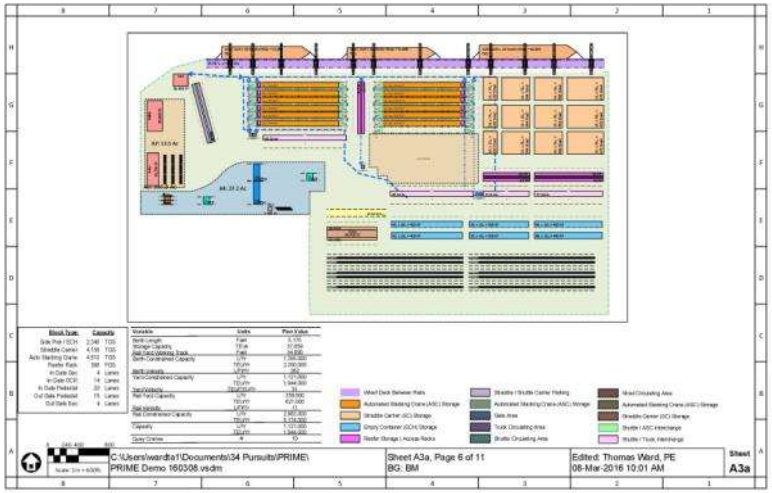


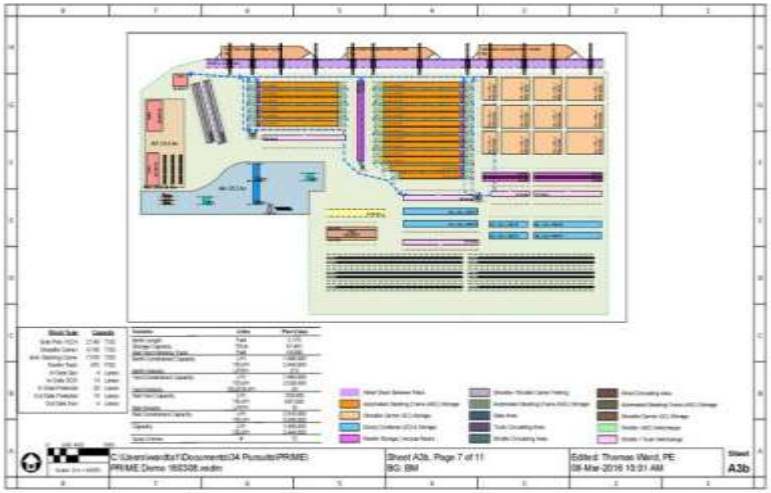


Phases 2, 3

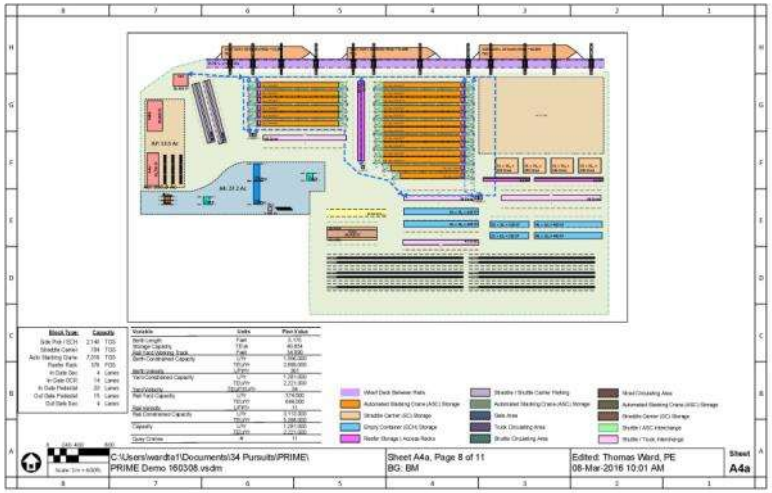


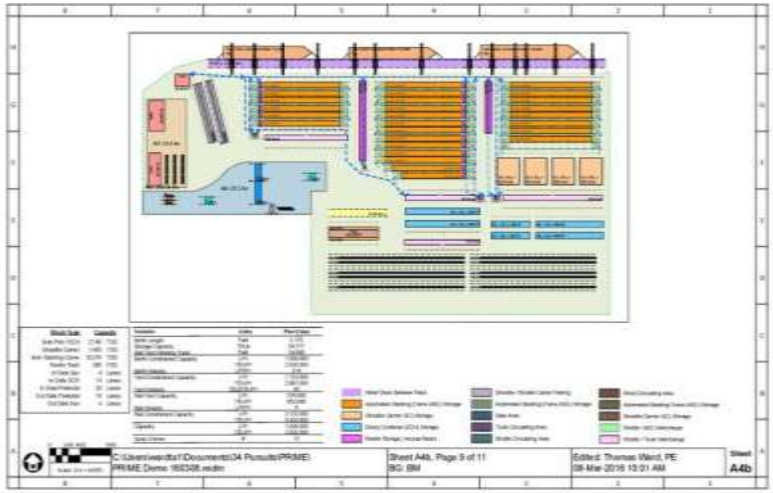


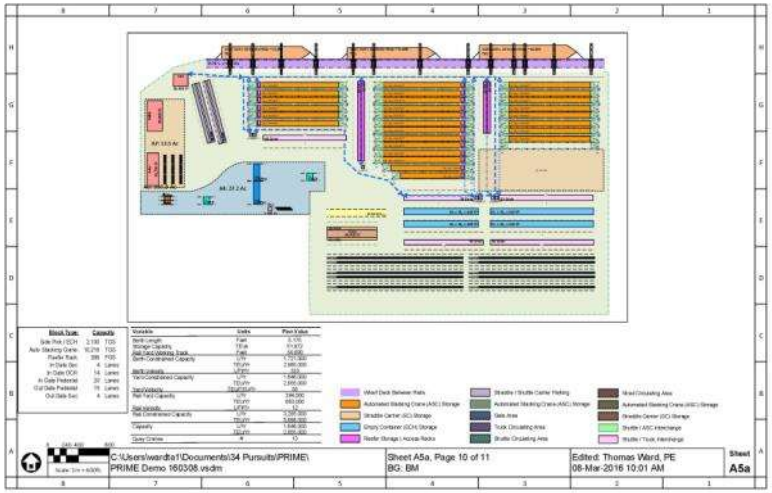


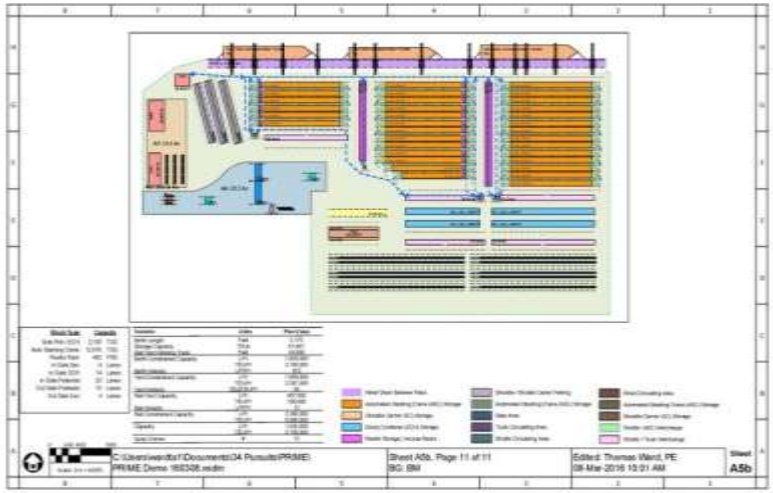


Phases 4, 5

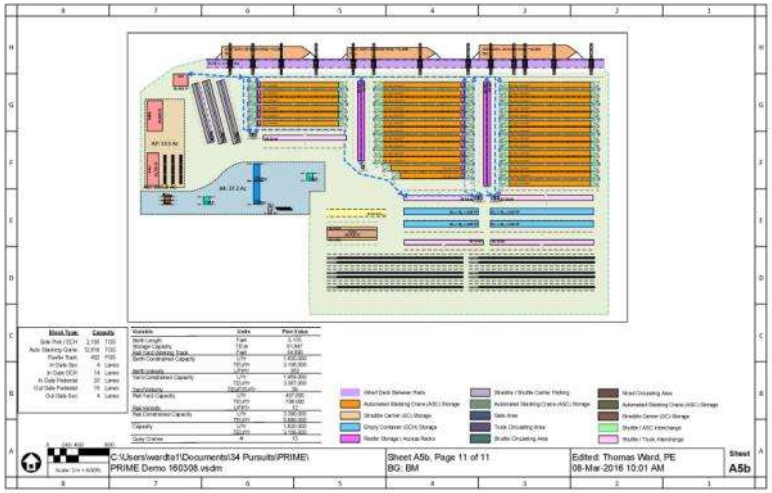








Phased Development



Block Type:	Capacity	
Side Pick / ECH:	2,100	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

- Storage capacities and other site characteristics calculated automatically
- Displayed on the drawing
- Transferred to the analysis model

Statistics Transferred to Model

	Ground Slots in Visio Layout: PRIME Demo 160308.vsdm on 3/8/2016 at 09:11:37										
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	656	656	656	656	824	544	636	448	428	428	600
SP	2,340	2,340	2,340	2,340	2,340	2,340	2,140	2,140	2,140	2,100	2,100
Strad	11,849	7,980	8,442	4,774	4,774	4,158	4,158	784	1,400	0	0
ASC/MS	0	0	2,400	2,400	4,800	4,800	7,472	7,472	10,672	10,672	13,072

- All elements of the Visio drawing are scanned
- All elements are reported directly to the Excel model
- Storage capacities are presented as 20-foot ground slots

