



Bringing Seaports Closer



MIT Center for
Transportation & Logistics

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Sponsoring Company: Aqaba Container Terminal



Objective

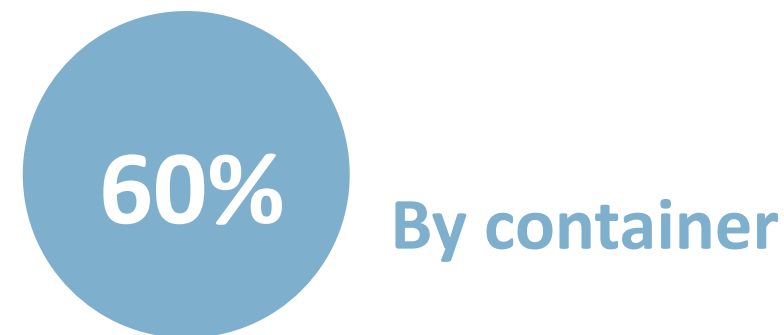
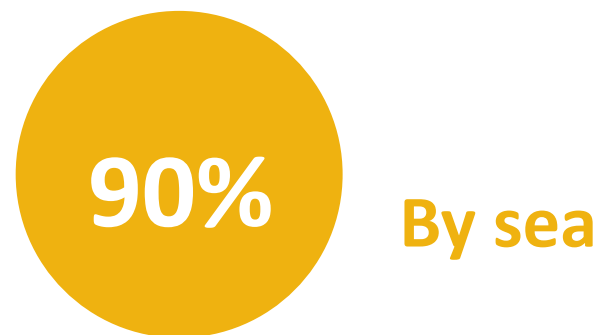
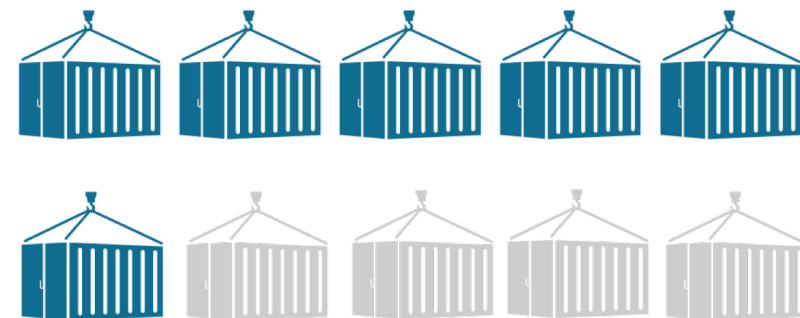
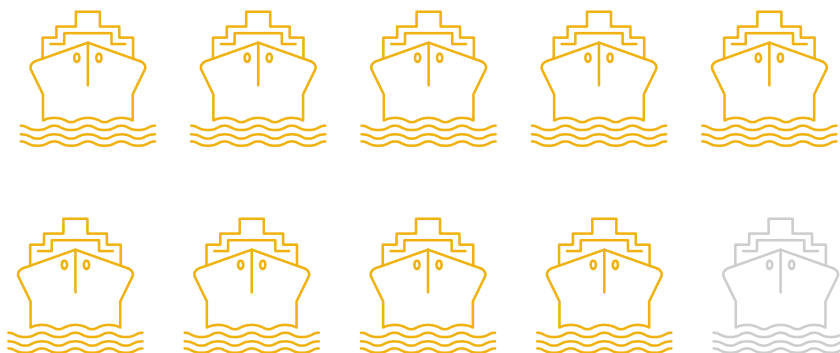
To develop a framework that assess the impact of policy and investment changes related to cargo movement on the container transport chain

Agenda

- Background
- Case Study - Jordan
- Methodology
- Conceptual Model
- Simulation Framework
- Simulation Outputs
- Conclusion
- Questions & Comments



