



**Beyond the Seaport:
Assessing the Impact of Policies & Investments
on the Transport Chain**

Researchers



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Objective

*[To develop a framework that assess the impact of **policy** and **investment** decisions on the inland **transport chain.**]*

Agenda

Background

Case Study: Jordan

Building the Framework

→ Conceptual Model

→ Simulation Model

Simulation Runs

Conclusion

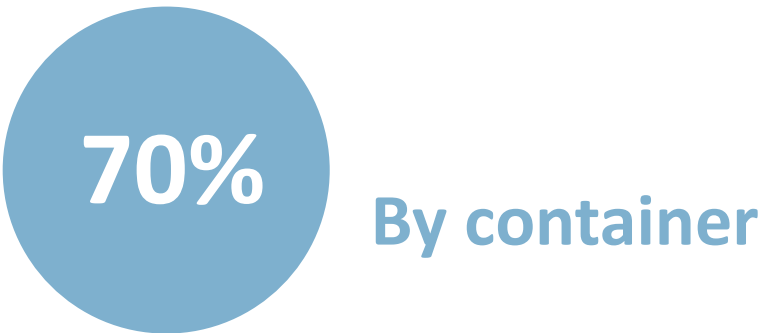
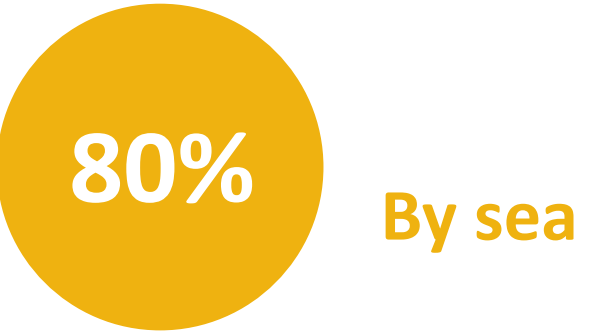
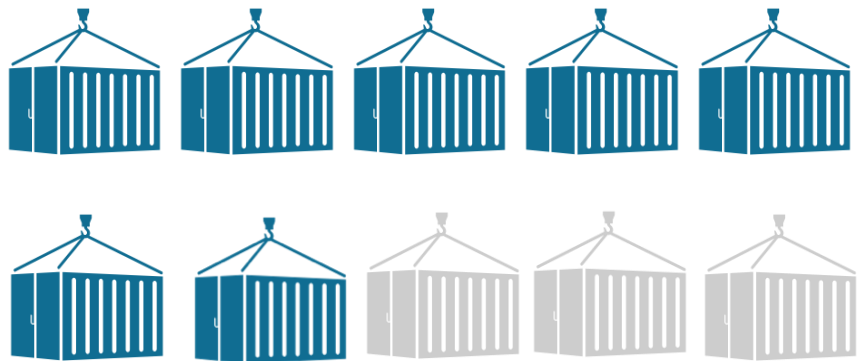
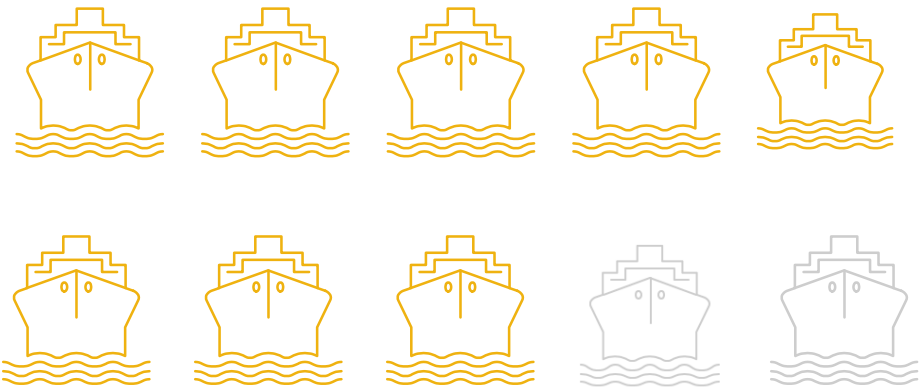
Questions & Comments