Statistics Transferred to Model

	Storage Blocks in Visio Layout: PRIME Demo 160308.vsdm on 3/8/2016 at 09:11:37										
Block Name	**A0**	**A1a**	**A1b**	**A2a**	**A2b**	**A3a**	**A3b**	**A4a**	**A4b**	**A5a**	**A5b**
SP	6	6	6	6	6	6	6	6	6	4	4
Strad	29	21	21	16	16	12	12	4	4	0	0
O	656	656	656	656	656	376	376	188	84	84	0
N	0	0	0	0	168	168	260	260	344	344	600
RfRk ASC	0	0	6	6	12	12	19	19	19	19	19
ASC/MS	0	0	6	6	12	12	19	19	27	27	33
Subtotal ASC	0	0	6	6	12	12	19	19	27	27	33
ASC/XX	0	0	0	0	1	1	0	0	1	1	0
Active ASC	0	0	6	6	12	12	19	19	27	27	33
Built ASC Blocks	0	0	6	6	13	13	19	19	28	28	33
	Berth Availability										
Block Name	**A0**	**A1a**	**A1b**	**A2a**	**A2b**	**A3a**	**A3b**	**A4a**	**A4b**	**A5a**	**A5b**
Wharf	5,175	5,175	5,175	5,175	5,175	5,175	5,175	5,175	5,175	5,175	5,175
Berth Out	0	0	0	0	0	0	0	0	0	0	0
Net Berth	5,175	5,175	5,175	5,175	5,175	5,175	5,175	5,175	5,175	5,175	5,175

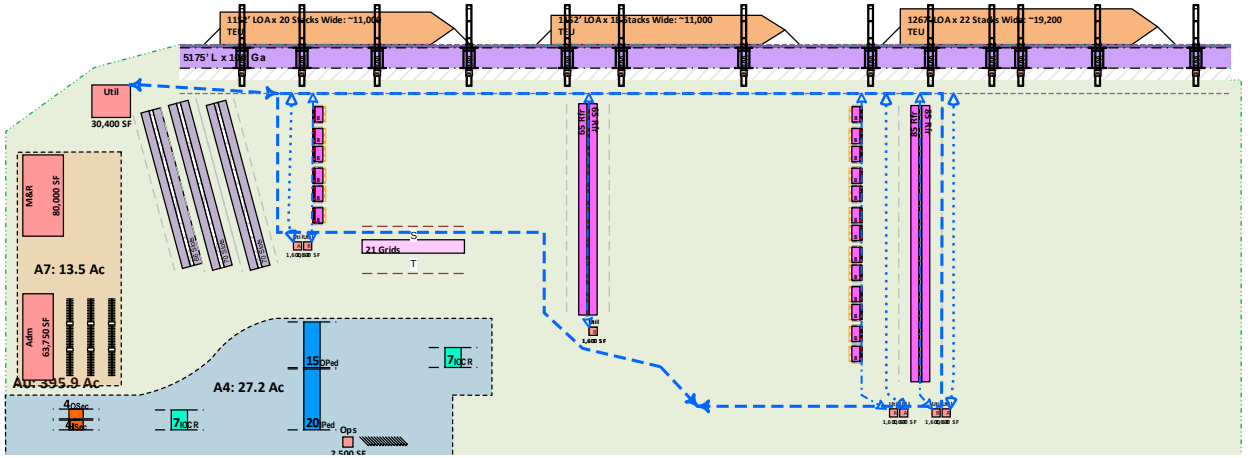
- Storage block counts
- Wharf length

Statistics Transferred to Model

Block Name	A0	A1a	A1b	A2a	A2b	A3a	A3b	A4a	A4b	A5a	A5b
IGate Bth_0	4	4	4	4	4	4	4	4	4	4	4
IGate Lns_1	14	14	14	14	14	14	14	14	14	14	14
IGate Lns_0	20	20	20	20	20	20	20	20	20	20	20
OGate Lns_0	15	15	15	15	15	15	15	15	15	15	15
OGate Bth_0	4	4	4	4	4	4	4	4	4	4	4
In/Out Peds	35	35	35	35	35	35	35	35	35	35	35
Track	34,090	34,090	34,090	34,090	34,090	34,090	34,090	34,090	34,090	34,090	34,090