Global Trade



Source: WTO , 2017

Source: IMO, 2017

Source: Statista, 2017





Container Movement – Interactions & Complexities

Port Terminal

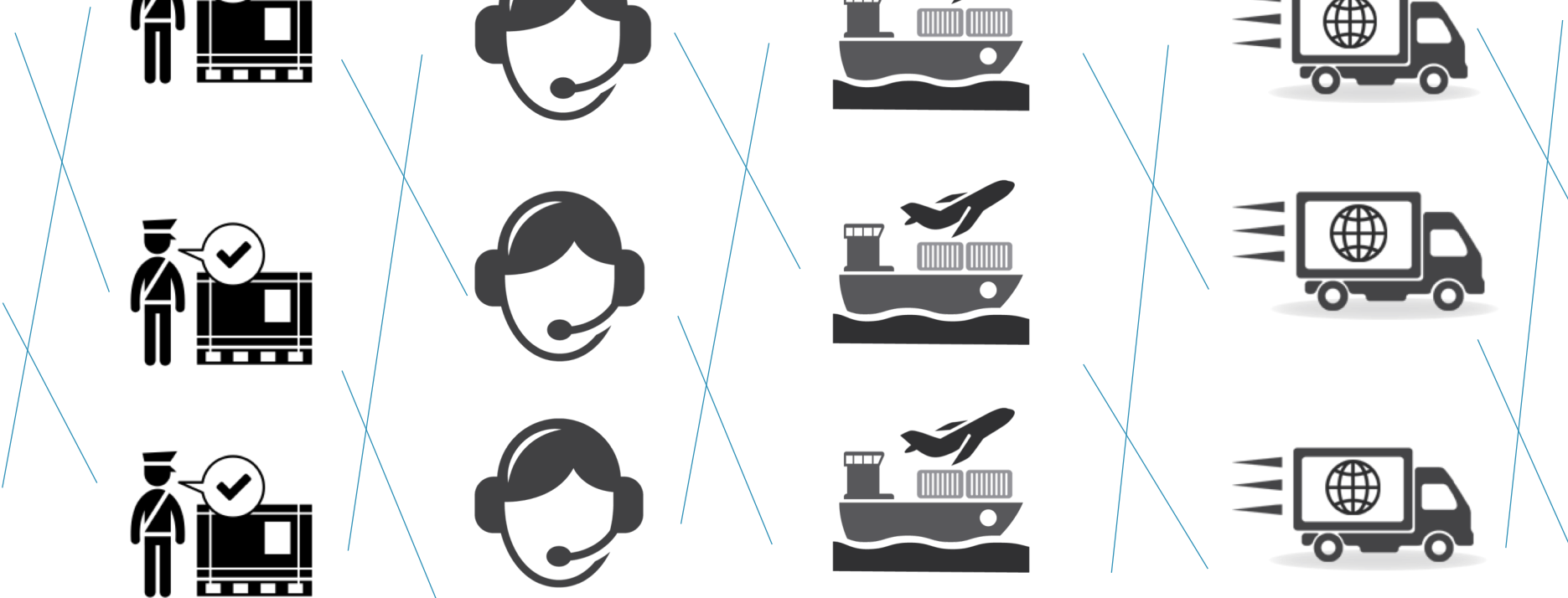
Customs

Ship Agent

Flight Forwarder

Trucker

Customers



Industry Trends



Mega ship:
Fast Operation Needed



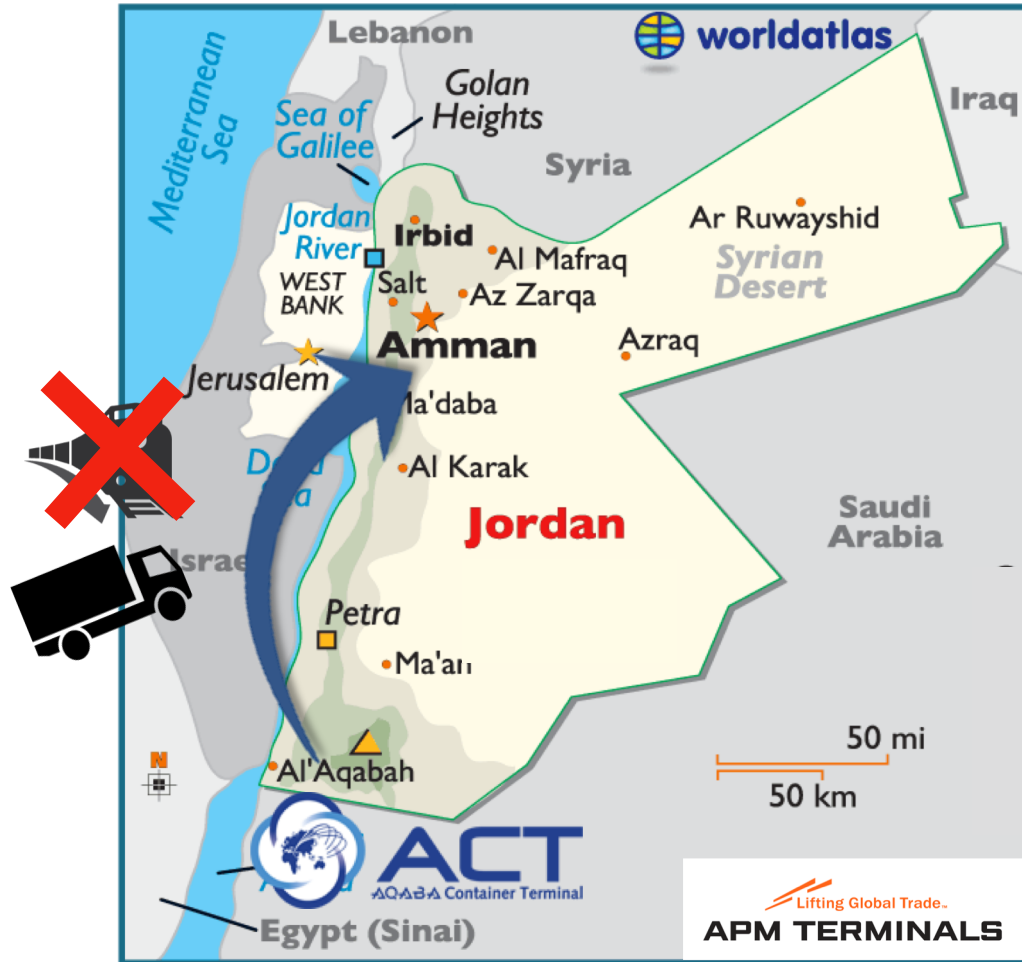
Vertical Integration:
Hinterland Investments



Technology :
Blockchain



Jordan's Containerized Trade



75% Of containerized Trade are imports



45% Growth between 2008 to 2016

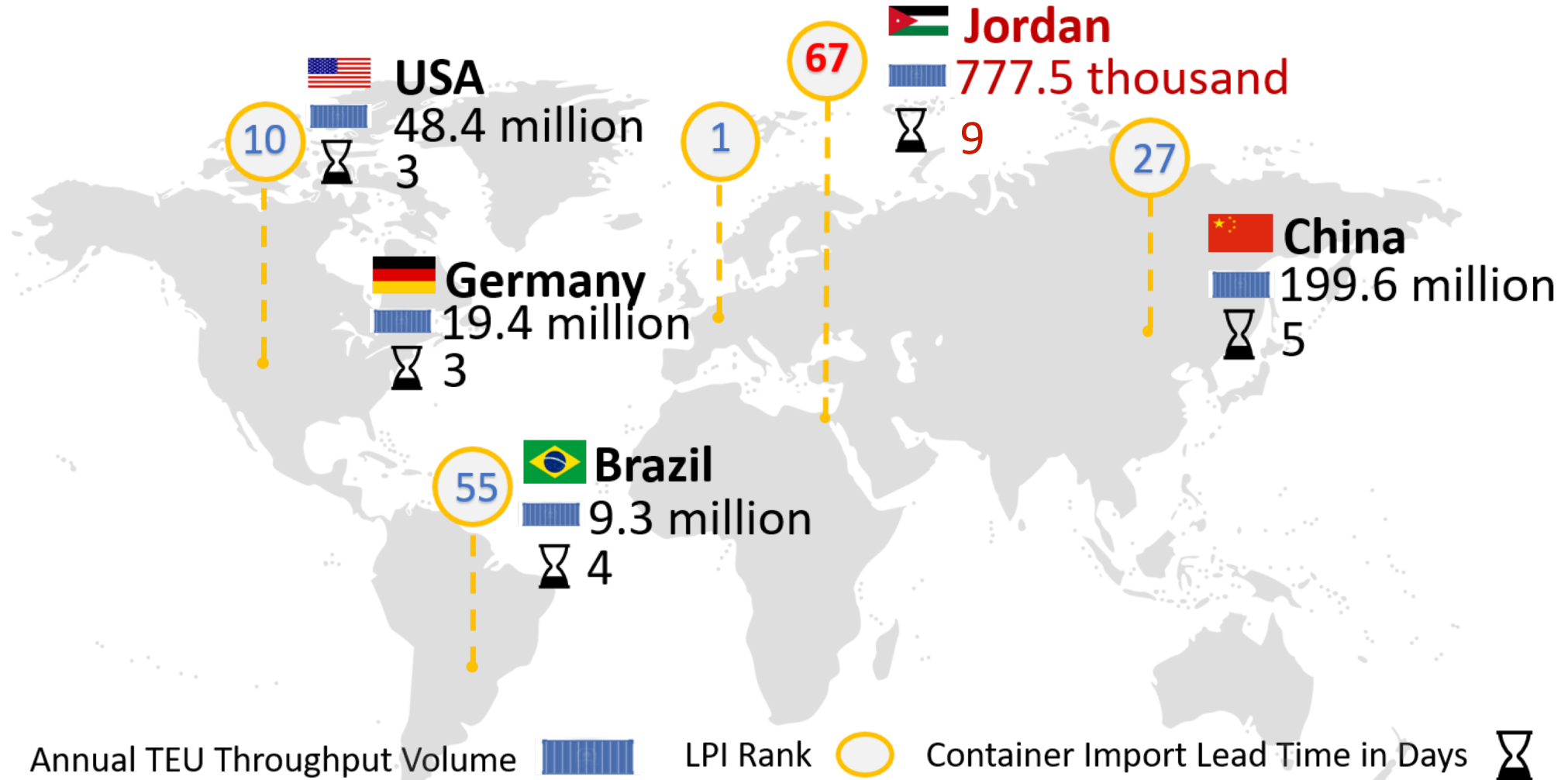


95% throughput growth rate in 10 years





LPI Comparison



Sources: Logistics Performance Index 2016, World Bank, UNCTAD

Expected Initiatives

- ADC plans to reduce container dwell time to 3 days in the coming years, by improving documentation processing time.
- Establishment of a Dry Port to be located close to the capital Amman.

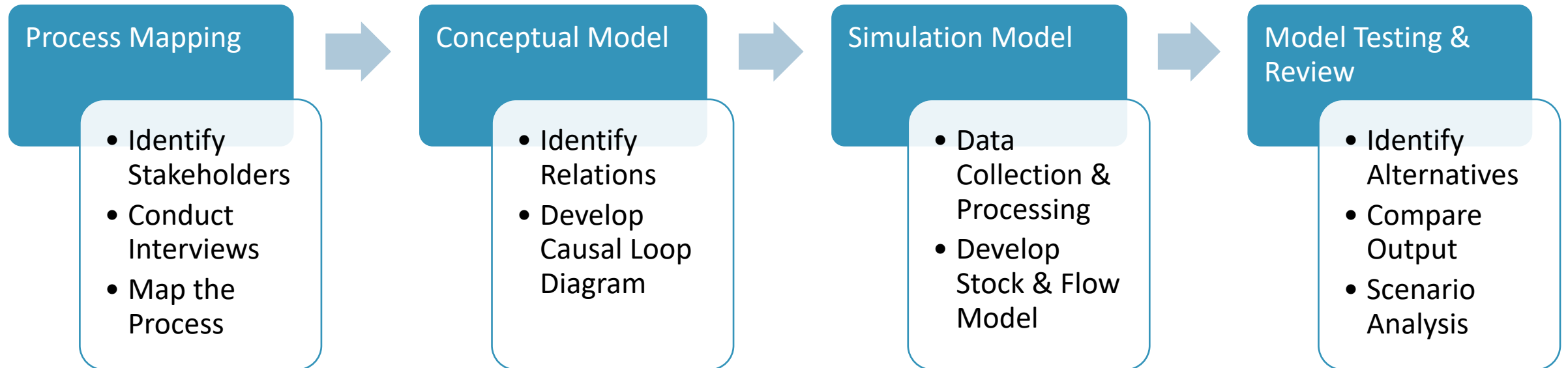
Question:

How effective would these strategies be on the overall container transport chain?