Background



Seaport Plays an Vital Role in Global Trade



Source: WTO , 2017

Source: Review of Maritime Transport , 2017



Industry Aiming at Moving Cargo Faster, and More Efficiently



Mega ships & Alliances:
Fast Operation Needed



Vertical Integration:
Hinterland Investments



Technology :
Blockchain

Number of Interactions Increase Complexities

Port Terminal

Customs

Ship Agent

Freight Forwarder

Trucker

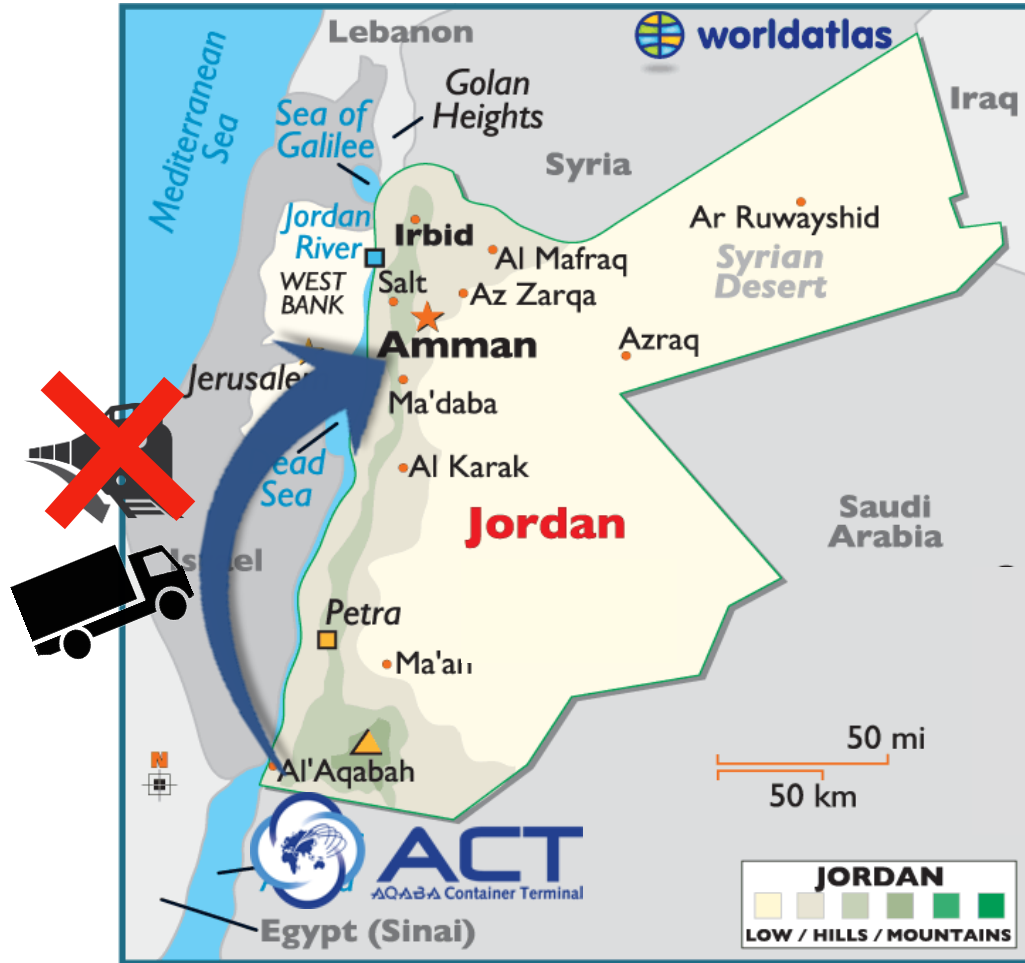
Customers



Case Study: Jordan



Jordan's Inbound Containerized Trade Growing Over Past 10 Years



75% Of containerized Trade are imports



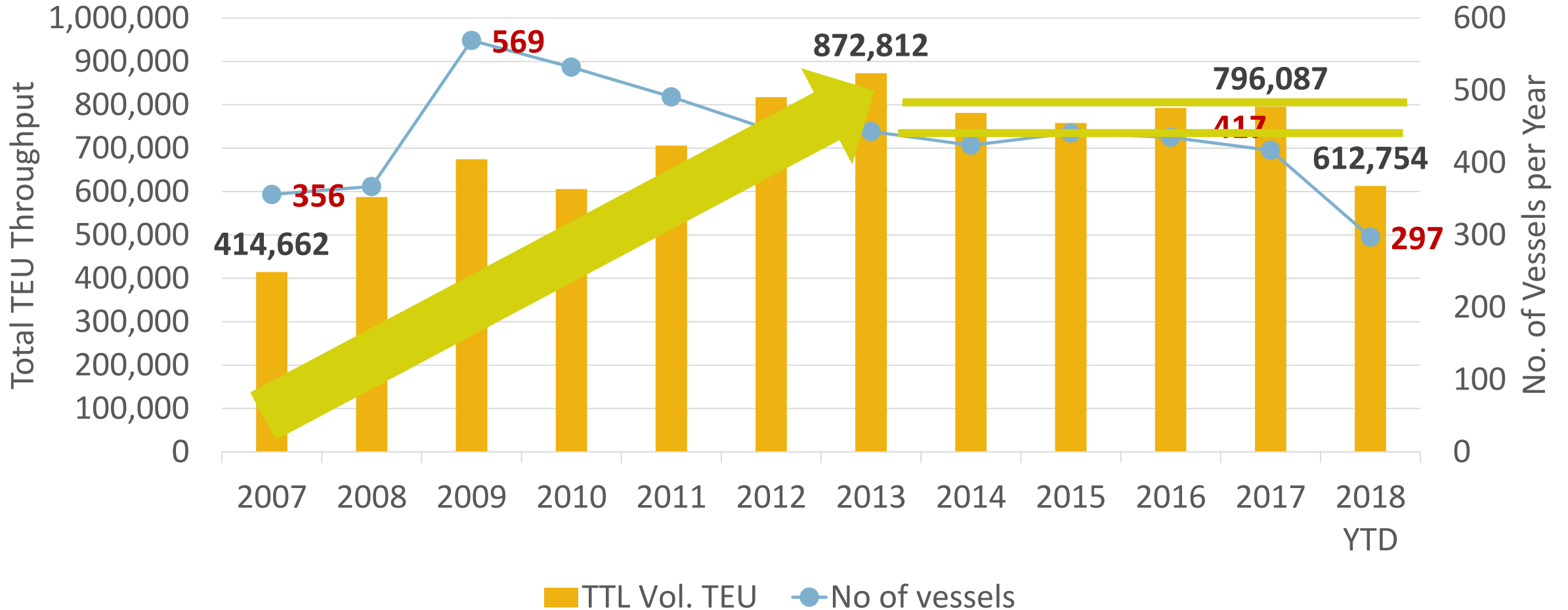
45% Growth between 2008 to 2016



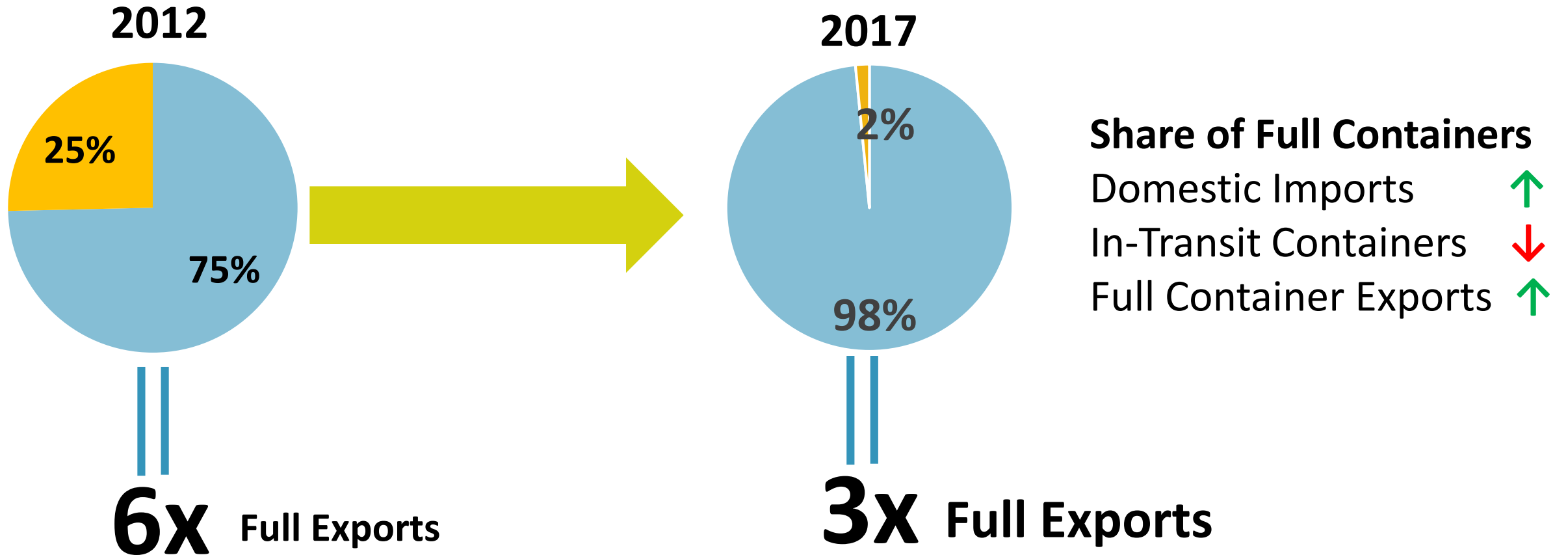
95% throughput growth rate in 10 years



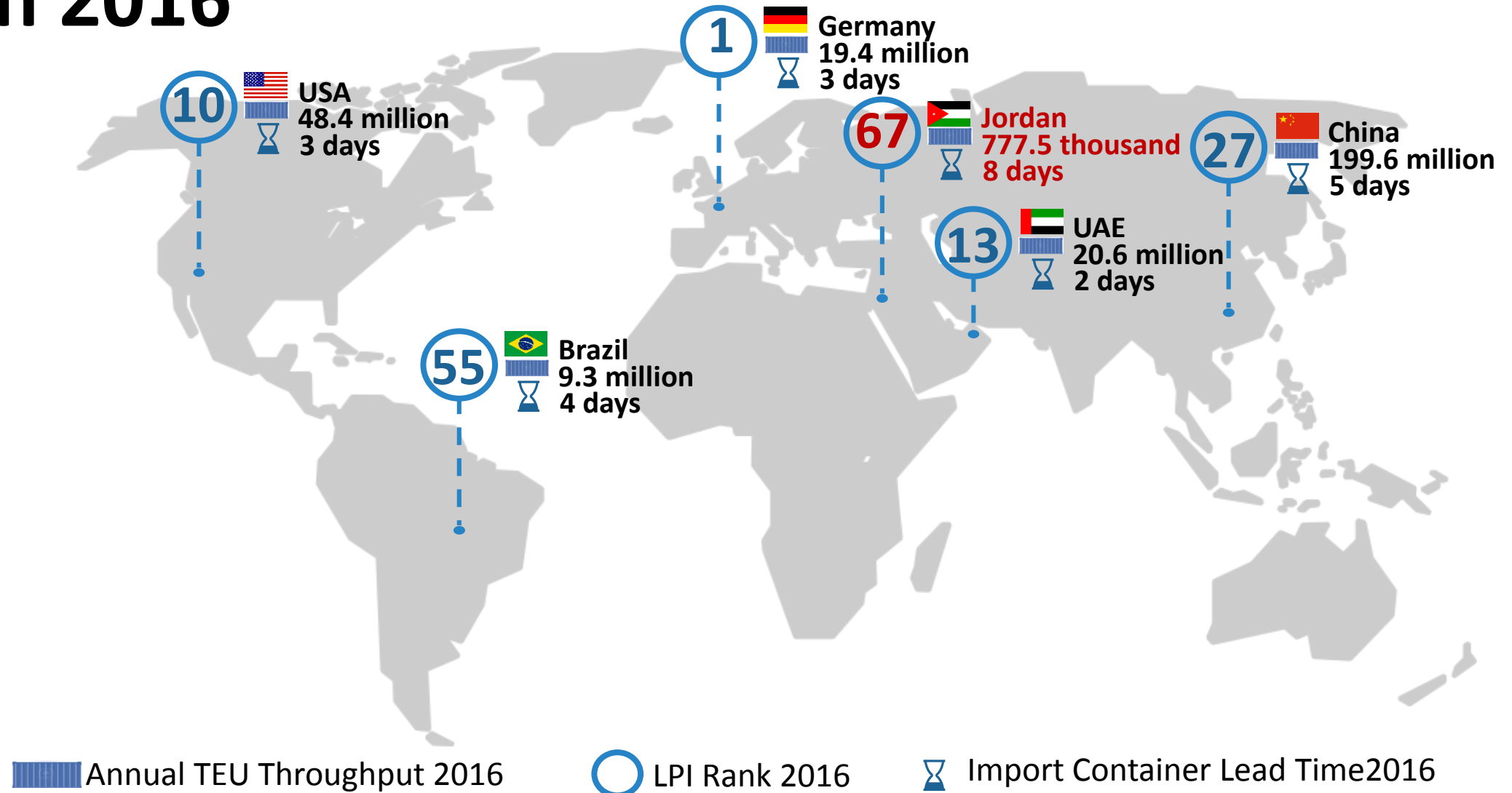
Fewer Ships with Bigger Volumes. Positive Throughput Growth from 07 – 13, then Dropped



In-Transit Containers was 25% of Imports in 2012, Today it's at <2%, BUT Exports are Rising



Logistics Performance Index: Ranks Jordan 67 in 2016



Annual TEU Throughput 2016

LPI Rank 2016

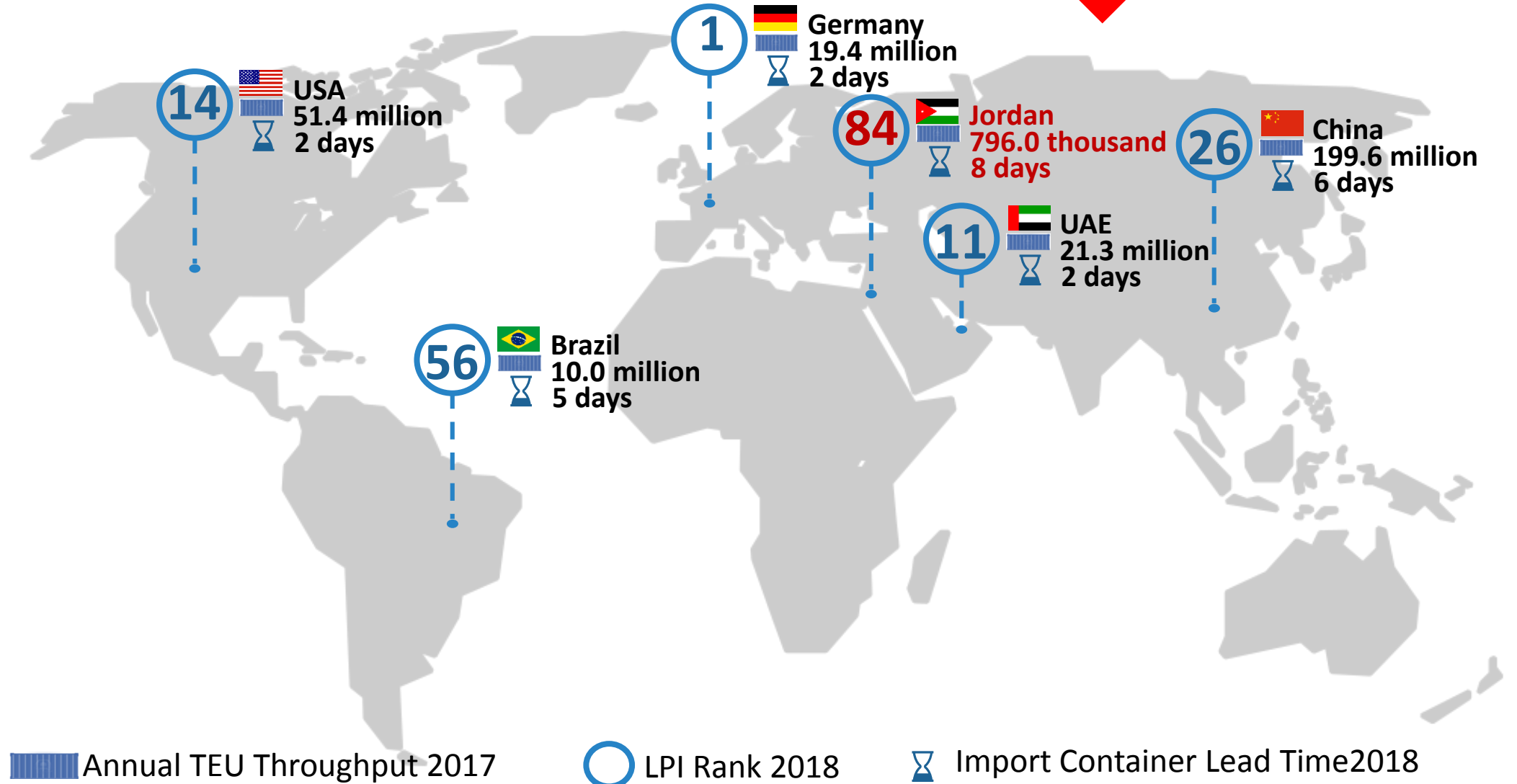
Import Container Lead Time 2016

Sources: LPI 2016, World Bank, UNCTAD 2016, ACT for JO data



Jordan Dropped to 84 in LPI 2018

17 LPI Ranking



Annual TEU Throughput 2017

LPI Rank 2018

Import Container Lead Time 2018

Sources: LPI 2018, World Bank, UNCTAD 2017, ACT for JO data

Toukan & Chan 2018

Beyond the Seaport



Reasons for Improving Jordan's Transport Chain

- Regional shifts impact containerized trade volumes.
- Due to its geo-political location, Jordan has the potential to act as a transit hub.
- Jordan has one access point to the sea.
- Jordan's LPI ranking is low, and has gotten worse.



How Should We Assess the Impact of New Initiatives/ Policies?

- Reduction of import dwell time by reducing documentation processing time.
- Establishment of a dry port outside of Aqaba.
- Rail project

Building the Framework

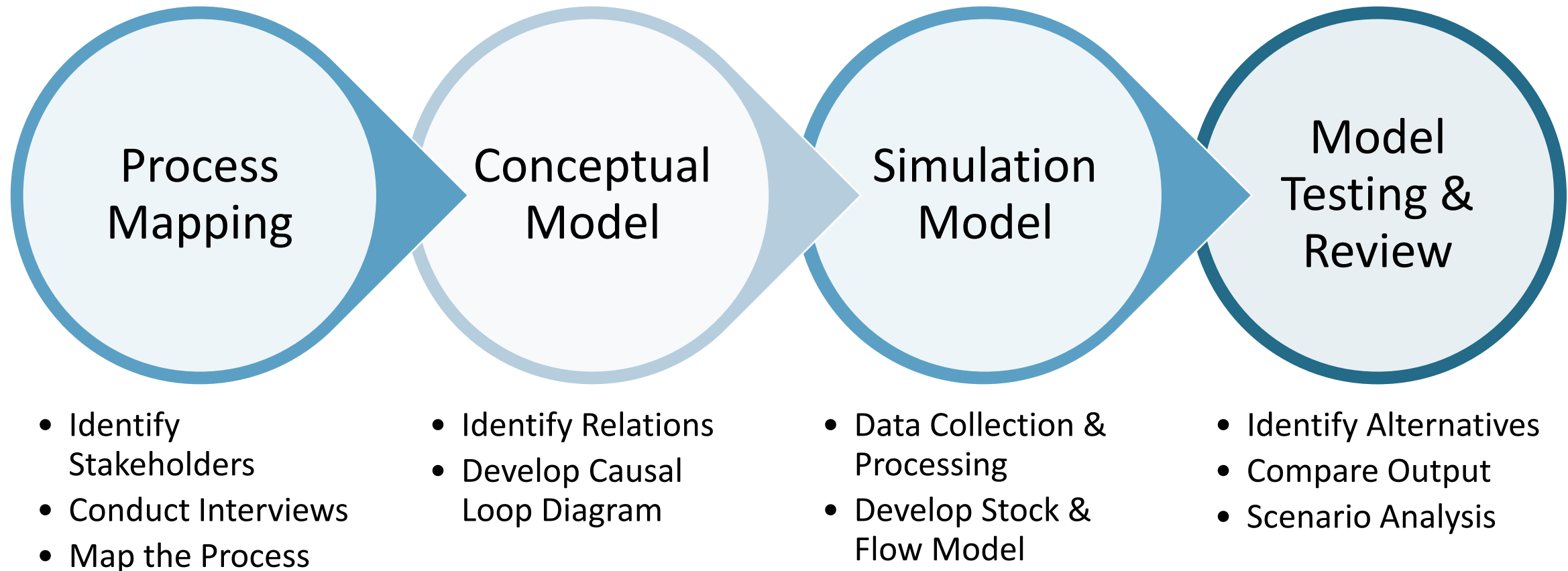


System Dynamics

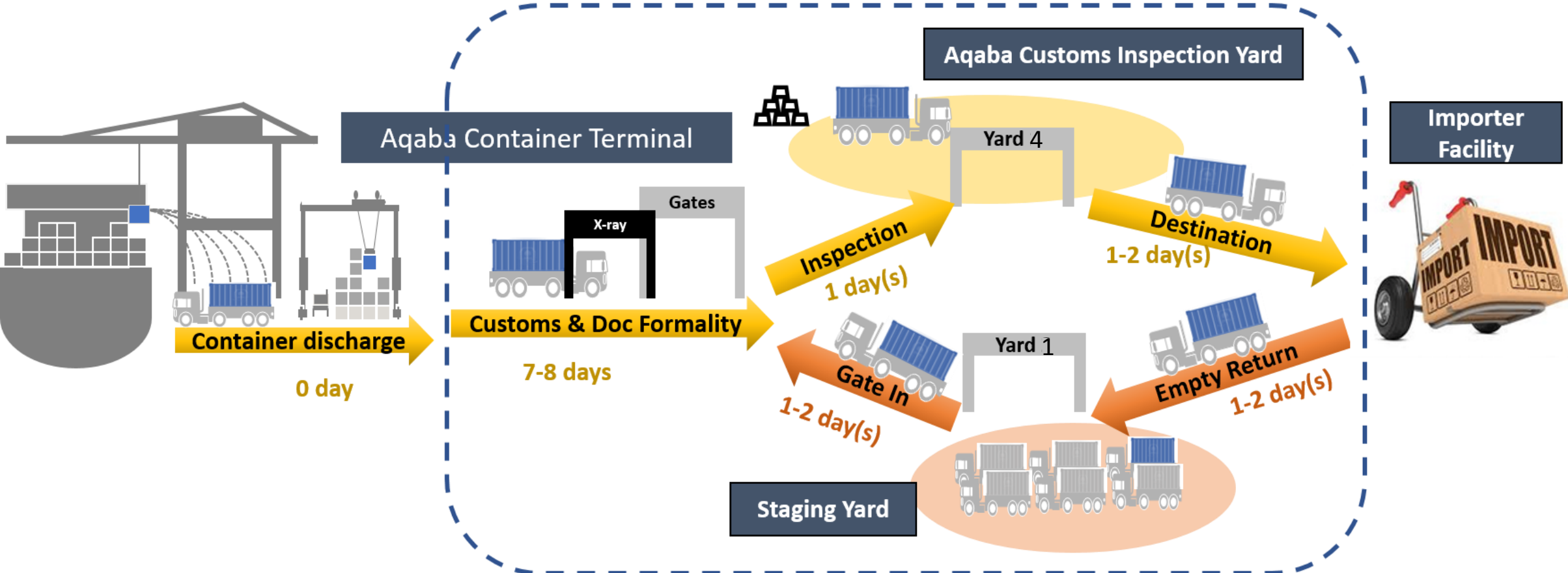
- A methodology for studying and managing **complex feedback systems**.
- Identifies the underlying structure of a system to gain insights into **behaviors**, focusing on the interactions between components of a system.
- Allows decision makers to design policies that seek to **eliminate unwanted** patterns of behavior.