- Gate lanes
- Intermodal rail working tracks

Infrastructure Elements



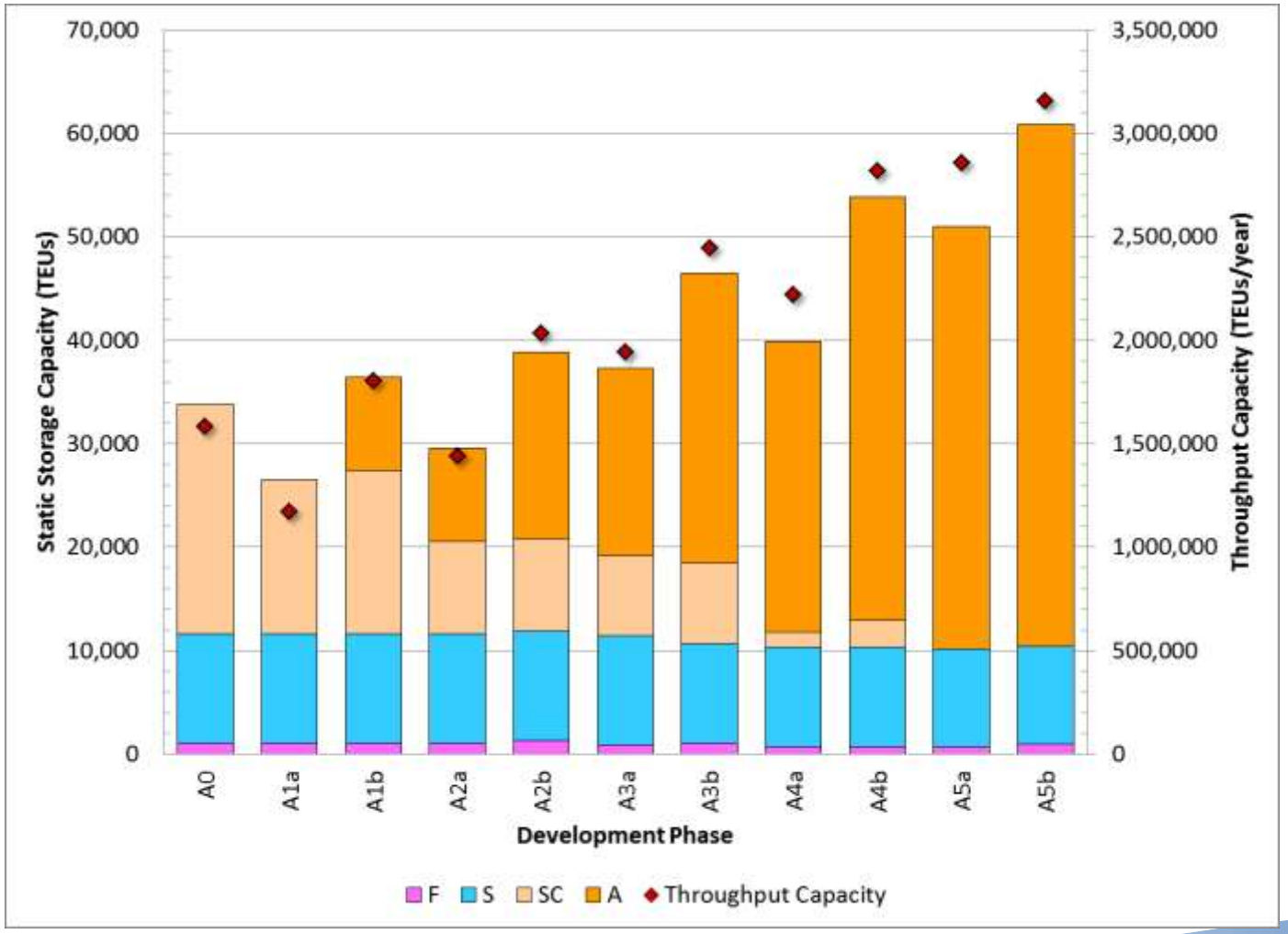
- Electrical distribution system laid out in the phased plans
- Quantities transferred to the analysis model

Block Name	A0	A1a	A1b	A2a	A2b	A3a	A3b	A4a	A4b	A5a	A5b	
ElecA	0	0	10,058	10,058	10,058	10,058	10,058	10,058	10,058	10,058	10,058	Ring Main
ElecB	0	0	734	734	2,339	2,339	2,339	2,339	3,892	3,892	3,892	ASC Distribuition
ElecC	0	0	1,882	1,882	3,504	3,504	3,504	3,504	5,079	5,079	5,079	Reefer Distribution