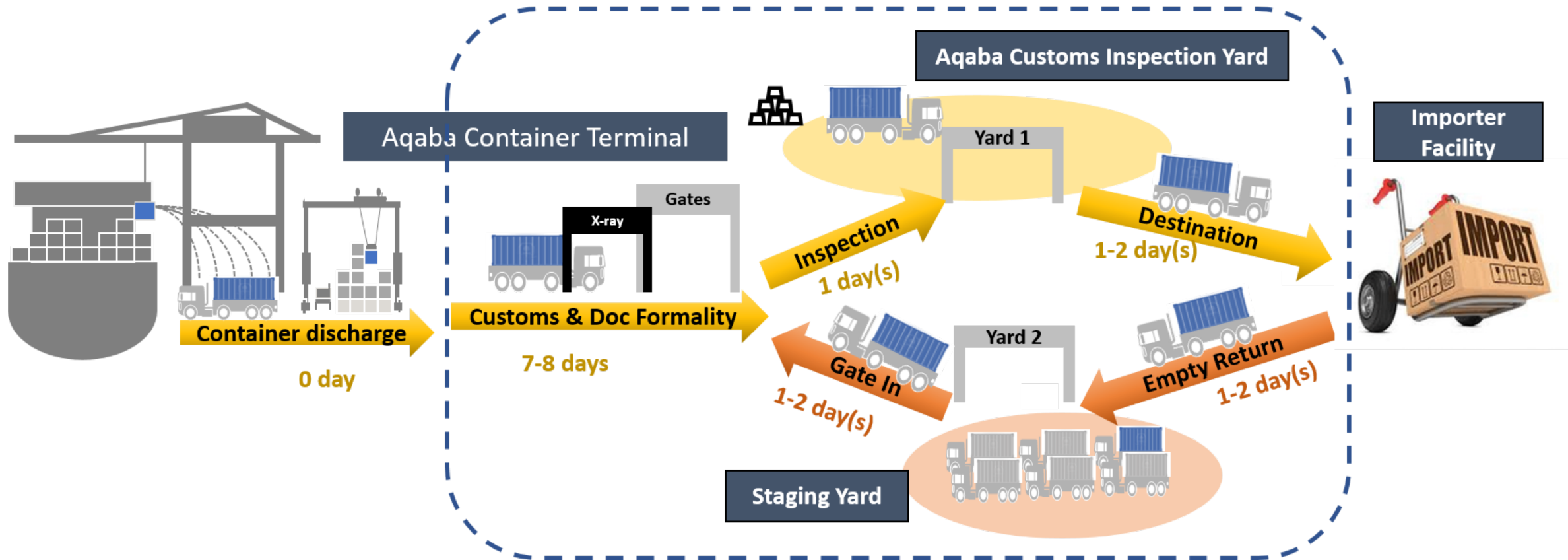
System Dynamics

- 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.

Procedure



The Import Process



Assumptions



One size and type of containers



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



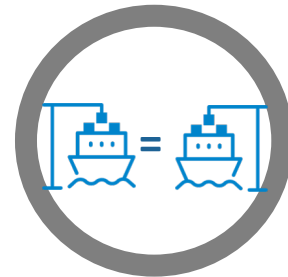
One size and type of trailers



Empty containers for export bookings are picked up from container depots



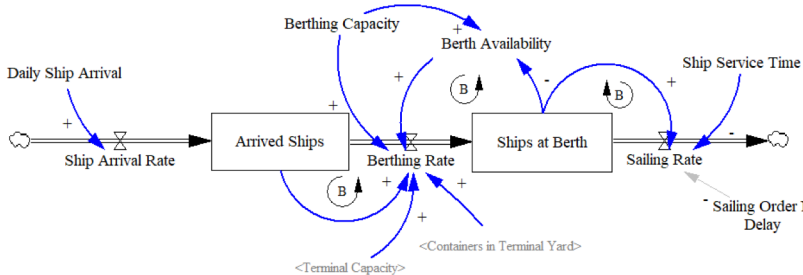
Third order delay assumed in documentation processing



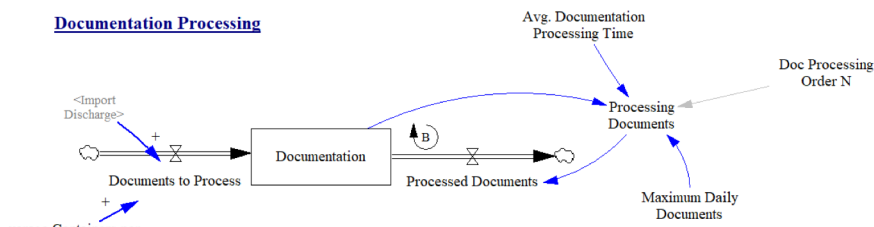
Vessel load capacity = discharged containers