The Framework Follows 4 High Level Steps



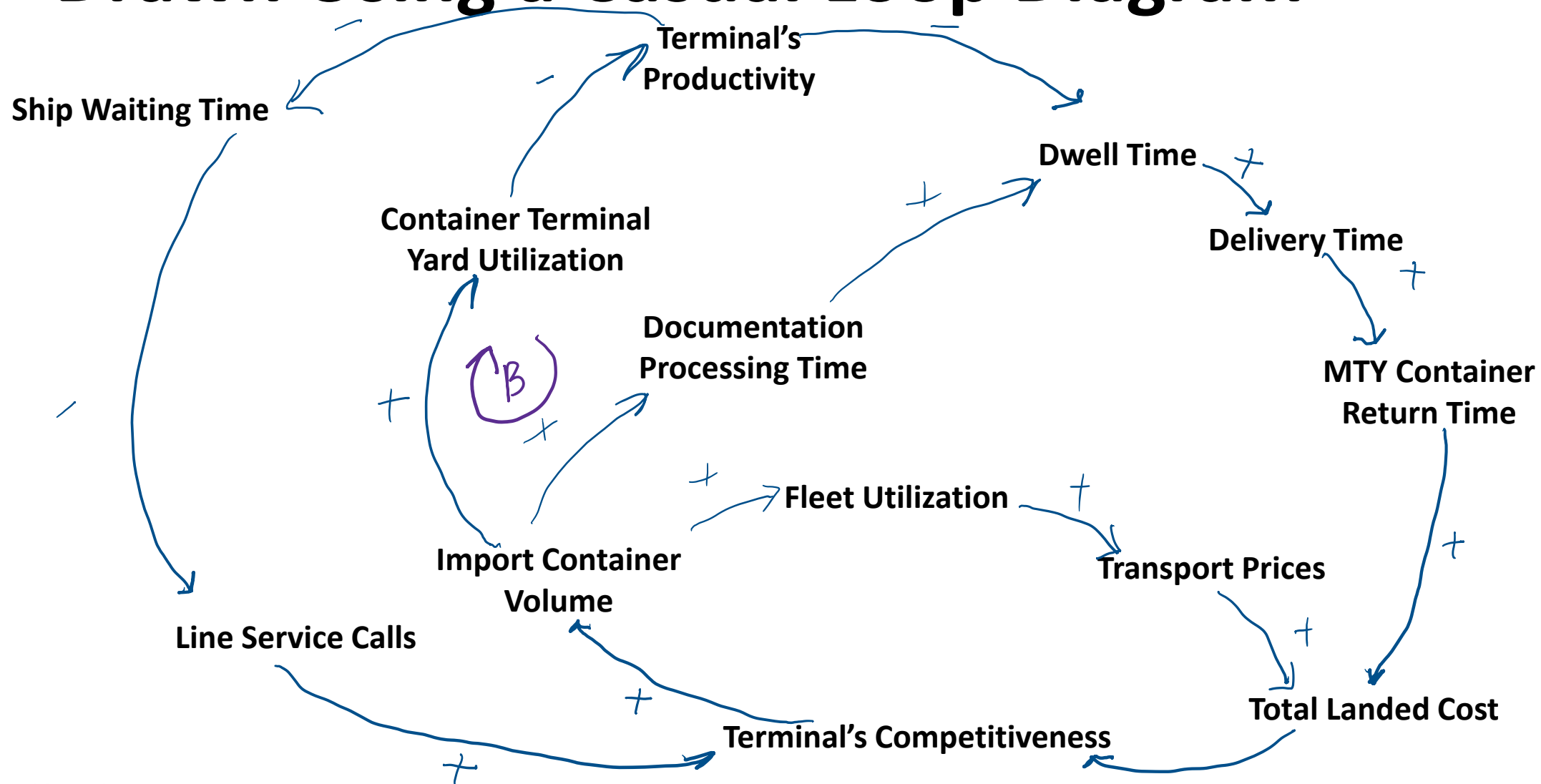
The Import Process Overview

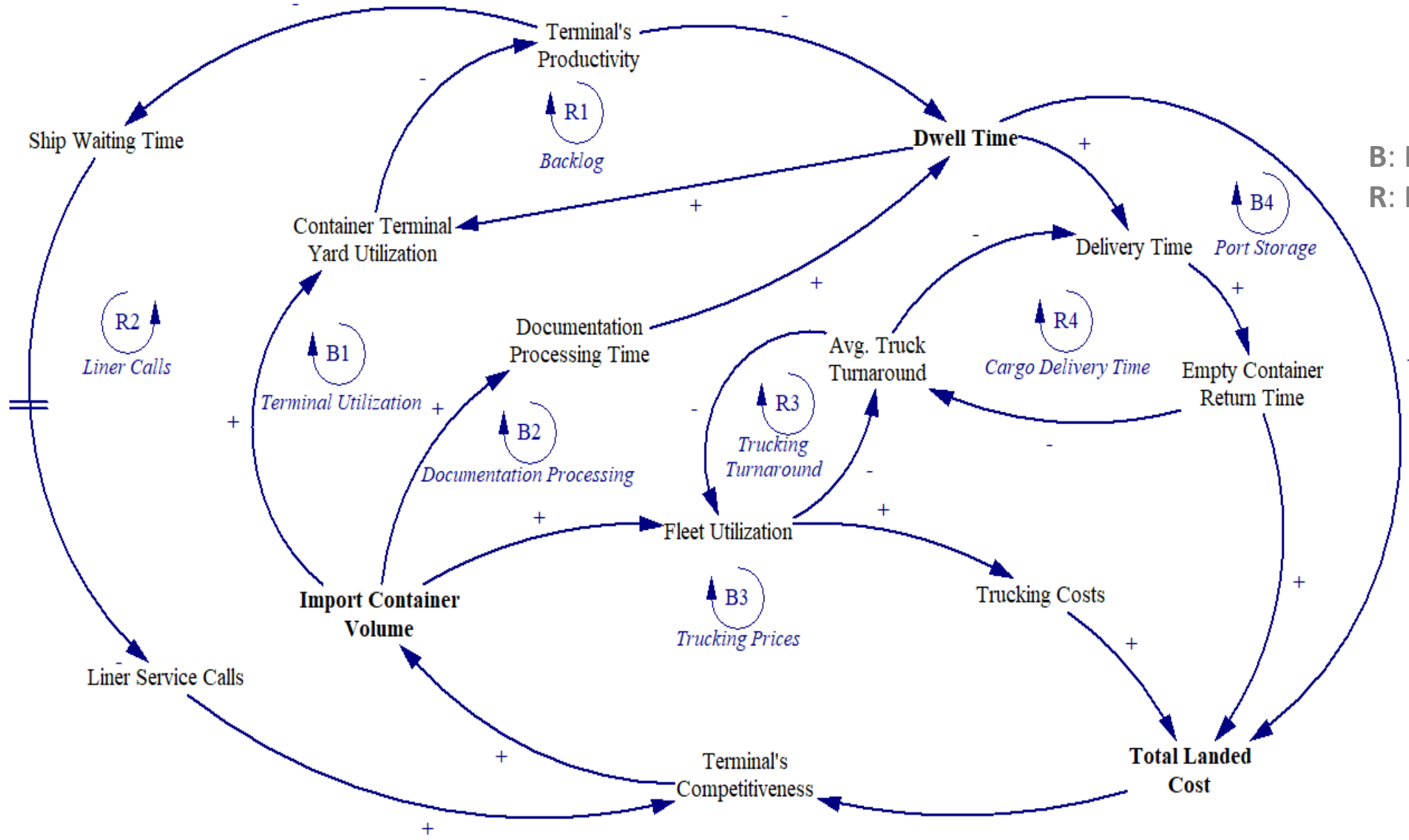


Conceptual Model



The System's Elements and Interactions are Drawn Using a Casual Loop Diagram



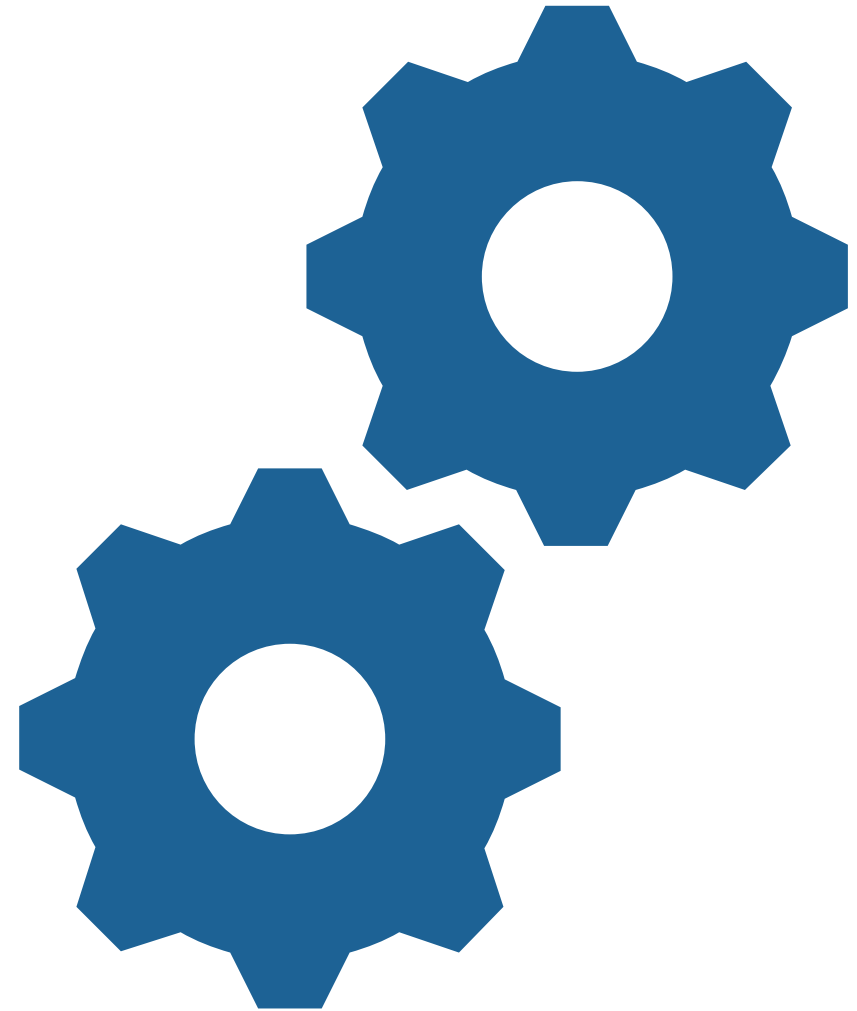


B: Balancing Loops
R: Reinforcing Loops

Casual Loop Diagram – developed using Vensim



Simulation Model



Assumptions are Made to Simplify the Model



One size and type of containers



Terminal productivity is at 100%, unless yard gets fully congested



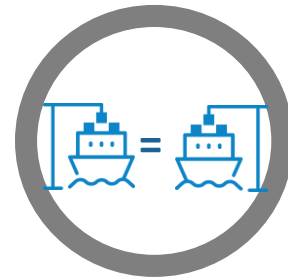
One size and type of trailers



Empty containers for export bookings are picked up from container depots



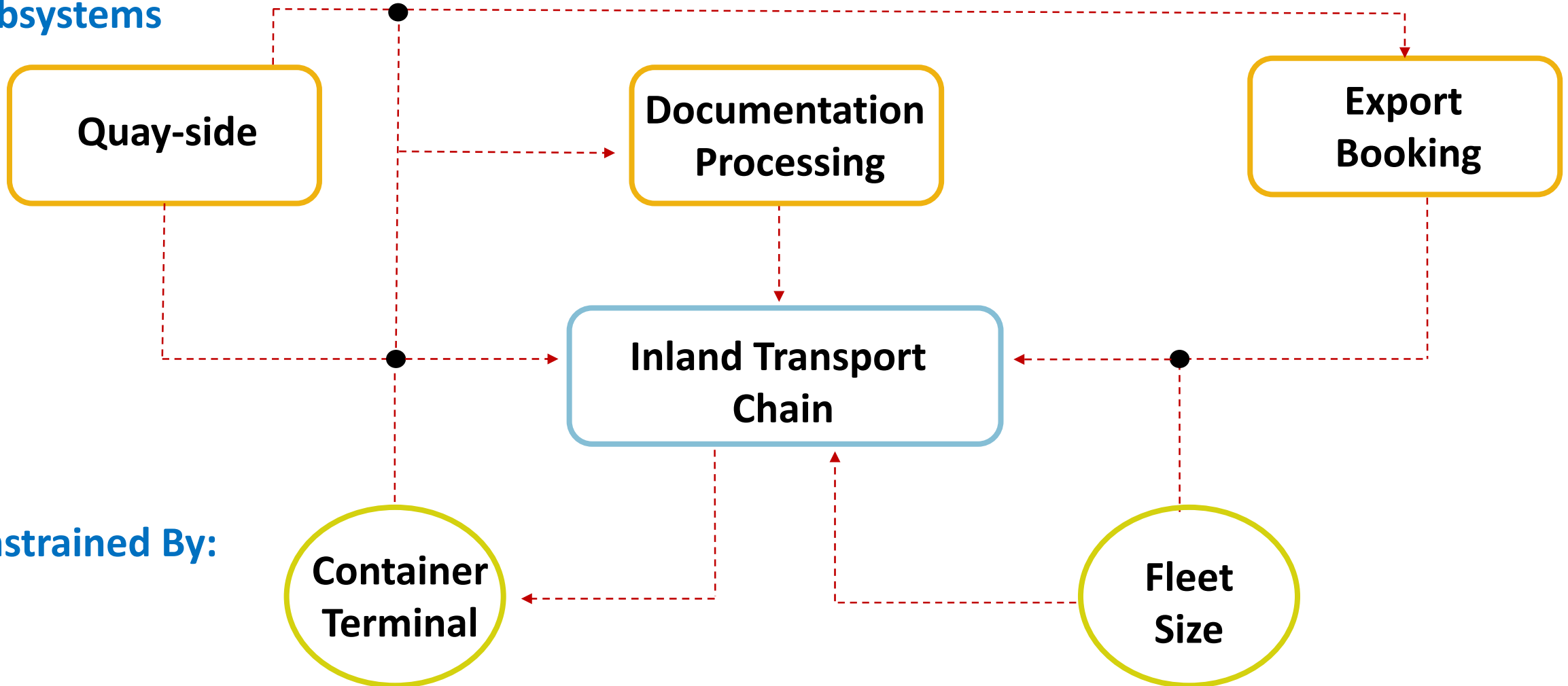
Third order delay assumed in documentation processing



Vessel load capacity = discharged containers

The Model's Backbone: 4 Subsystems Limited by 2 Main Constraints

Subsystems



Constrained By:

Container
Terminal

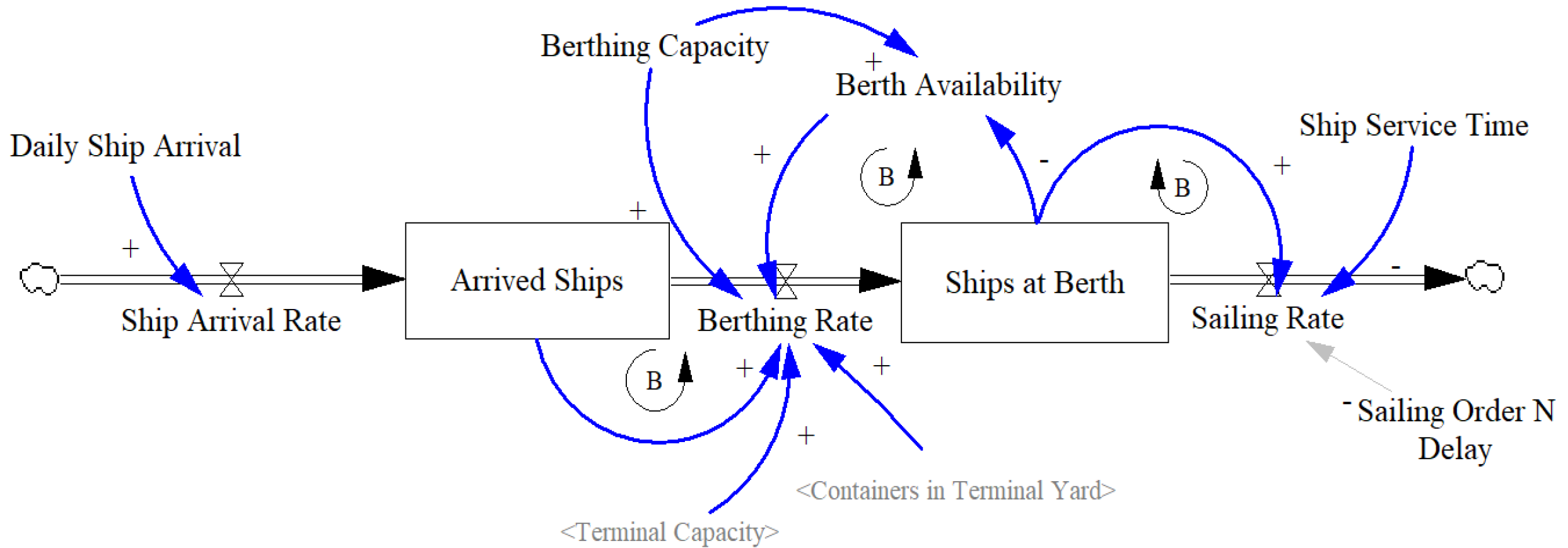
Fleet
Size



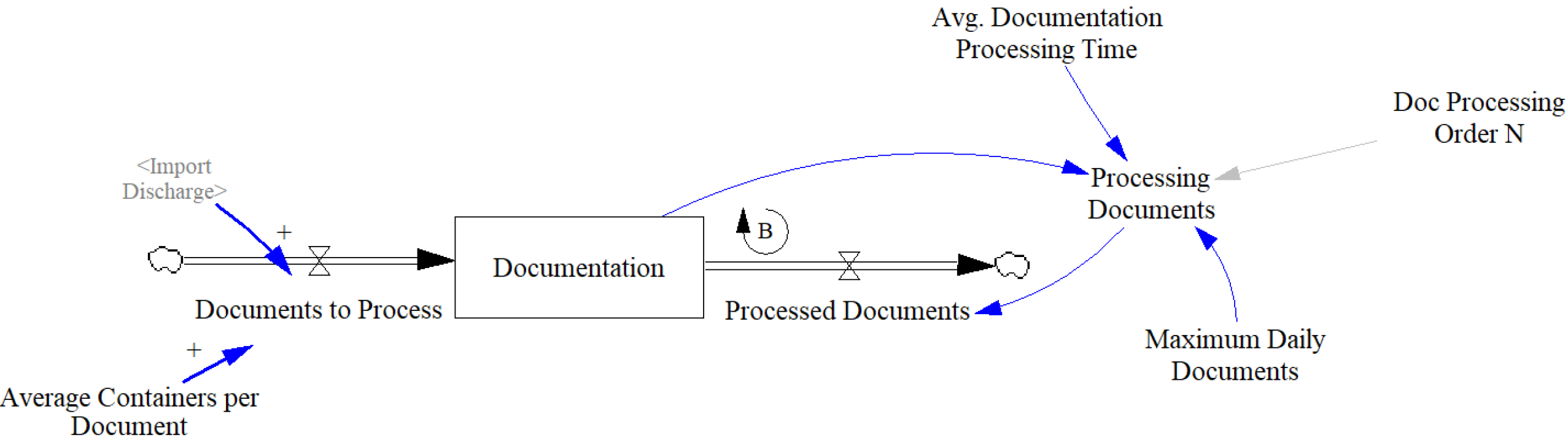
What the Model Actually Looks Like ?