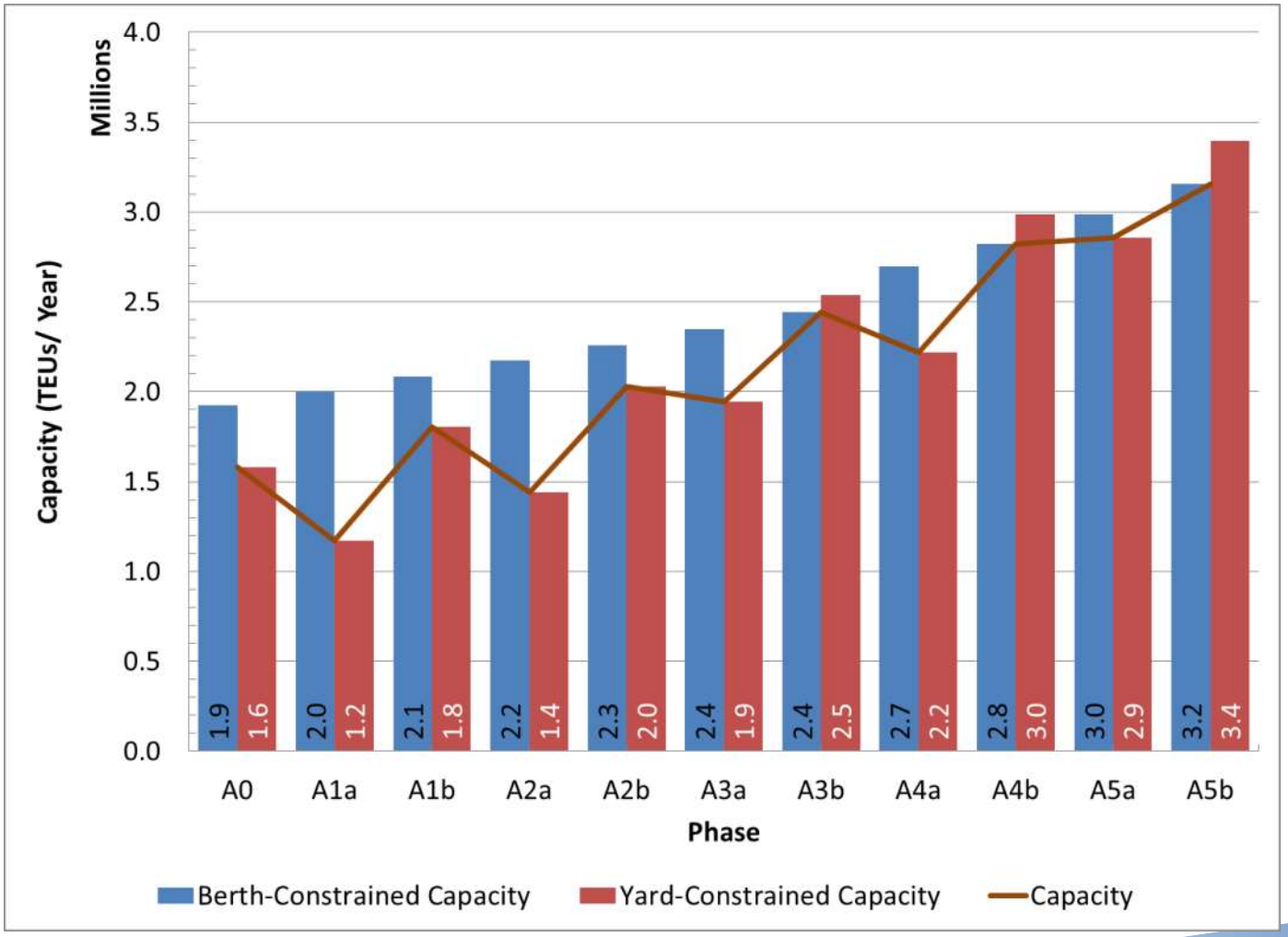
Analysis Model

- Excel-based static model
- ***Tied to plan via direct bilateral data transfer***
- 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