Stock & Flow Model

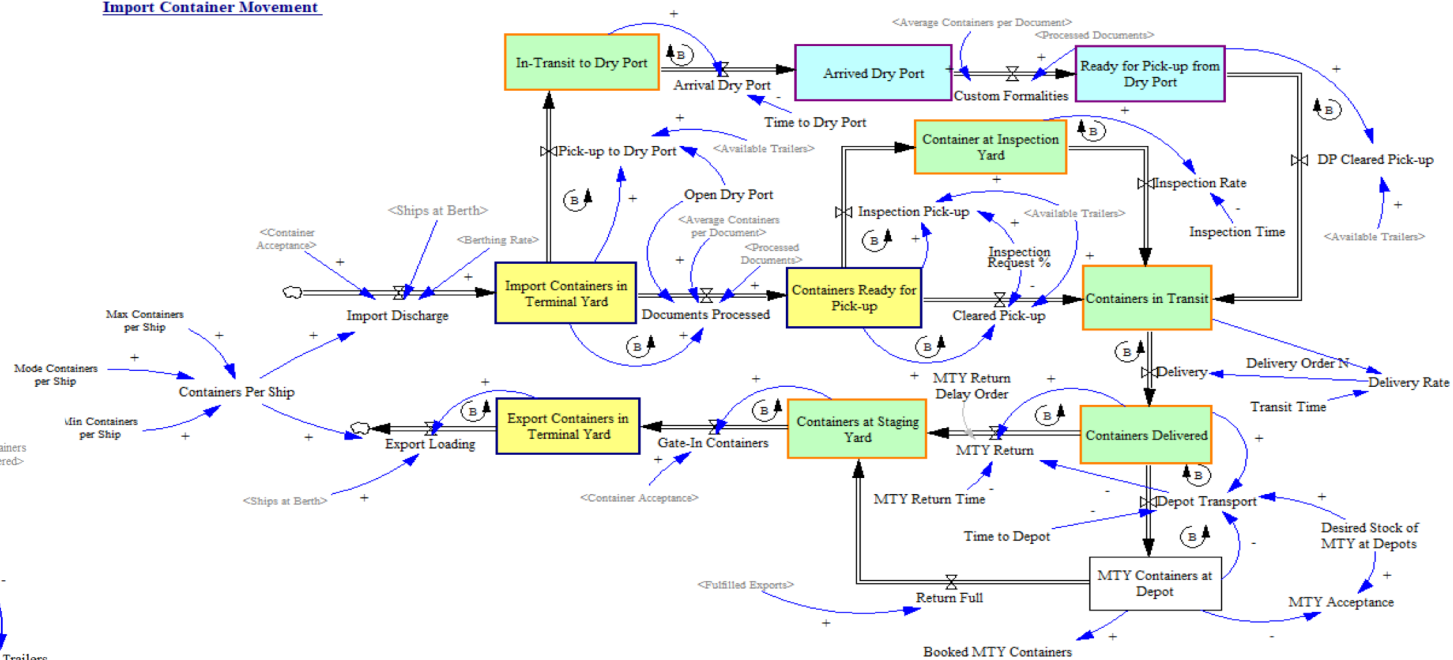
Queueside Sub-System



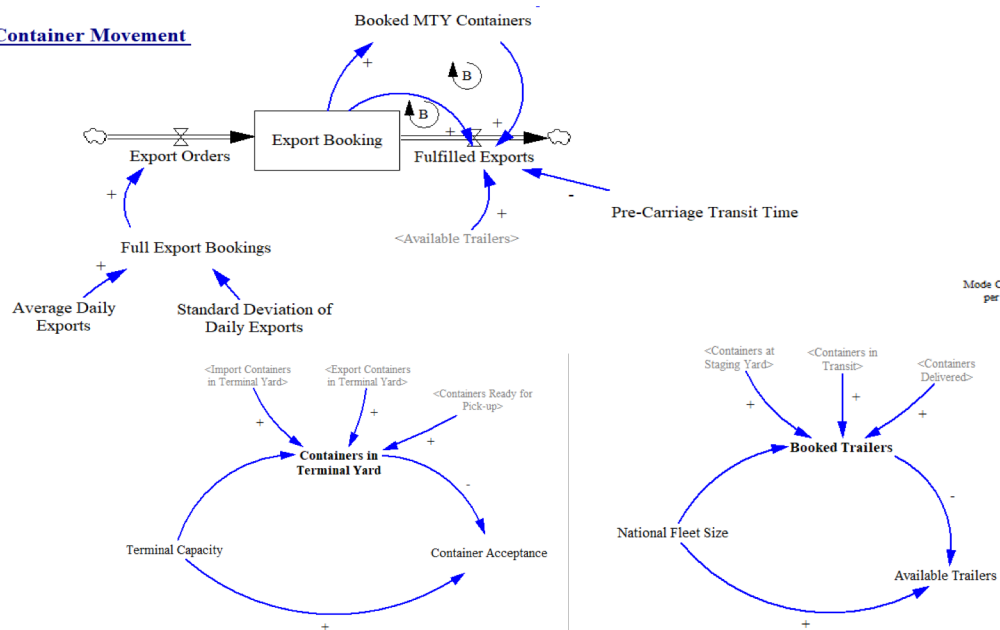
Documentation Processing



Import Container Movement

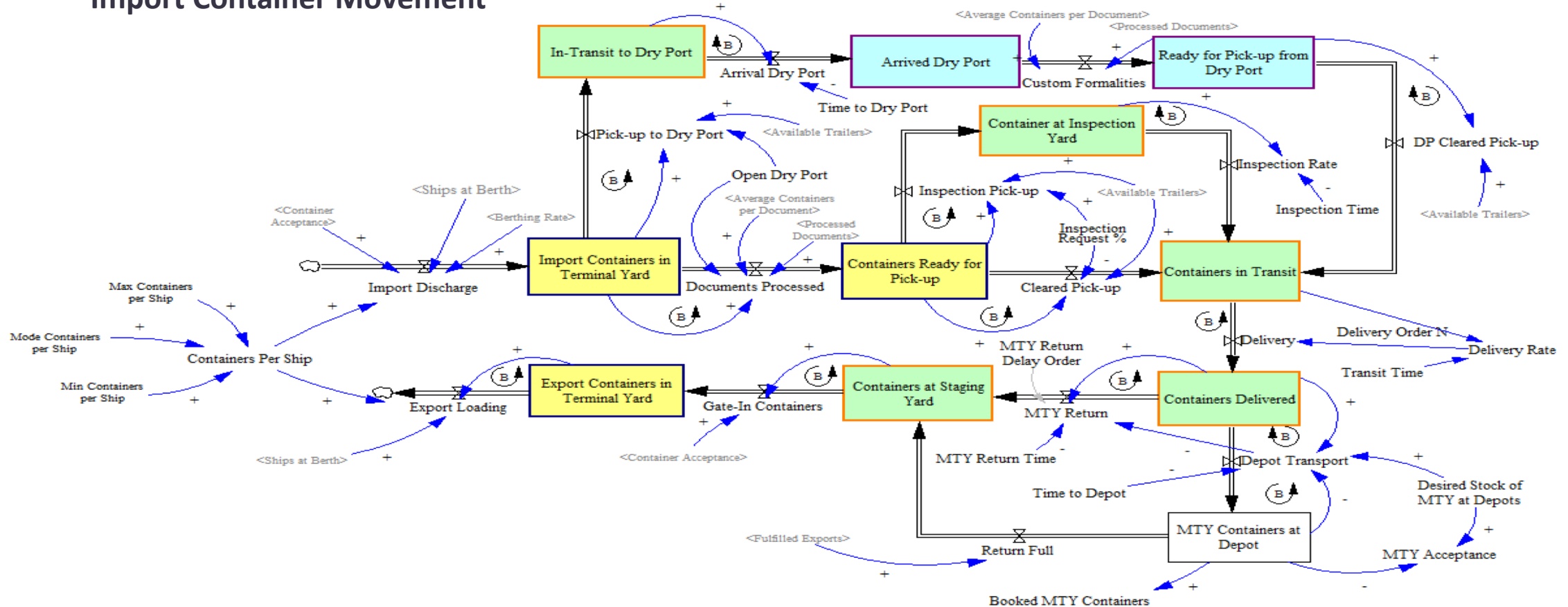


Export Container Movement



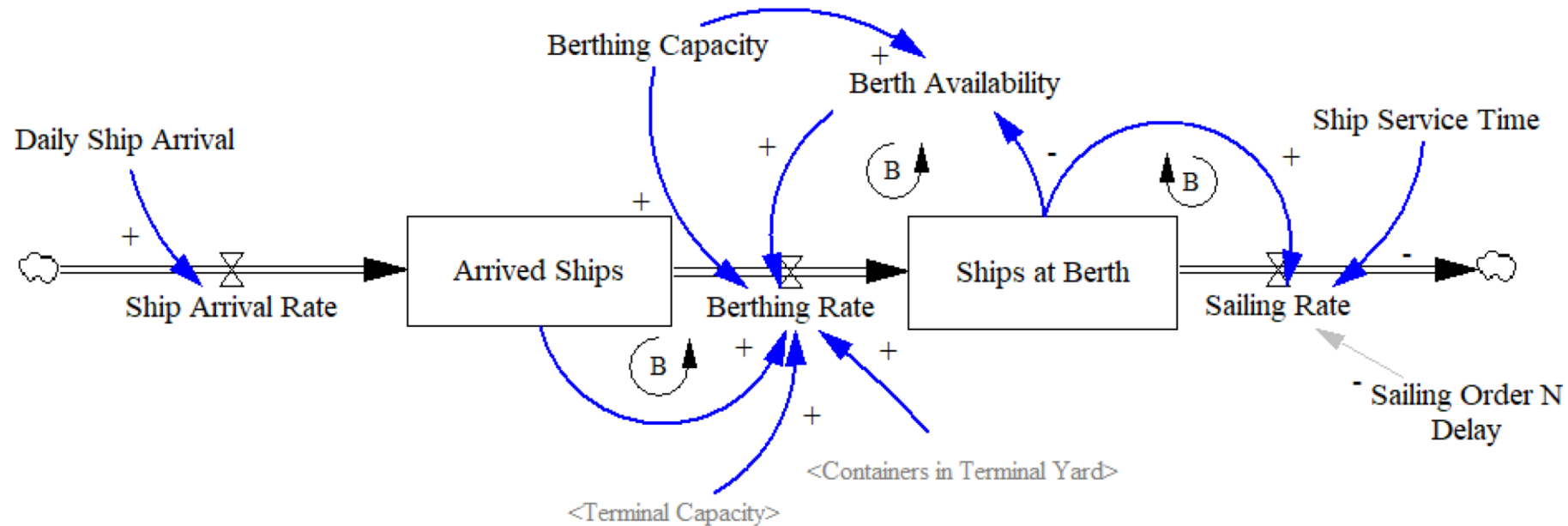
Stock & Flow Model

Import Container Movement



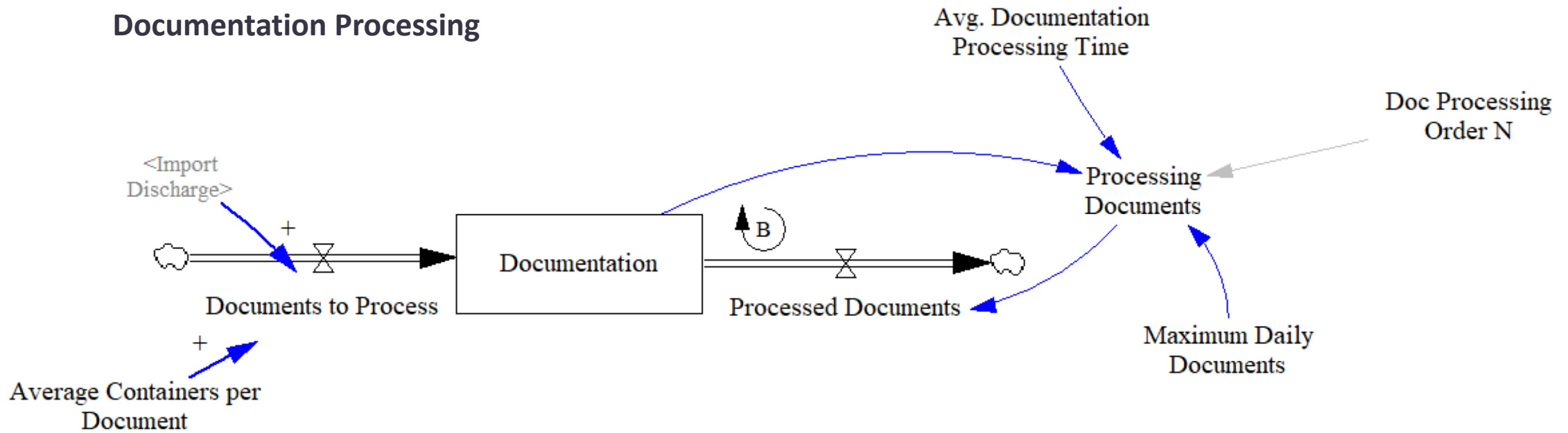
Stock & Flow Model

Quayside Sub-System



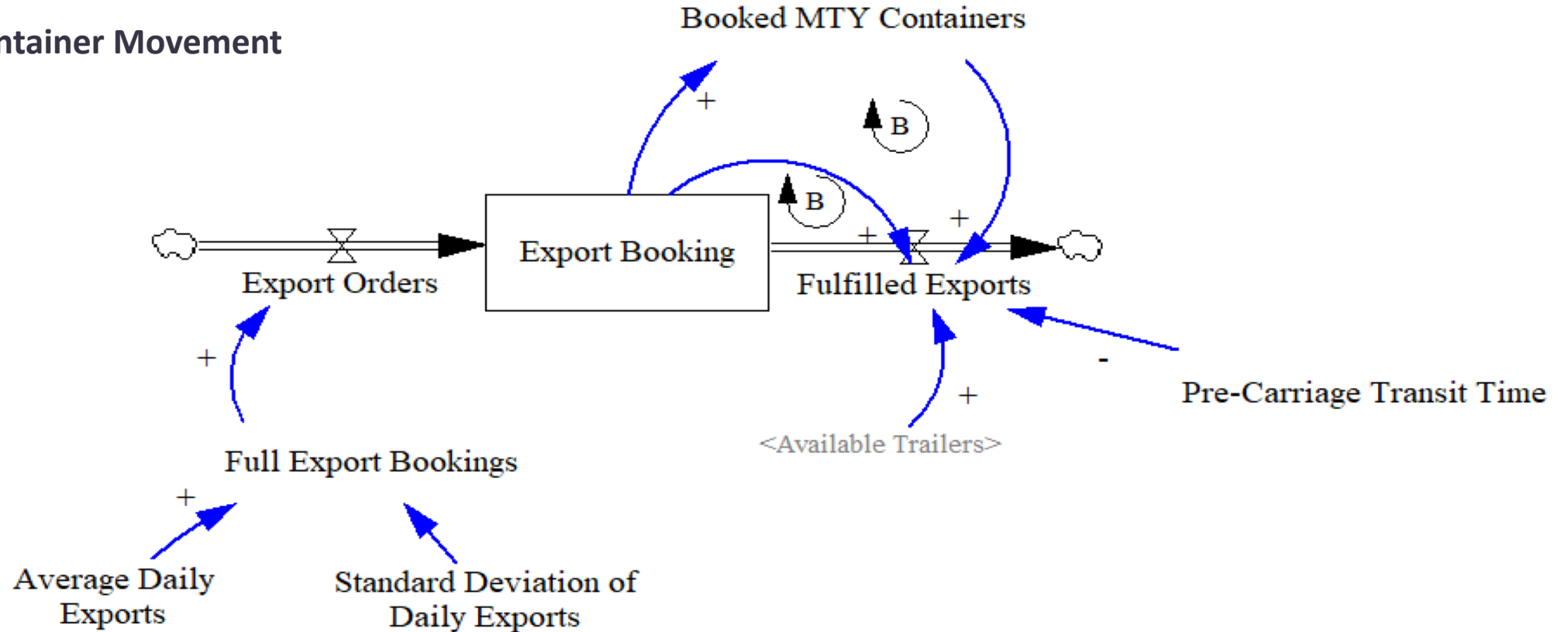
Stock & Flow Model

Documentation Processing