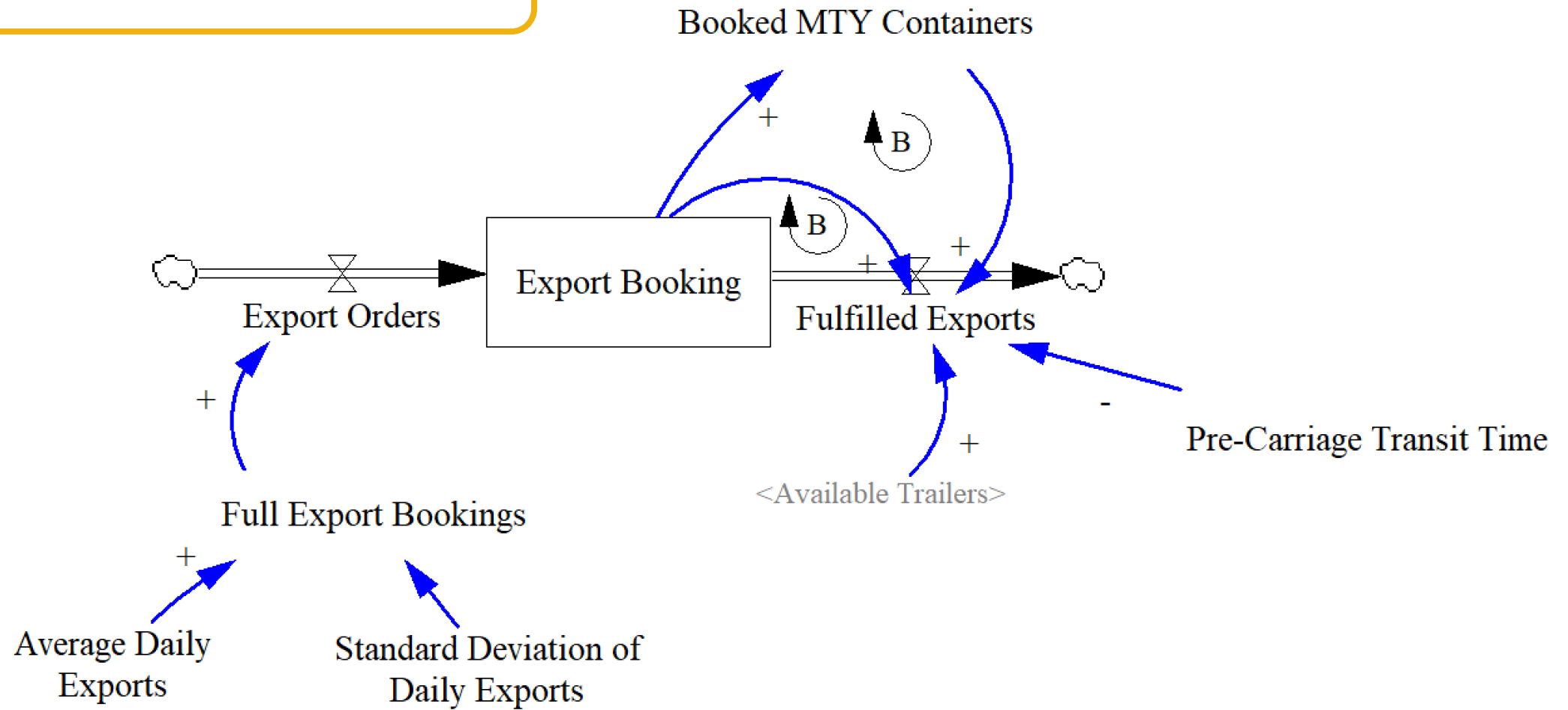
Quay-side



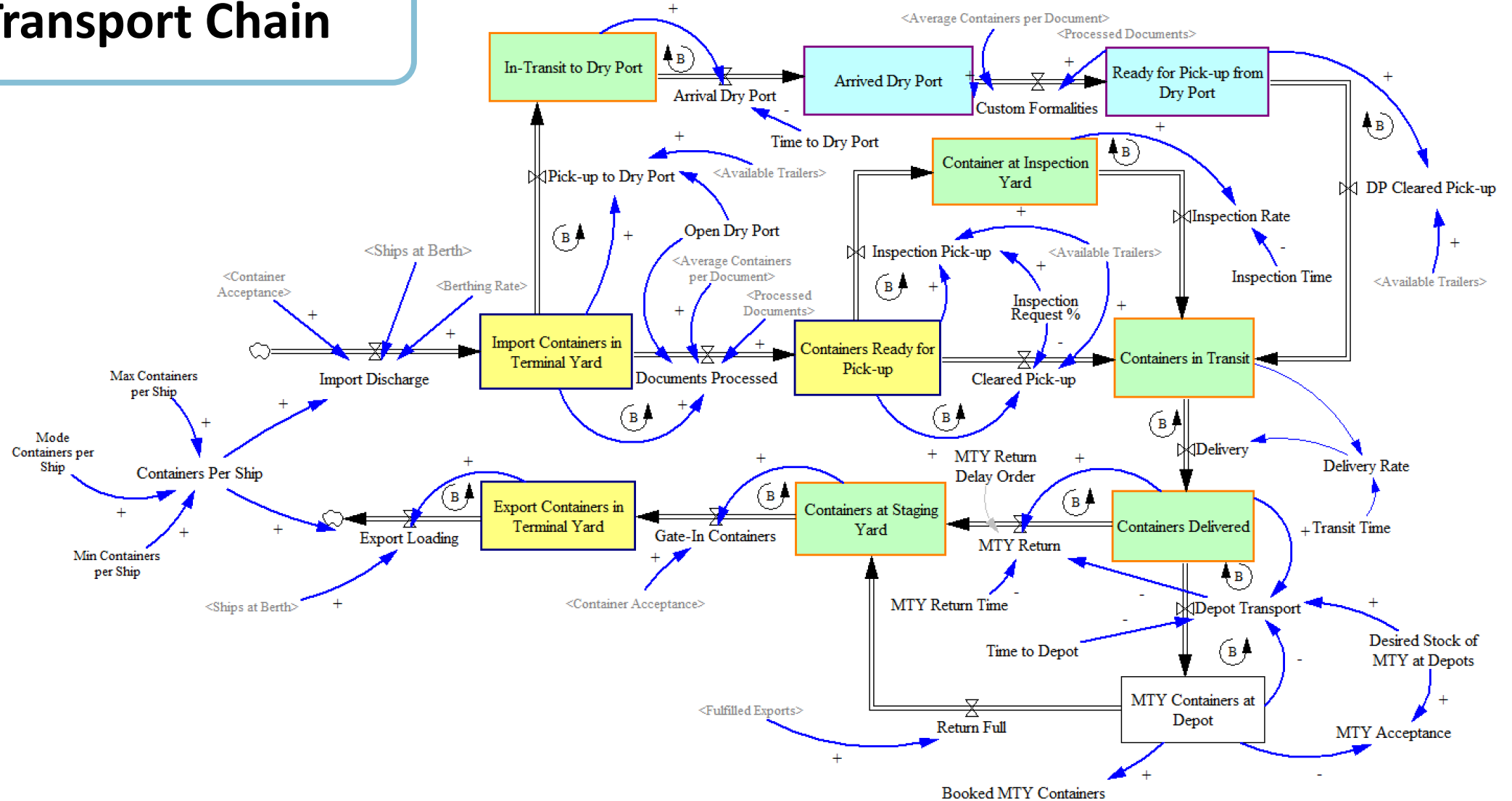
Documentation Processing



Export Booking



Inland Transport Chain



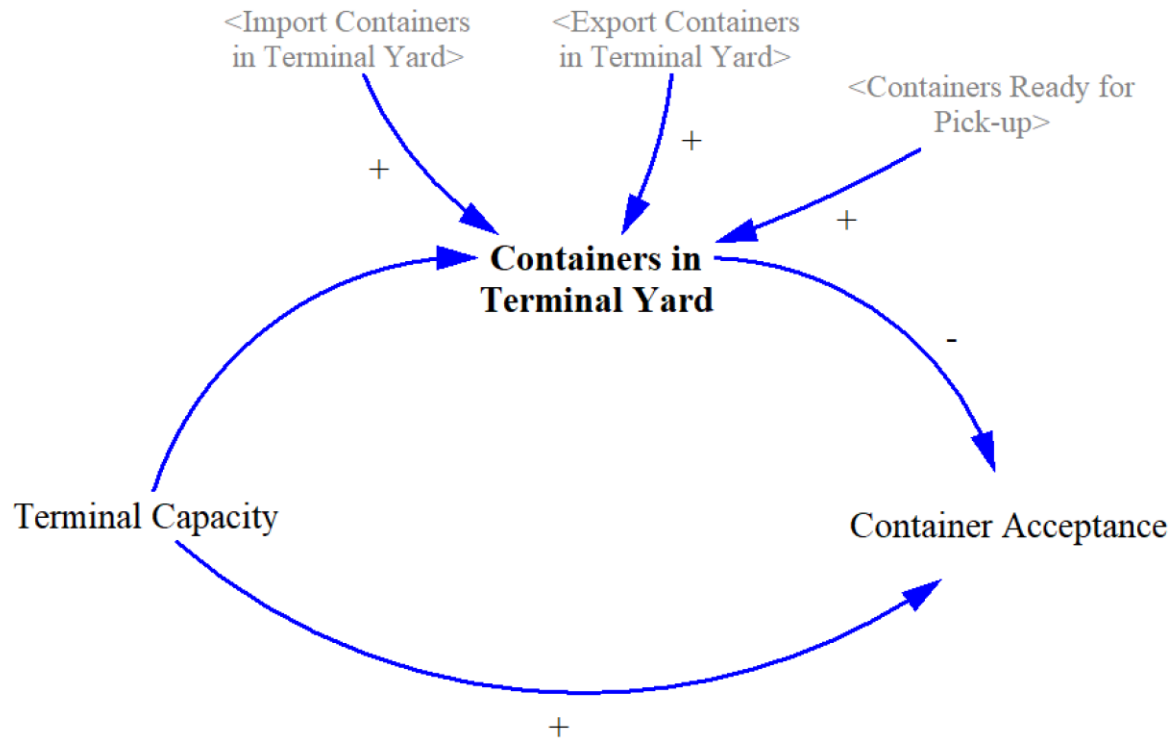
Indicators:

Containers in the Terminal

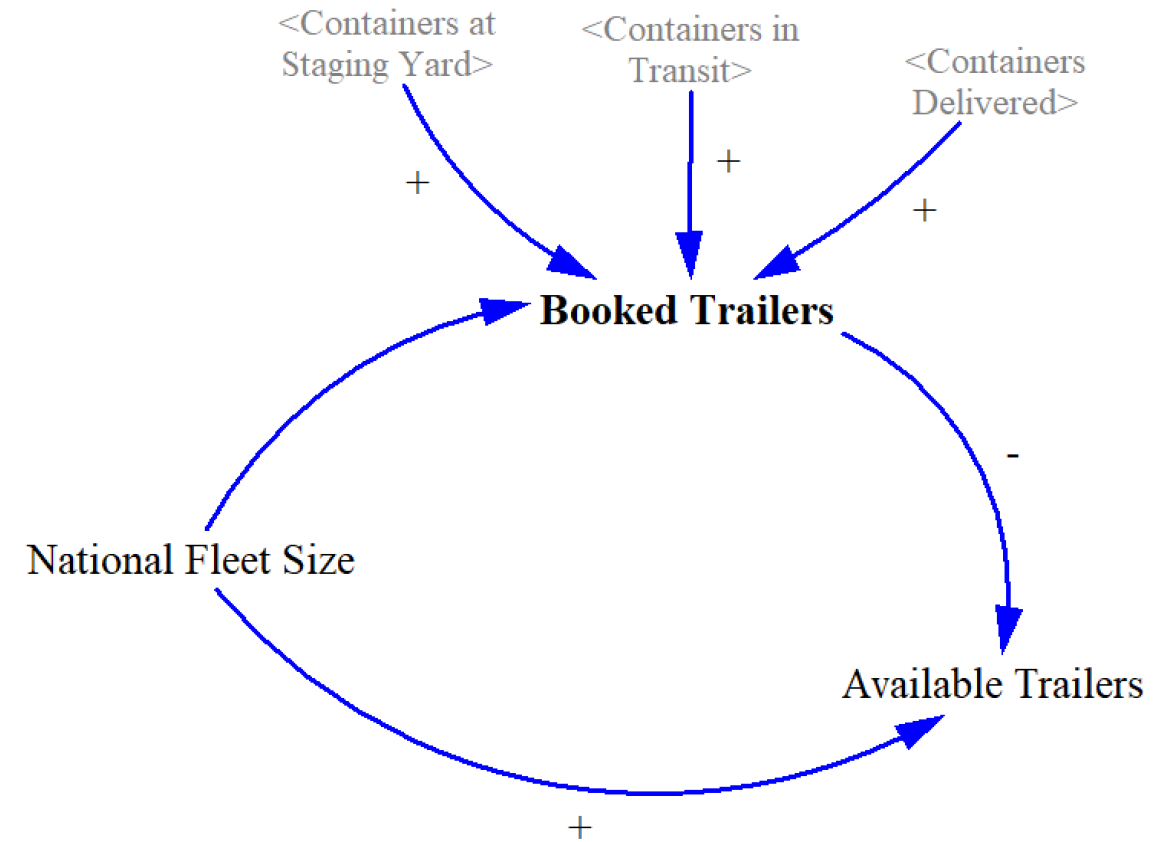
Containers at Dry Port

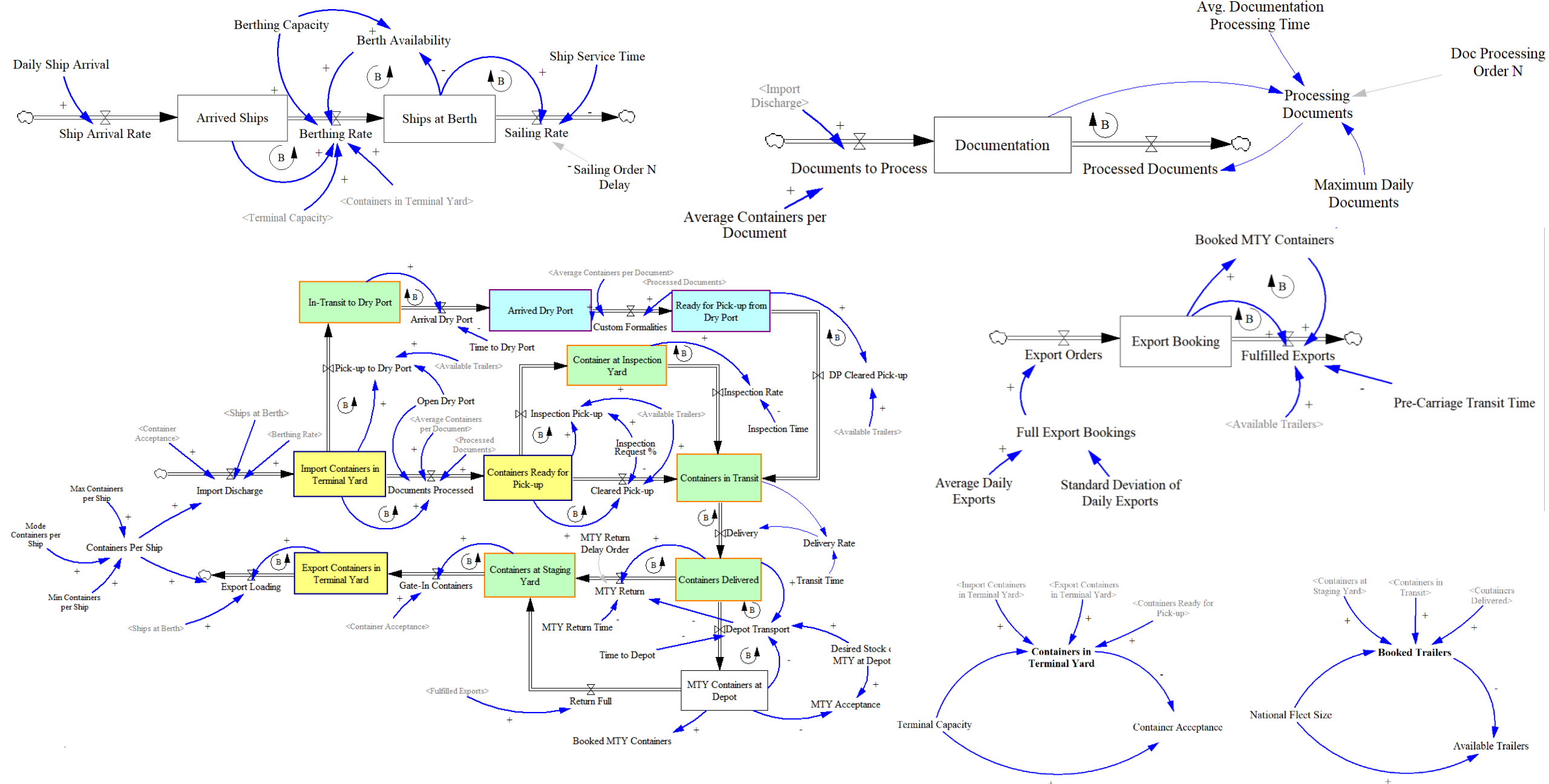
Containers on Trailers

Container Terminal



Fleet Size

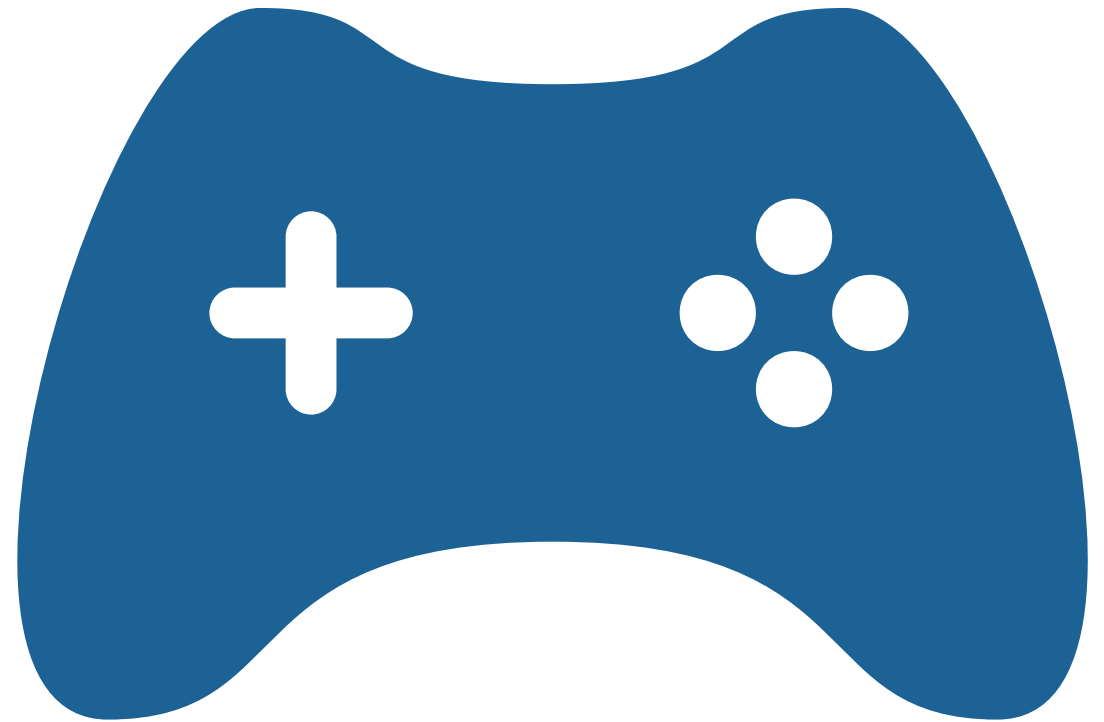




Developed using Vensim by Vanata Systems
 Toukan & Chan 2018
 Beyond the Seaport



Simulation Runs



Simulation Setup

Time Line: 30-days | One Ship Arrival | 1,375 Containers

Alternative Policies

Status
Quo

Invest in
Dry Port

Invest in
Technology

Combo
Dry Port + Tech

Scenario Analysis

Base
Case

Limited
Yard Capacity

Limited
Trucking Capacity

Limited
Doc. Capacity

Measured Against

Container
Turnaround

Delivery
Time

Trailers
Turnaround

Container
Acceptance



Alternative Policies Parameters

Time Line: 30-days | One Ship Arrival | 1,375 Containers

Status Quo

- Open Dry Port = **0**
- Documentation Processing Time = **5 days**

Invest in Dry Port

Open Dry Port = **1**

Invest in Technology

Documentation Processing Time = **3 days**

Combo Dry Port + Tech

- Open Dry Port = **1**
- Documentation Processing Time = **3 days**

** A hypothetical terminal, all numbers here may not present reality, the aim is just to show how the model works*

Scenario Analysis Parameters

Time Line: 30-days | One Ship Arrival | 1,375 Containers

Base
Case

- Terminal Capacity = 40,000 Containers
- Fleet Size = 4,000 Trailers
- Max Daily Document = 700 Documents