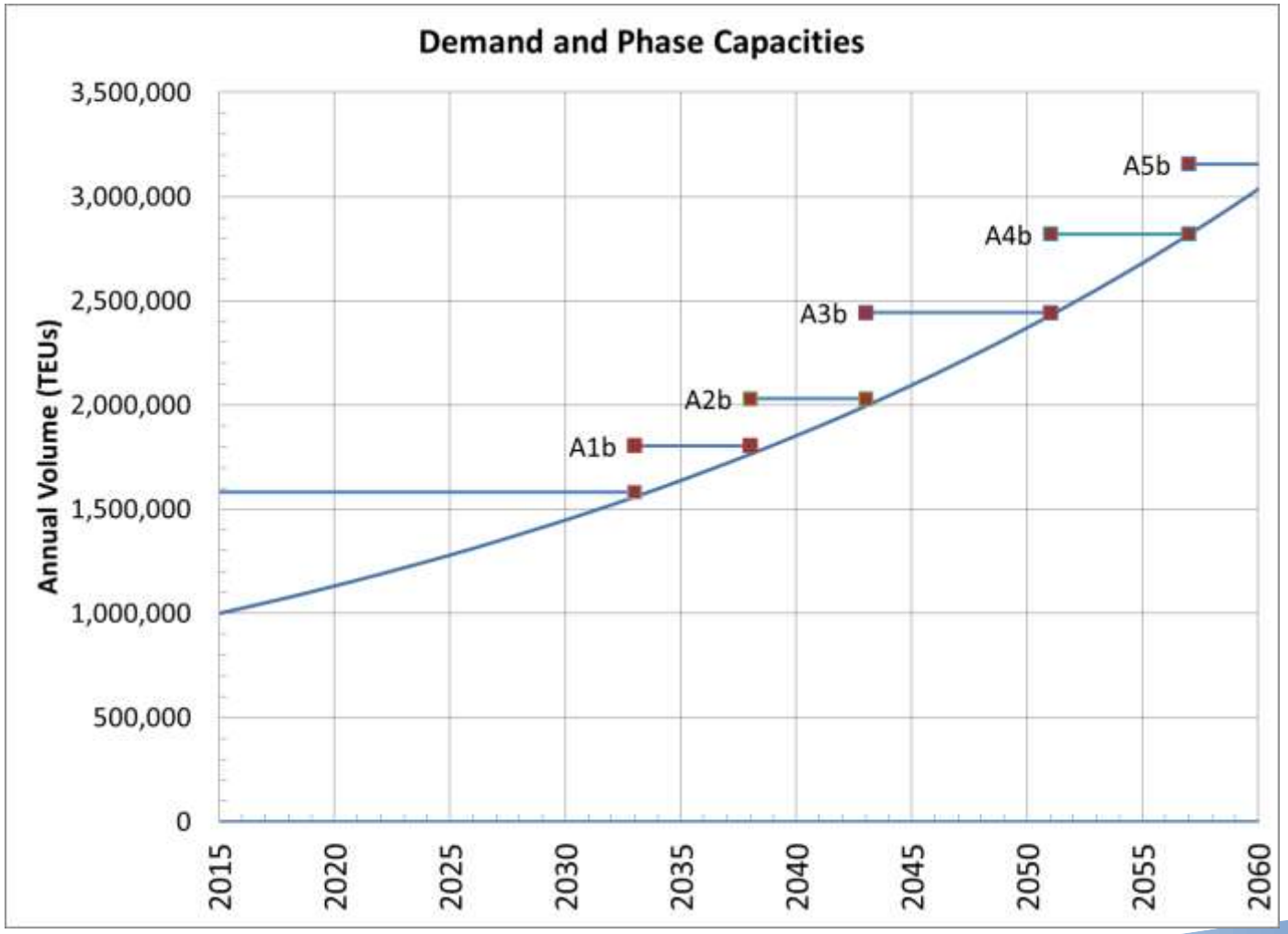
Container Yard & Throughput Capacity



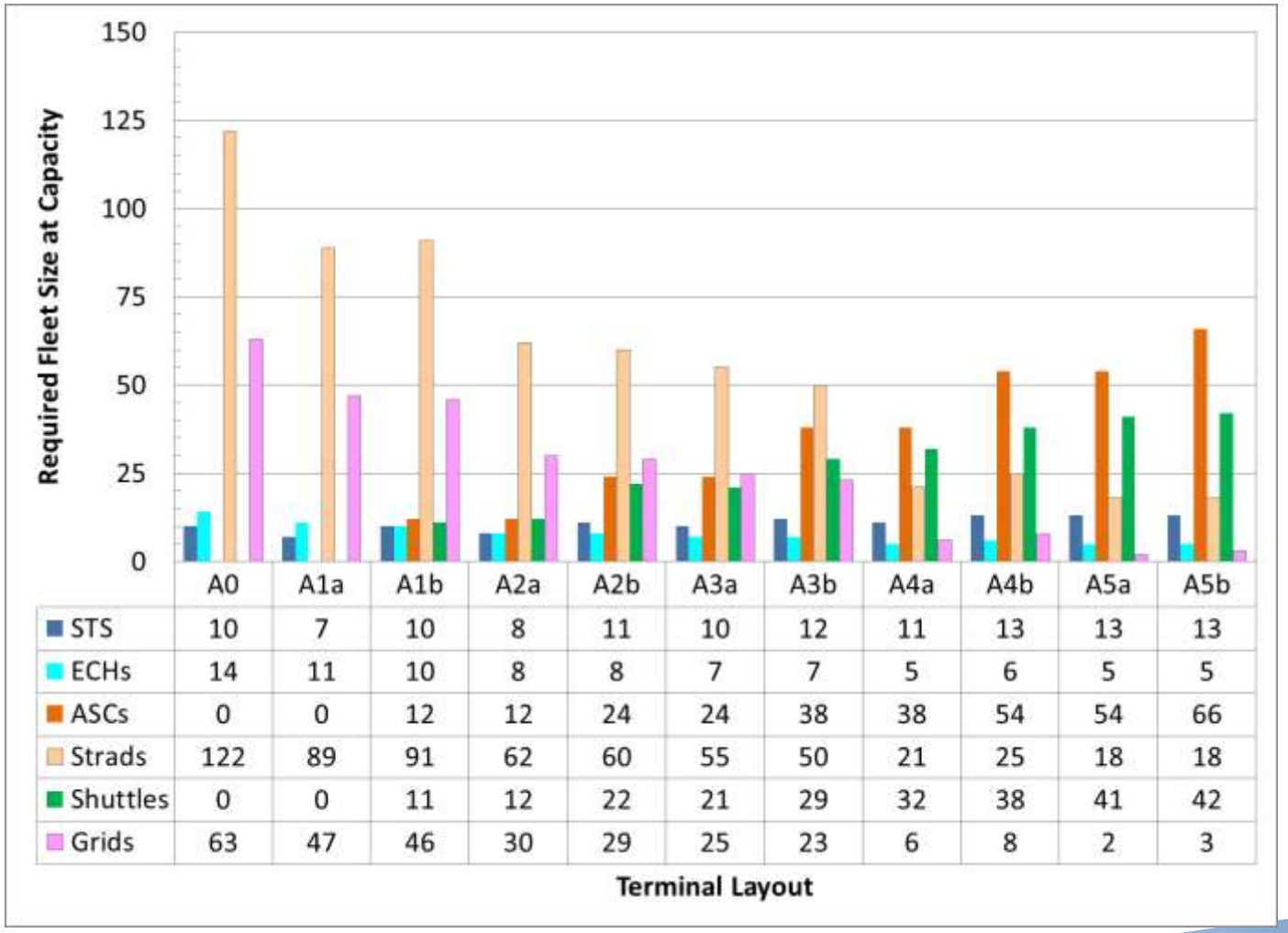
Berth- and Yard-Constrained Capacity



Phase Timing vs. Demand

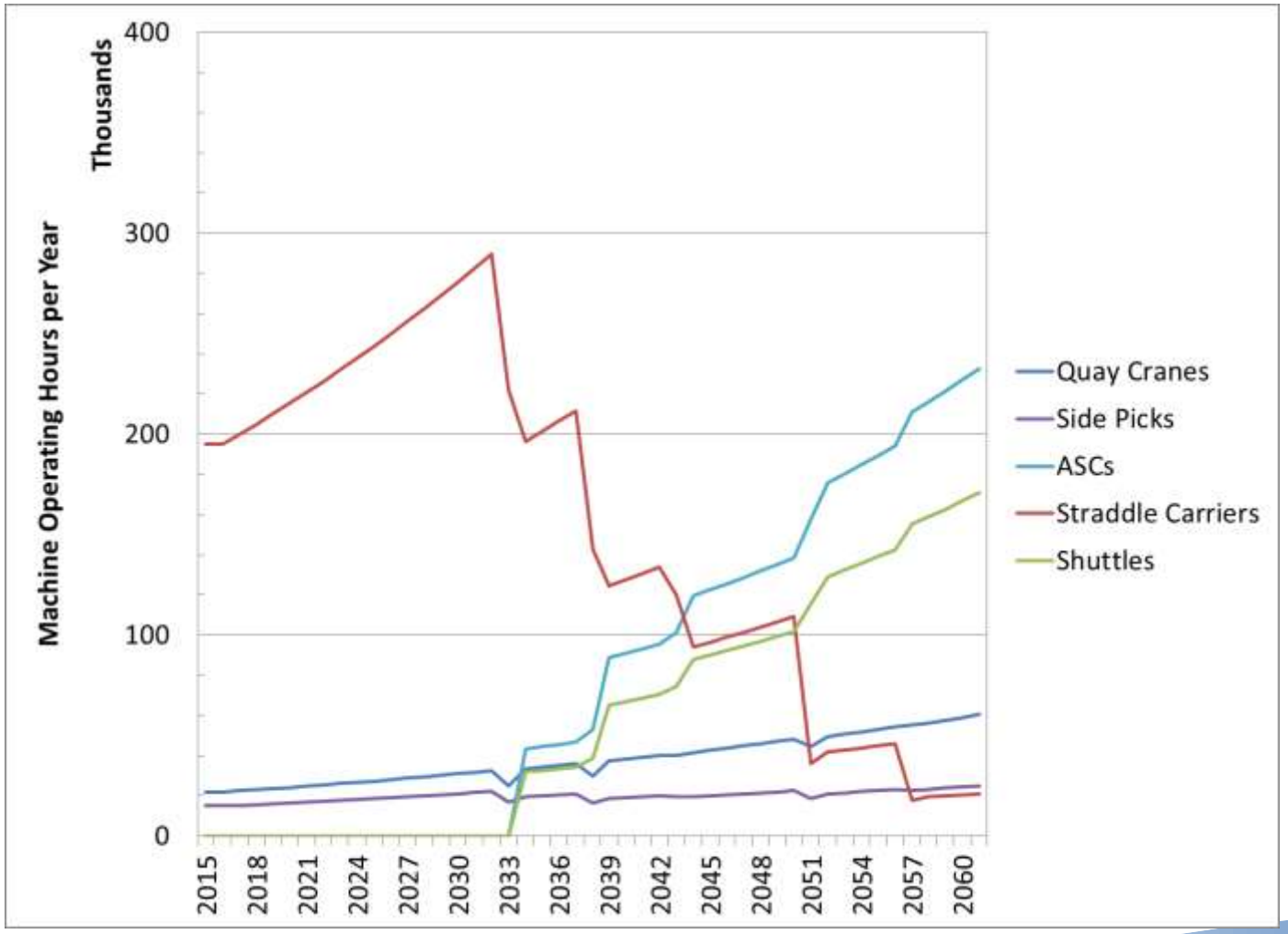


Equipment Fleet Sizing

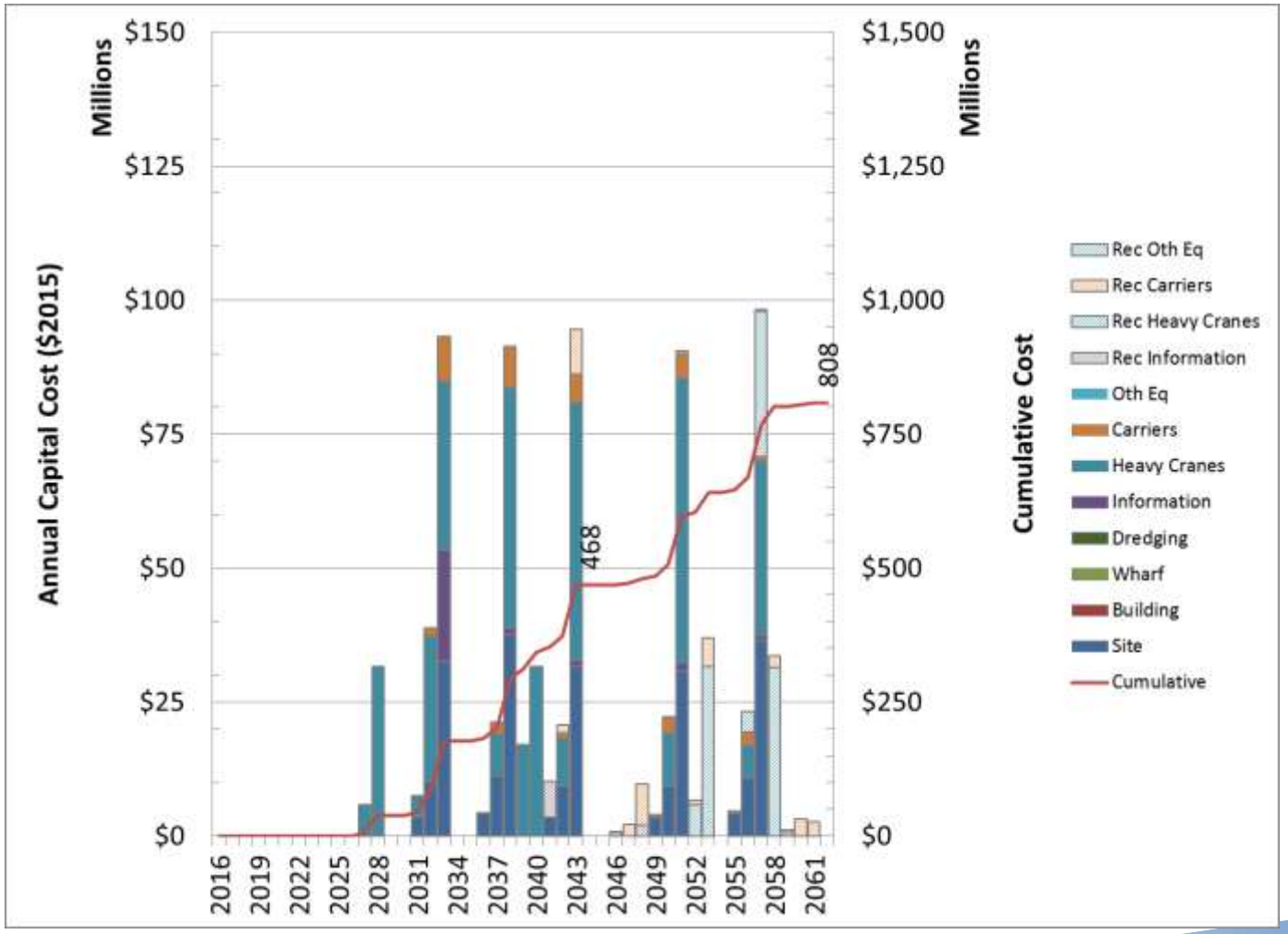


	A0	A1a	A1b	A2a	A2b	A3a	A3b	A4a	A4b	A5a	A5b
STS	10	7	10	8	11	10	12	11	13	13	13
ECHs	14	11	10	8	8	7	7	5	6	5	5
ASCs	0	0	12	12	24	24	38	38	54	54	66
Strads	122	89	91	62	60	55	50	21	25	18	18
Shuttles	0	0	11	12	22	21	29	32	38	41	42
Grids	63	47	46	30	29	25	23	6	8	2	3

Machine Operating Hours per Year



Capex Cash Flow



Conclusion

- Changes in the site plan are immediately reflected in all aspects of terminal performance
  - Capacity
  - Machine requirements and utilization
  - Traffic, rail, and emissions impacts
  - Labor required
  - Development phases and their timing vs. demand
  - Project development elements
  - Capital and operating expense cash flow
- Go / no-go decisions are more robust, cover more options, are reached more quickly, at lower cost
- Cheaper, Faster, AND Better

The Wider View