Stock & Flow Model

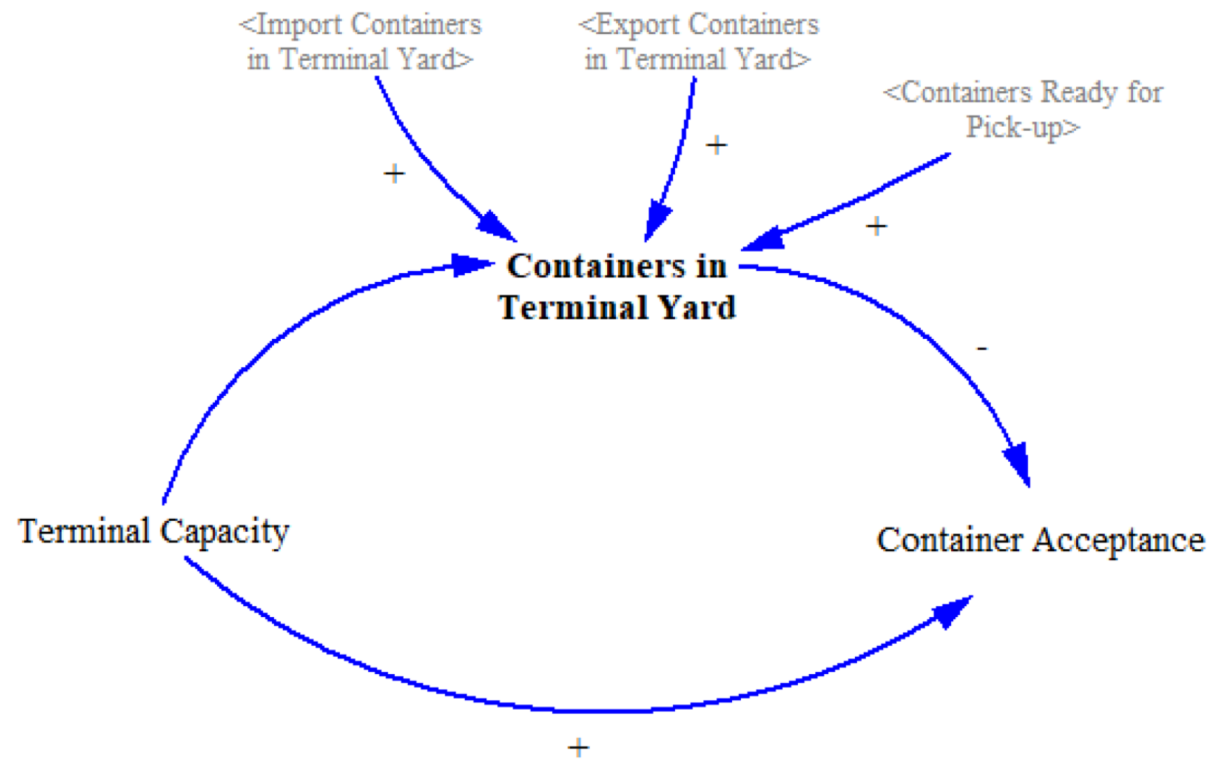
Export Container Movement





Stock & Flow Model

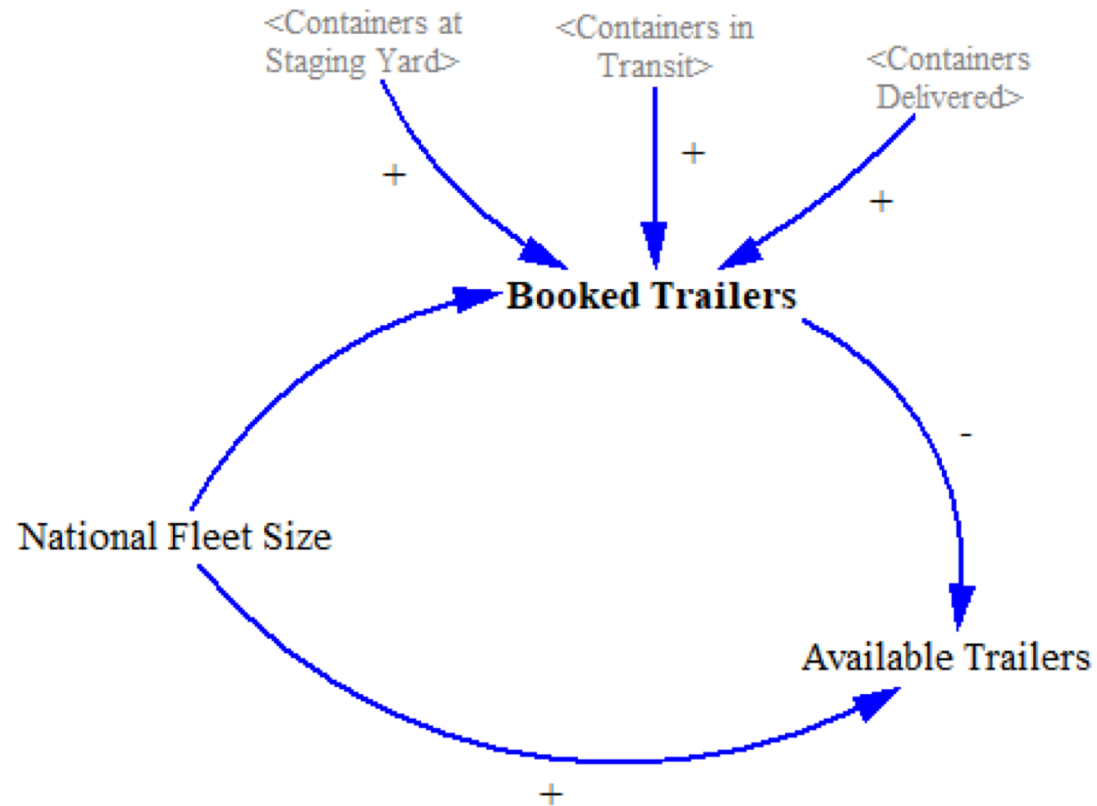
Containers in the Terminal Yard





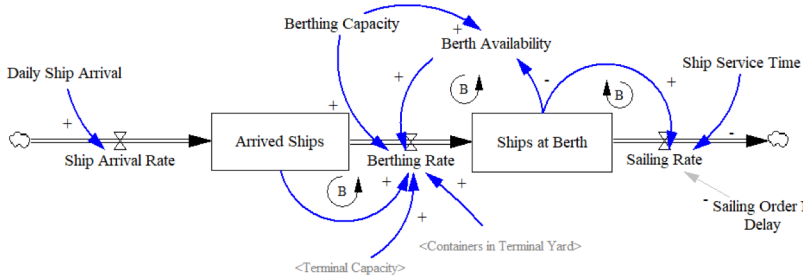
Stock & Flow Model

Booked Trailers

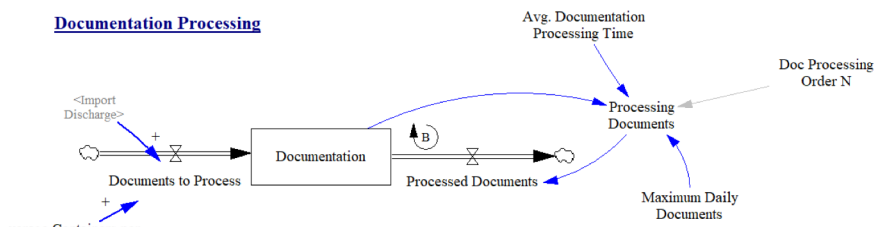


Stock & Flow Model

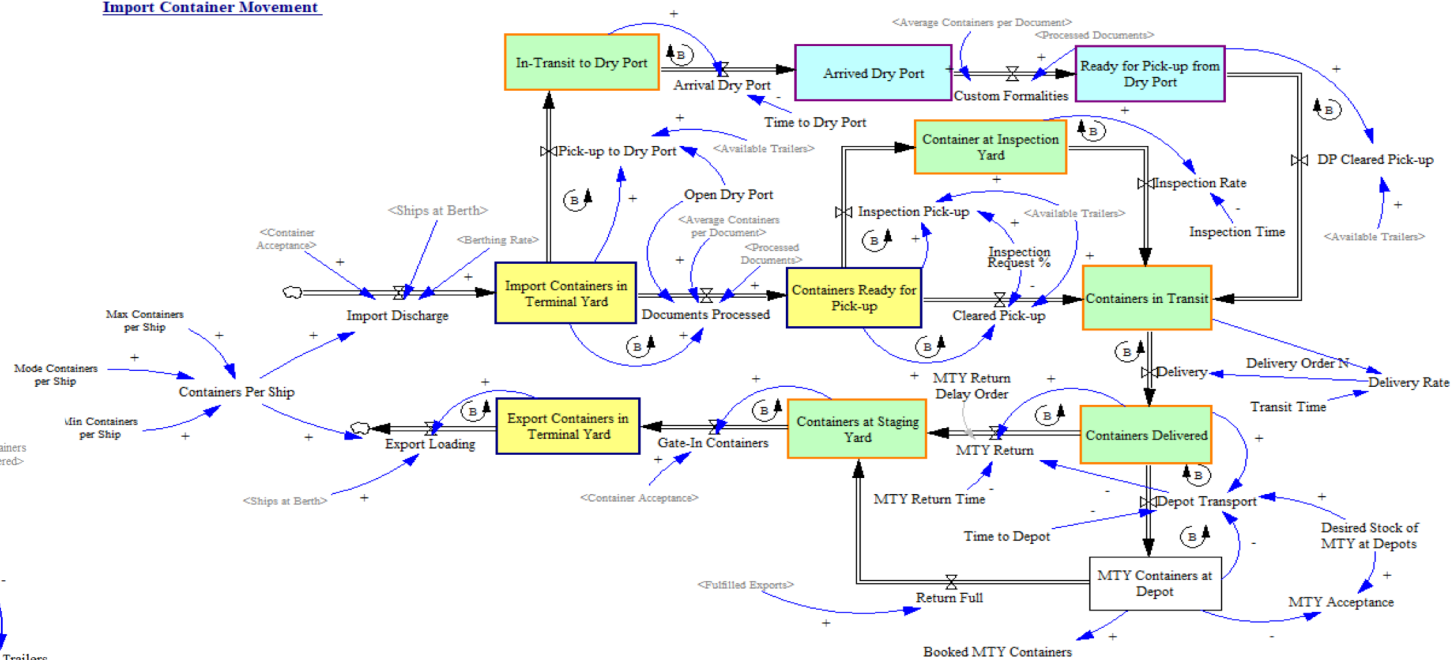
Queueside Sub-System



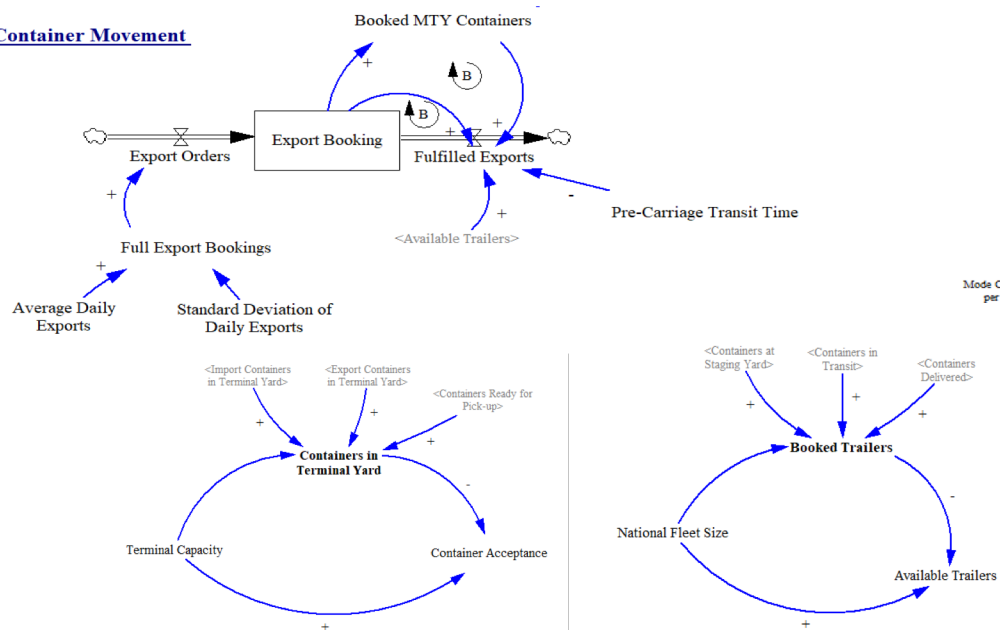
Documentation Processing



Import Container Movement



Export Container Movement



Status Quo (Current) – Inputs

Variables

Daily Ships Arrival

Containers per Ship

Inspection Requests

Containers per Document

Documentation Processing Time

Max Daily Documents Processed

Inputs

1 Ship

1375 Constrainers

30%

1 Container

5 days

700 Documents

Variables

Desired Stock of MTY at Depots

Avg. Daily Exports

Standard Deviation of Exports

Fleet Size

Terminal Capacity

Open Dry Port

Inputs

500 Containers

220 Containers

50 Containers

4,000 Trailers

40,000 Containers

0 (Binary Variable)