Limited
Yard Capacity

Terminal Capacity
= 1,000 Containers

Yard
capacity
98%

Limited
Trucking Capacity

Fleet Size
= 500 Trailers

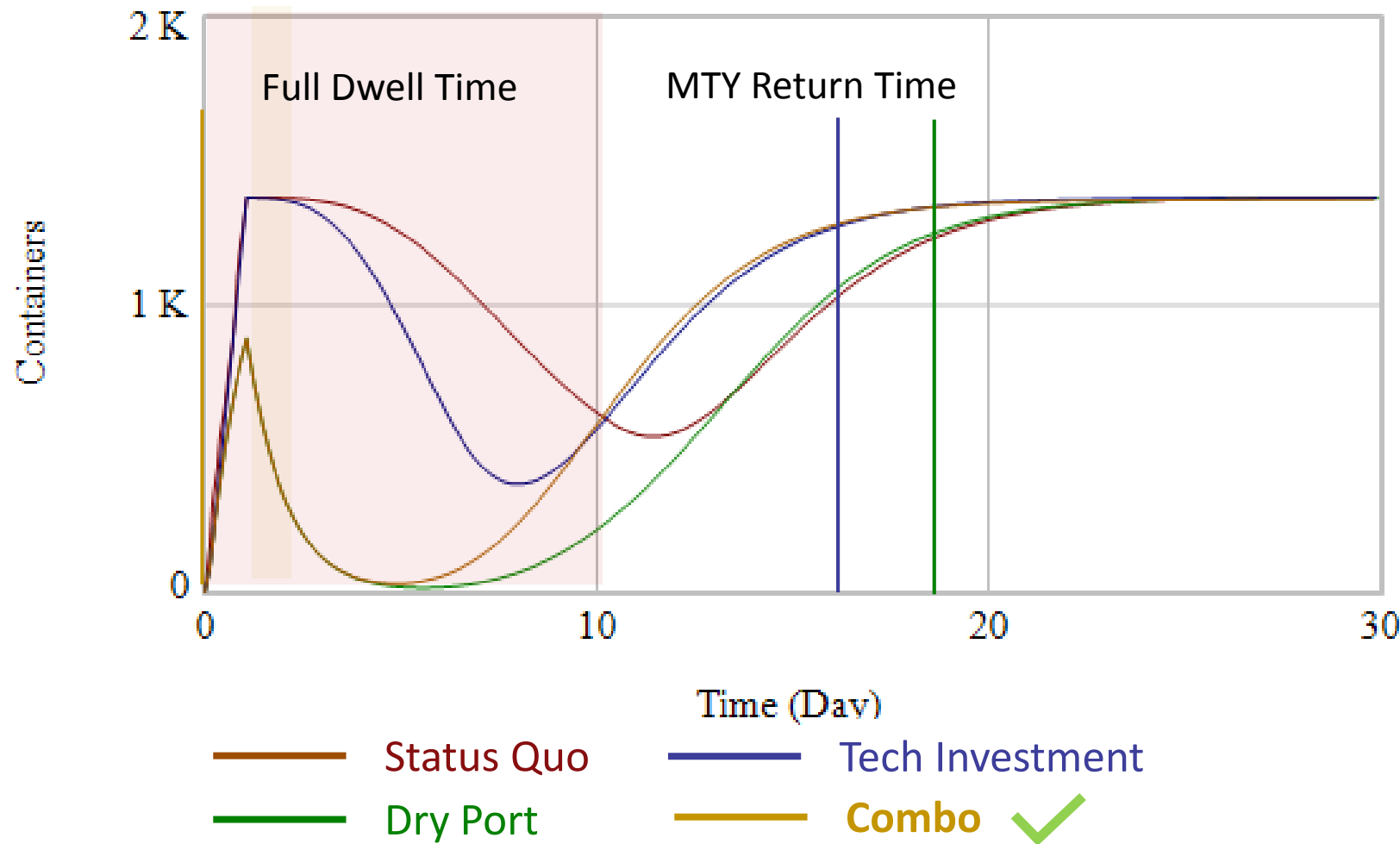
Fleet
capacity
88%

Limited
Doc. Capacity

Max Daily Documents
= 150 Documents

Doc
capacity
78%

Base Scenario: Containers in Terminal Yard



Container Turnaround

Status Quo 19

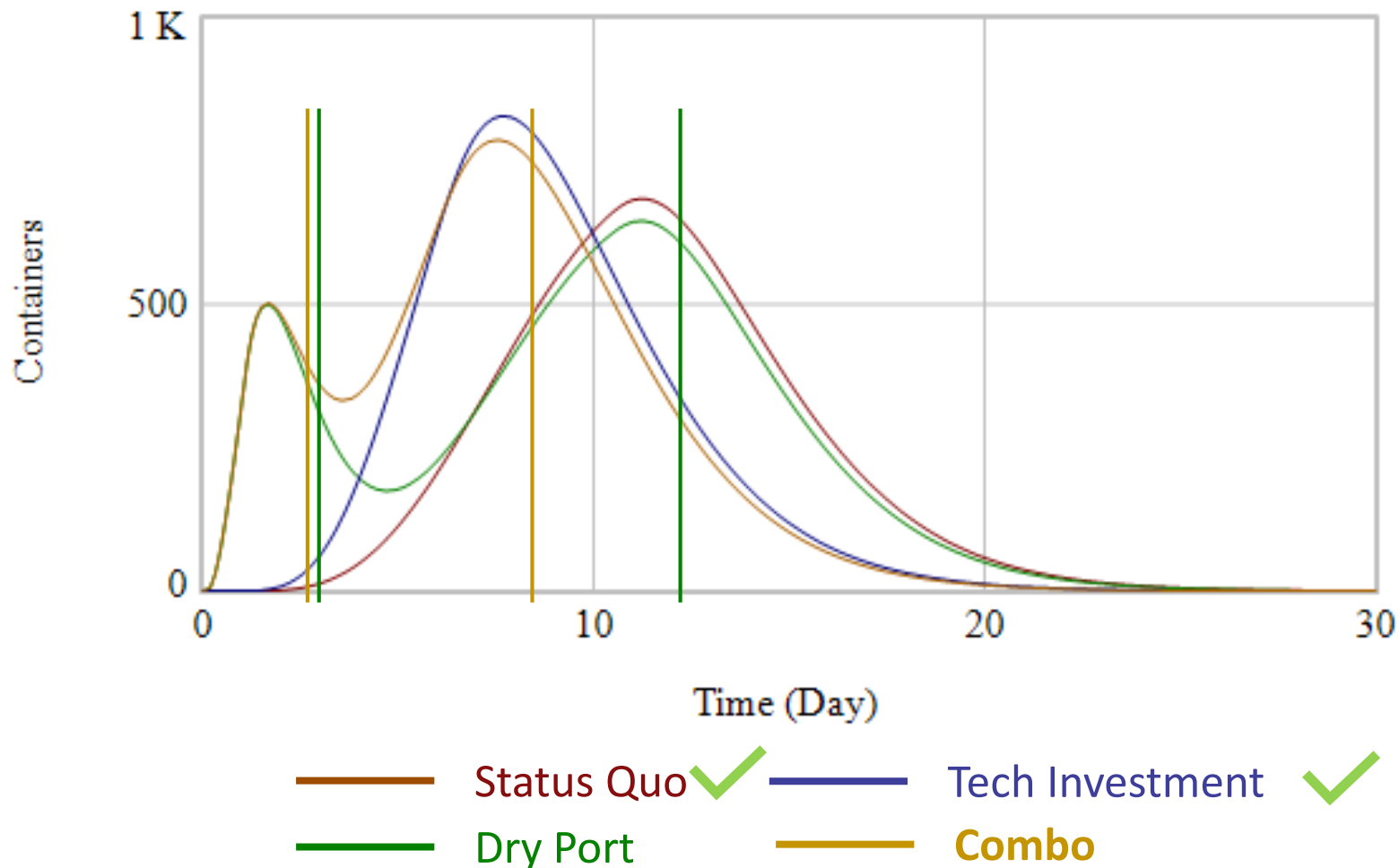
Dry Port 19

Tech 16

Combo 16



Base Scenario: Trailers Utilization



Trailers Utilization

Status Quo -

Dry Port +

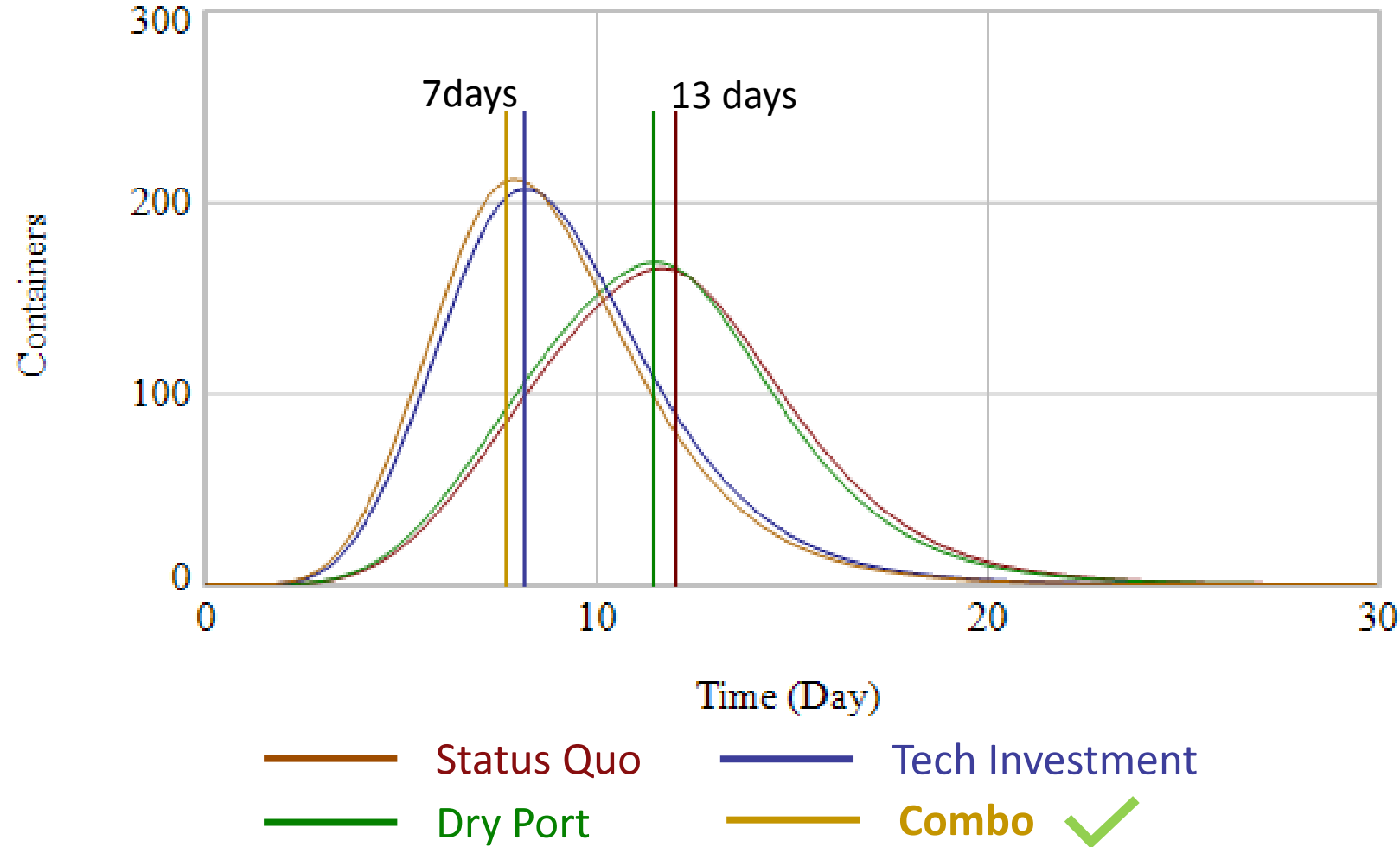
Tech -

Combo +

— Status Quo ✓ — Tech Investment ✓
— Dry Port — Combo



Base Scenario: Delivery Time



Delivery Time

Status Quo 13

Dry Port 12

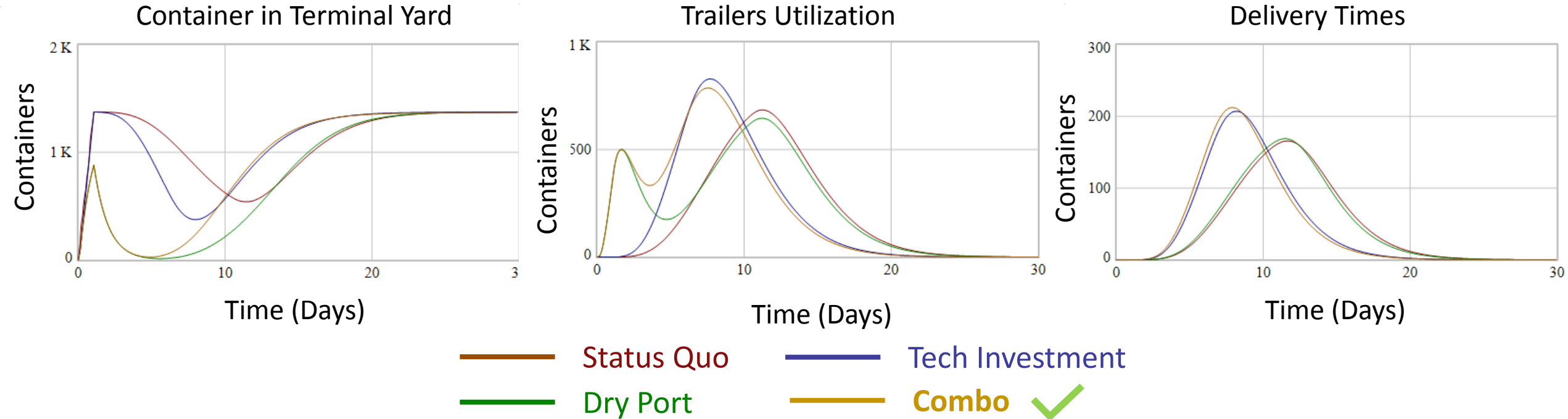
Tech 8

Combo 7

- Status Quo
- Dry Port
- Tech Investment
- Combo ✓



Combo Achieved Highest Rank in Base Scenario

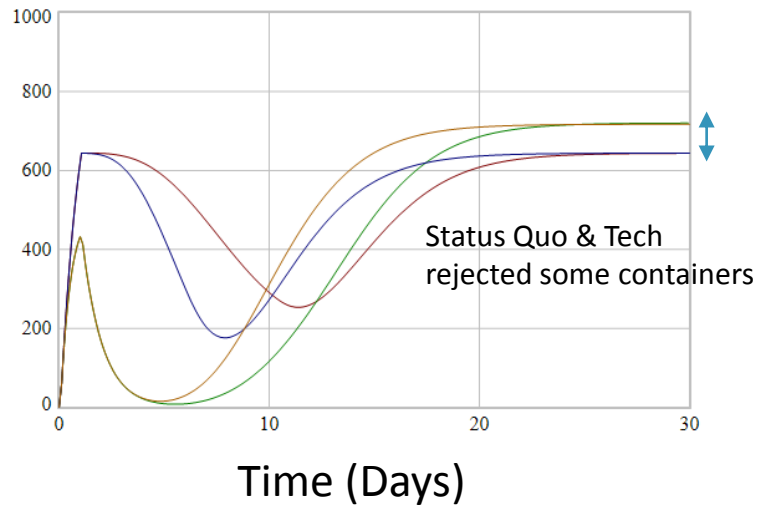


- Dry port reduces the dwell time, but not delivery and turnaround time.