Alternative Inputs

Alternative 1: Dry Port Move

Open Dry Port = 1

Alternative 2: Tech Investment

Documentation Processing Time = 3 days

Alternative 3: Combo 1+2

Open Dry Port = 1

Documentation Processing Time = 3 days

Scenarios

Scenario 1: Limited Terminal Capacity

Terminal Capacity = **1,000 Containers**

Scenario 2: Limited Fleet Size

Fleet Size = **500 Trailers**

Scenario 3: Limitation in Daily Processed Documents

Maximum Daily Documents = **150 Documents**

Assessment Criteria

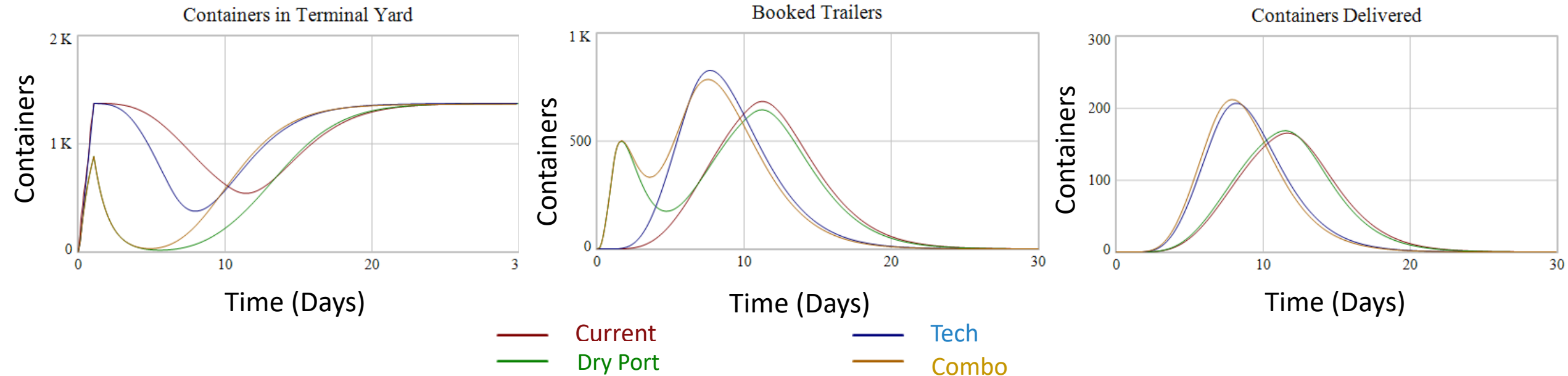
Time Line: 30-days | One Ship Arrival | 1,375 Containers

KPIs:

1. Container Turnaround
2. Delivery Time
3. Trailers Turnaround
4. Container Acceptance (for Scenario 1)



Simulation Output – Base Scenario



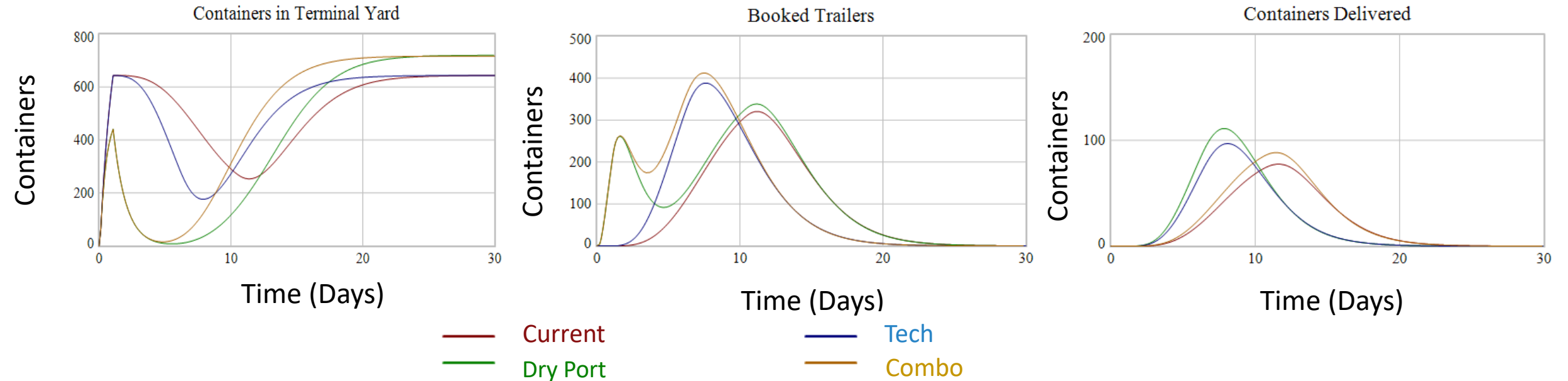
Insights:

- **Dry port** reduces the dwell time, but not the container delivery time or container turnaround.
- **Tech** reduces the delivery time and container turnaround compared to **Dry port**.
- **Combo** achieved highest rank.



Scenario 1 – Limited Terminal Capacity

1000
Cntrs

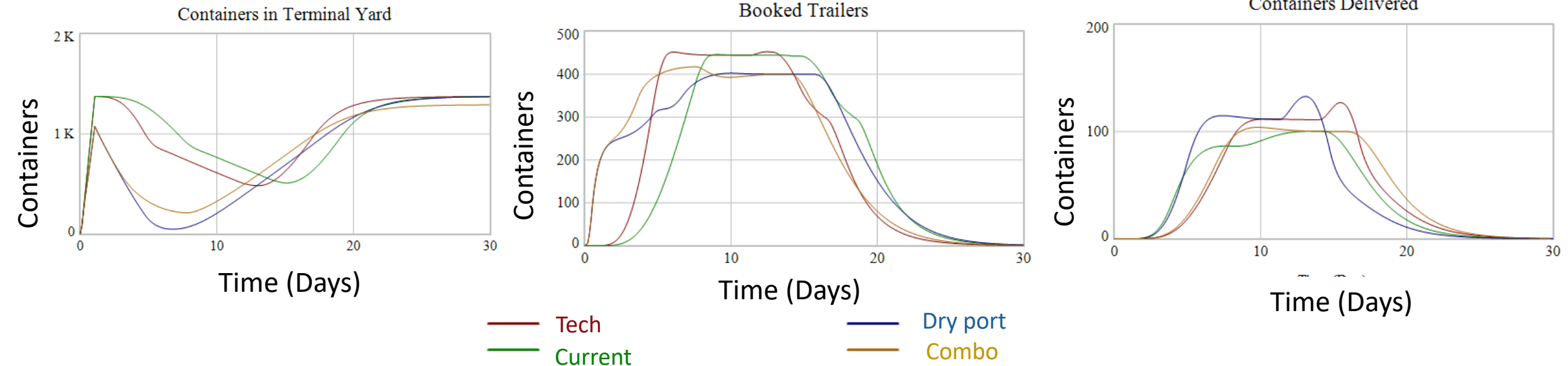


Insights:

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

Scenario 2 – Limited Fleet Size

500
Trailers



Insights:

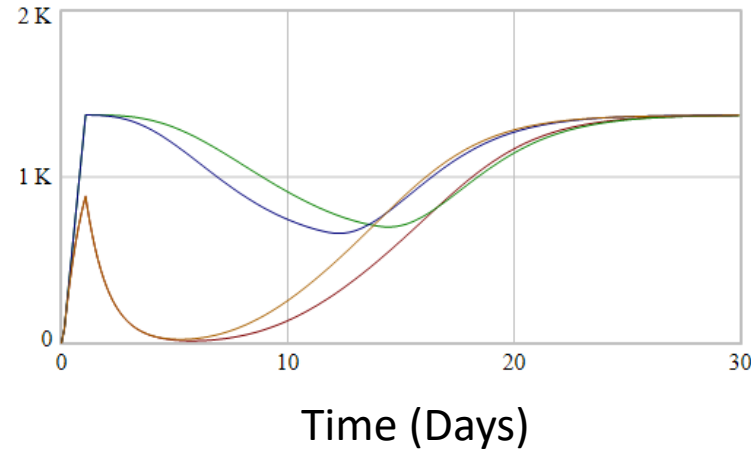
- The dry port alternatives, **Dry Port** and **Combo** had a greater utilization of trucks, which resulted in a higher container turnaround time.
- **Tech** achieved highest rank.