- Tech reduces the delivery time and turnaround compared to Dry port .

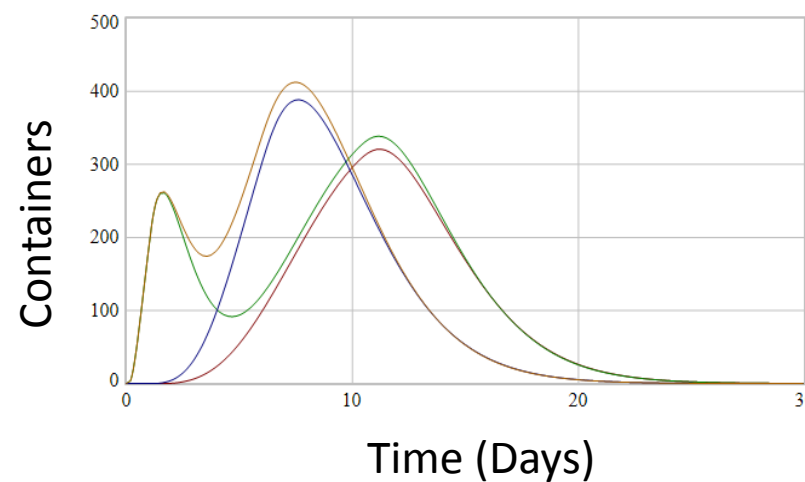
Combo Achieved Highest Rank in Limited Terminal Capacity

Yard
capacity
98%

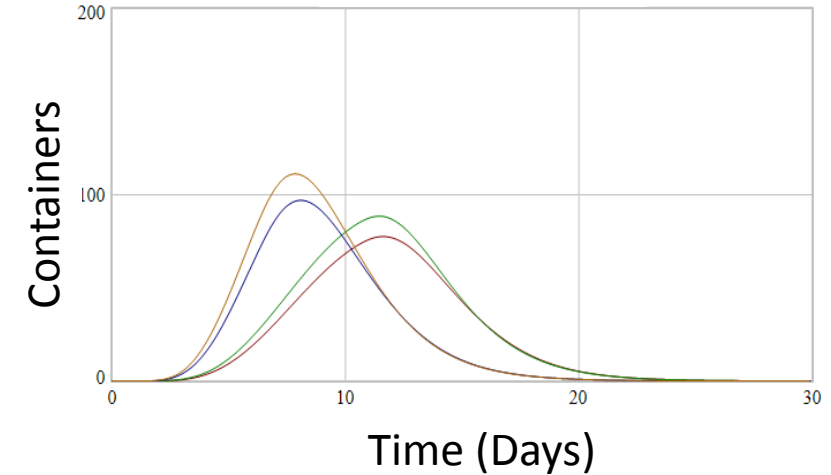
Container in Terminal Yard



Trailers Utilization



Delivery Times



— Status Quo — Tech Investment
— Dry Port — Combo ✓

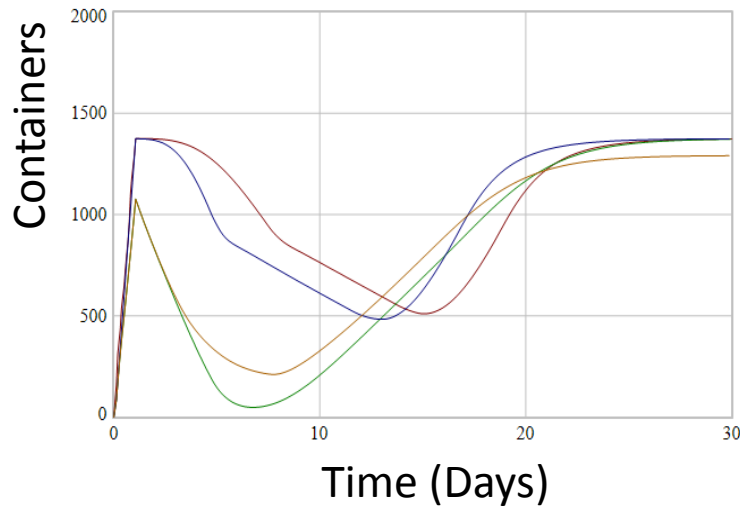
- The **Current** and **Tech** rejected some containers due to space.
- **Dry Port** and **Combo** were able to accommodate more containers.

Tech Achieved Highest Rank in Limited Fleet Size

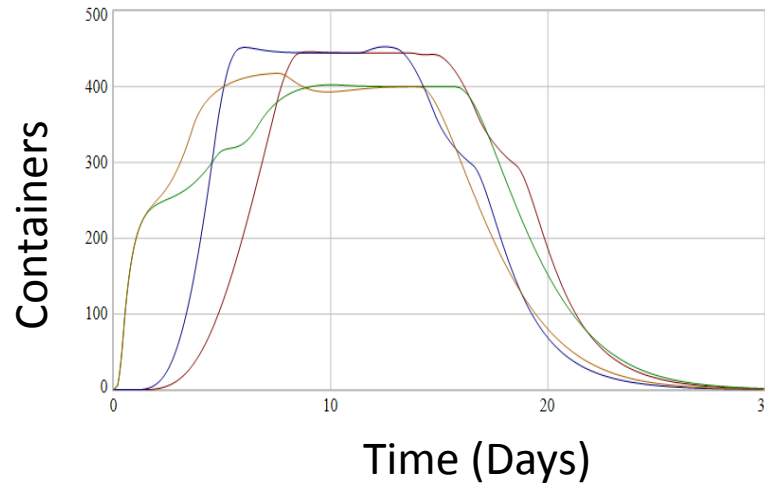
Simulation Runs



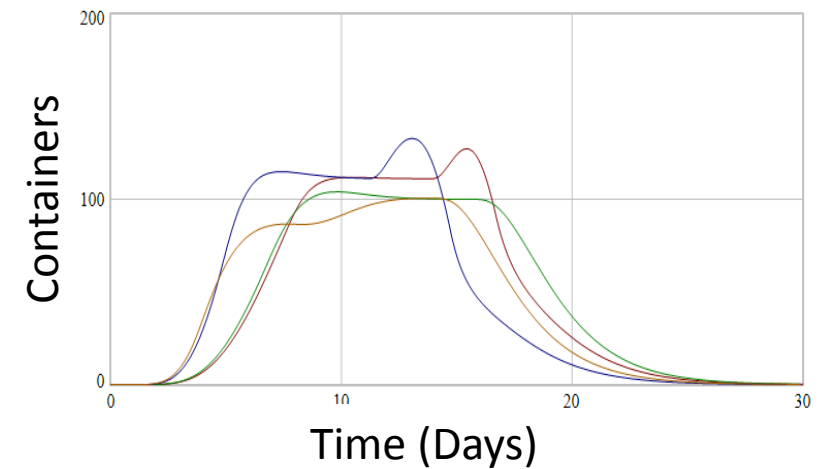
Container in Terminal Yard



Trailers Utilization



Delivery Times



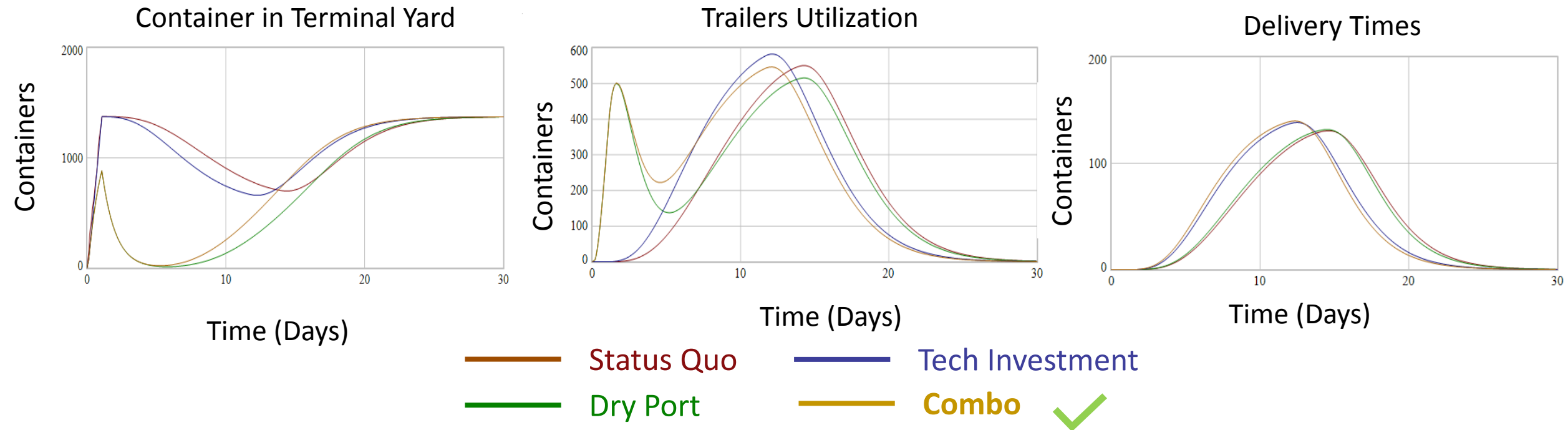
— Status Quo — Tech Investment ✓
— Dry Port — Combo

- The dry port alternatives, **Dry Port** and **Combo** had a greater utilization of trucks, resulting in higher container turnaround time.



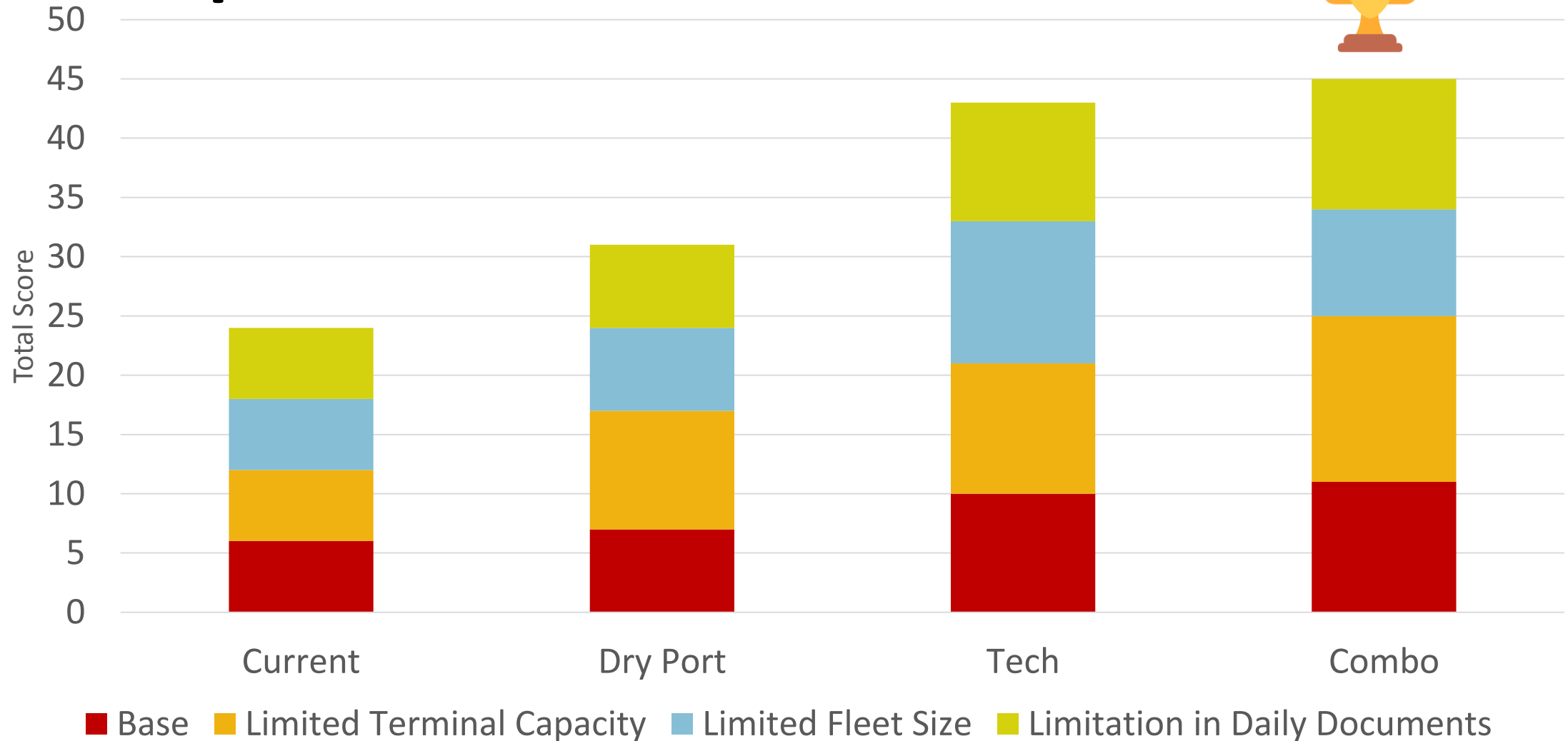
Combo Achieved Highest Rank in Limited Documentation Capacity

Doc.
Capacity
78%



- Tech and Combo achieved fastest container turnaround, and delivery times.
- Current and Combo had the highest fleet utilization.

Combo Achieved the Highest Rank, No Surprise!



What happens over a longer time period?



Simulation Output: 365 Days

Crisis on Day 275

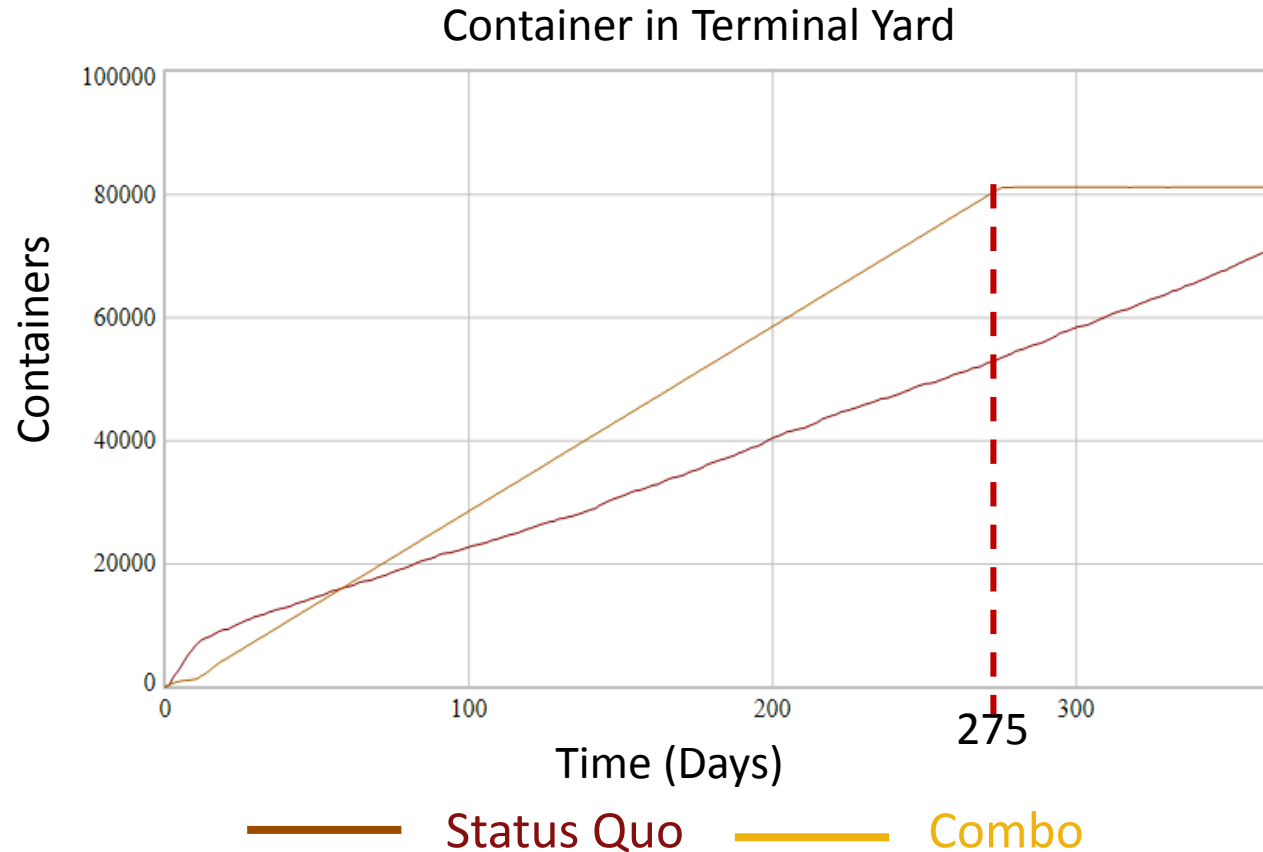
Status Quo vs. Combo
 Terminal Capacity: 82500 CNTRs
 Fleet Size: 4000 Trucks
 Daily Ship Arrivals



Day 275:

Max capacity reached.

1. Empty containers couldn't gate in
2. To load exports, imports must first discharge
3. Vessels couldn't discharge
4. Terminal yard completely block.



No. of containers in the yard kept piling up, as trailers couldn't keep up with the number of moves.

Simulation Output: 365 Days Problem Solved by ↑ Fleet

Simulation Runs

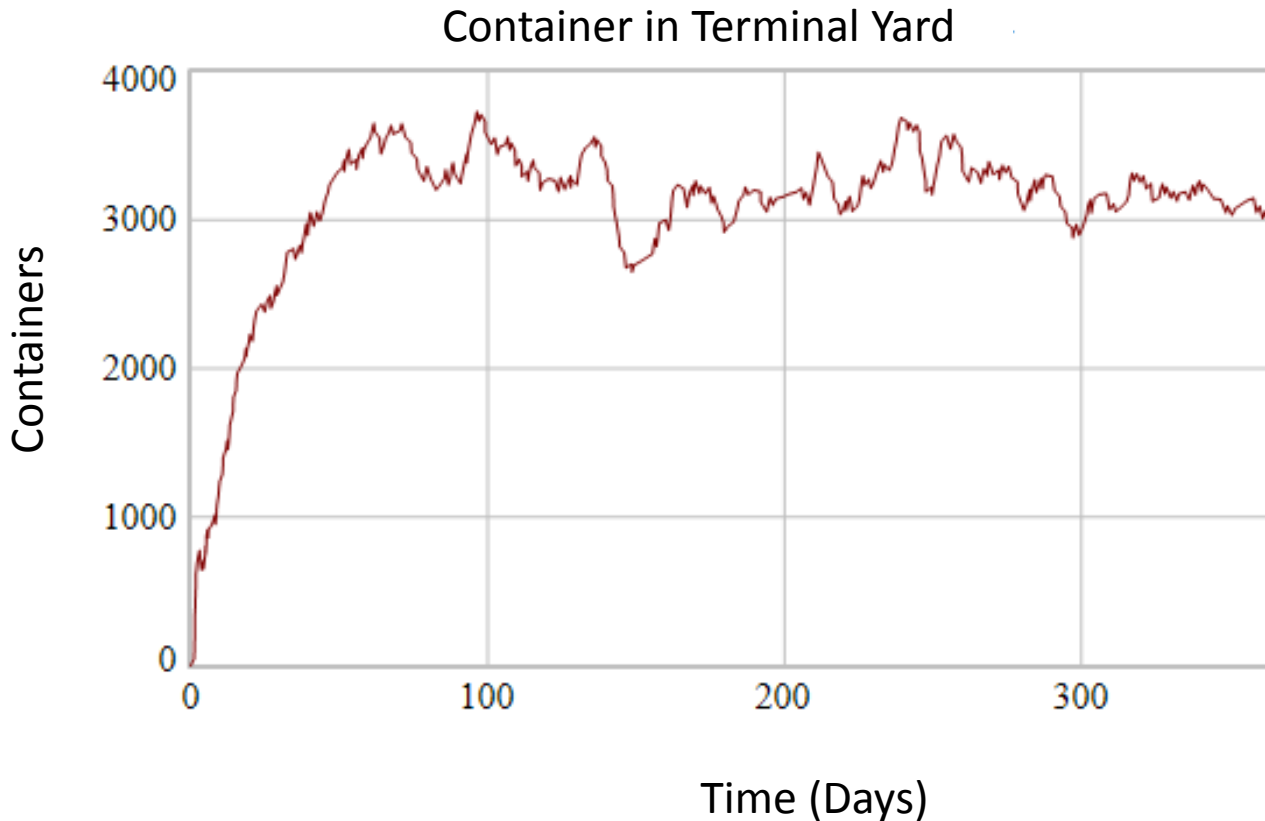
Combo+

Trailers

Terminal Capacity: 82500 CNTRs

Fleet Size: 5000 Trucks

Daily Ship Arrivals



— **Combo +**

- By increasing the fleet size, the build-up of containers in the yard was reduced.
- Lower daily yard utilization to an average of 4%.
- A desirable outcome to the status quo.

Conclusion



Moving Forward: Using the Model in Practice

- Run the model with **real-data** and create a goodness of fit.
- **Relax** certain assumptions, to gain additional insights.
- Factor in **financial implications**.
- Develop a web-base easy to use **interface** for decision makers.
- The model is just a supportive tool, **humans** make the final decision.



Look Beyond the Seaport & Take a Holistic View

- Encourages **collaboration** between stakeholders.
- Support decision makers in selecting the decisions the will **improve** the **overall** container transport chain.
- Evaluates the current container transport chain **under different scenarios**.
- Encourages a **proactive** approach in planning.



Questions & Comments



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