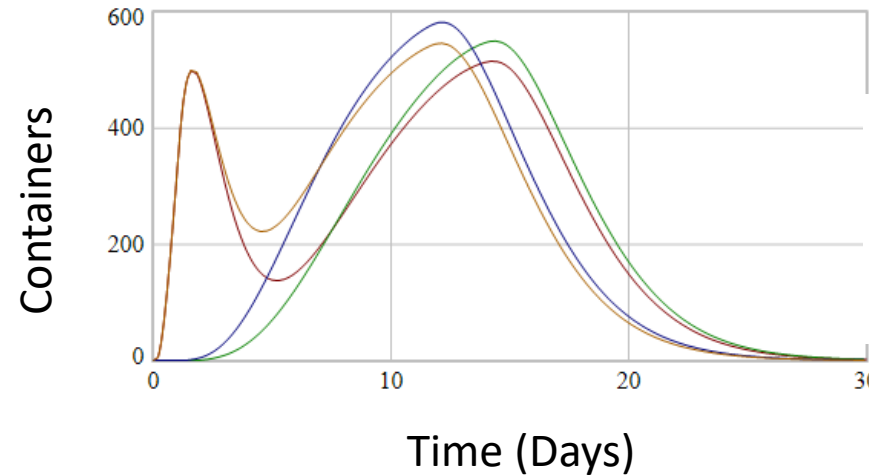
Scenario 3 – Limitation in Daily Documents

150
Docs

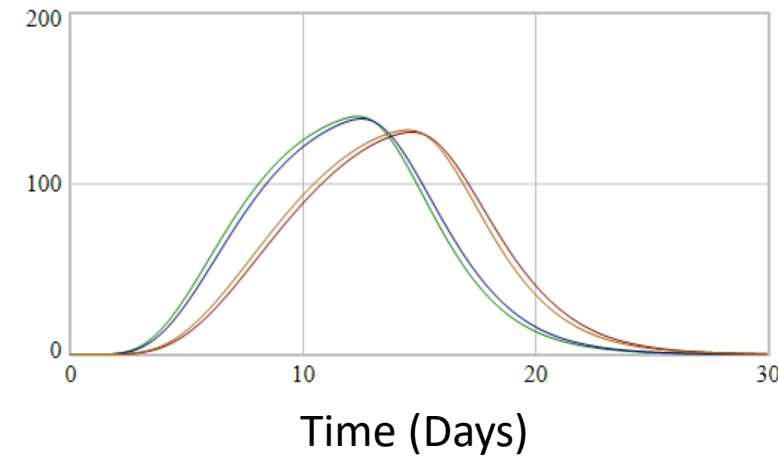
Containers in Terminal Yard



Booked Trailers



Containers Delivered



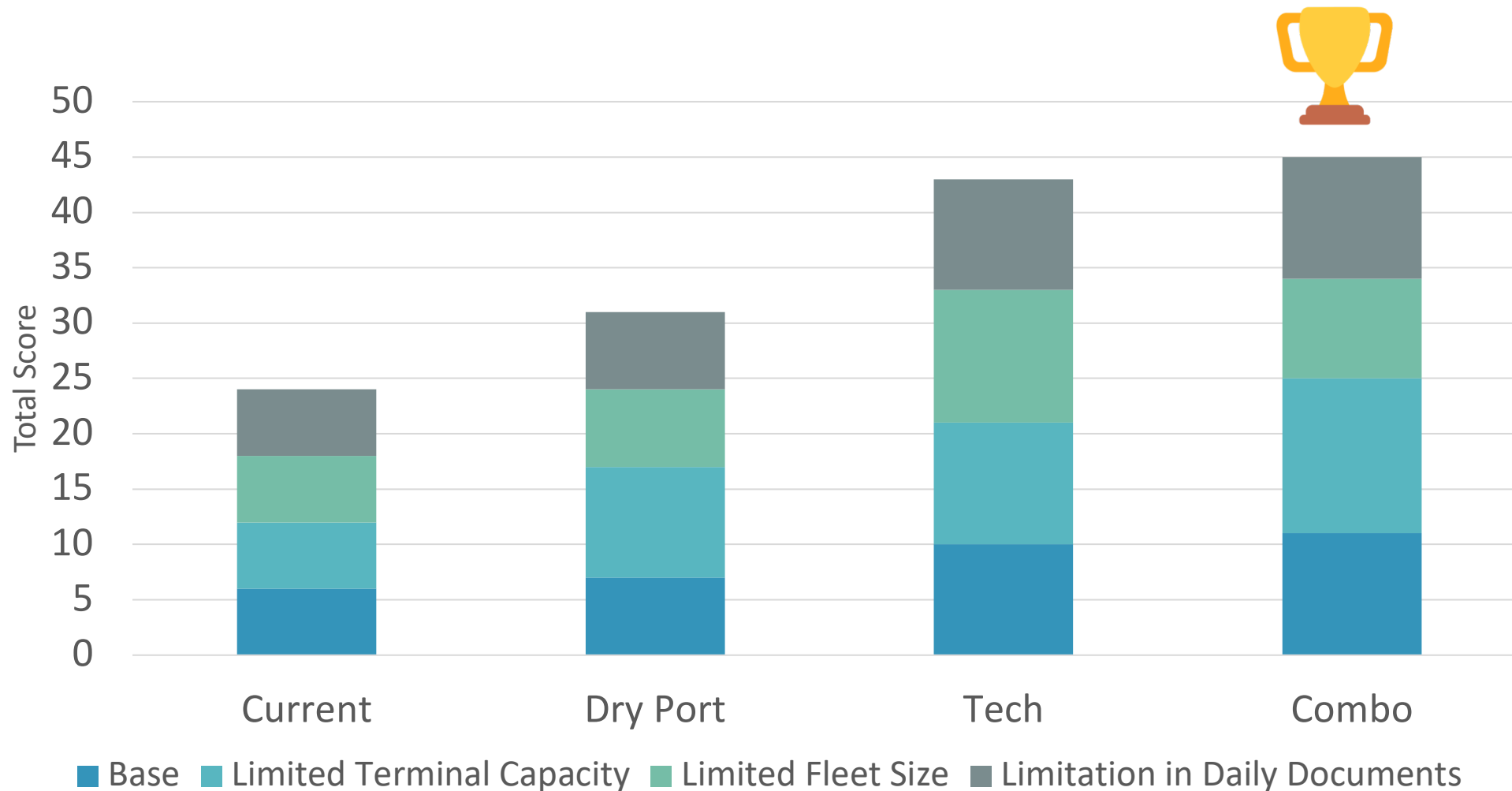
— Dry Port
— Current

— Tech
— Combo

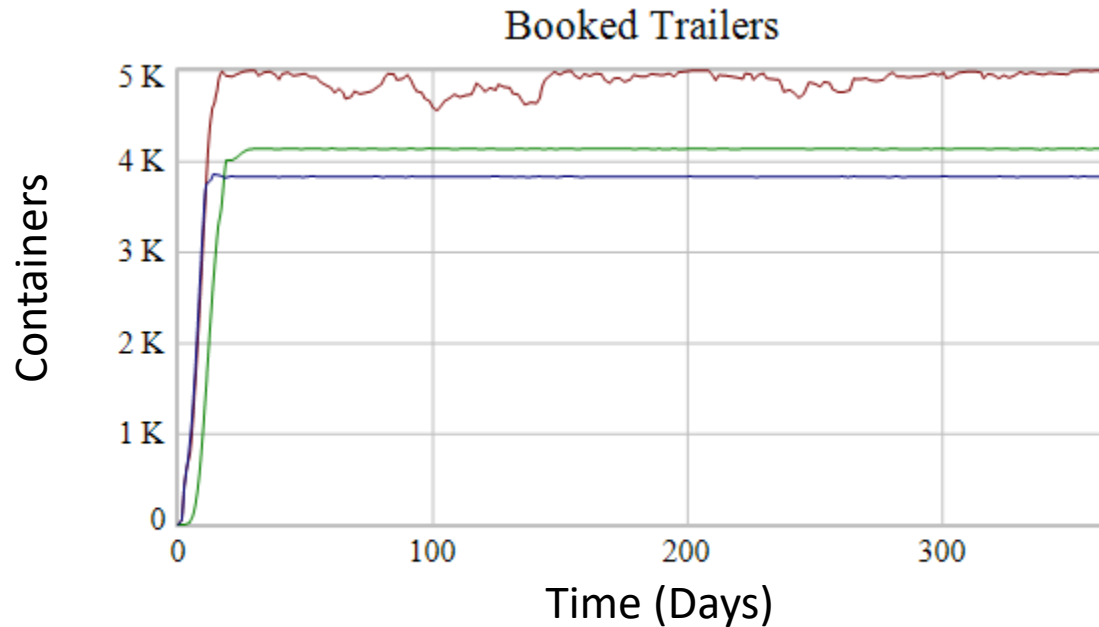
Insights:

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

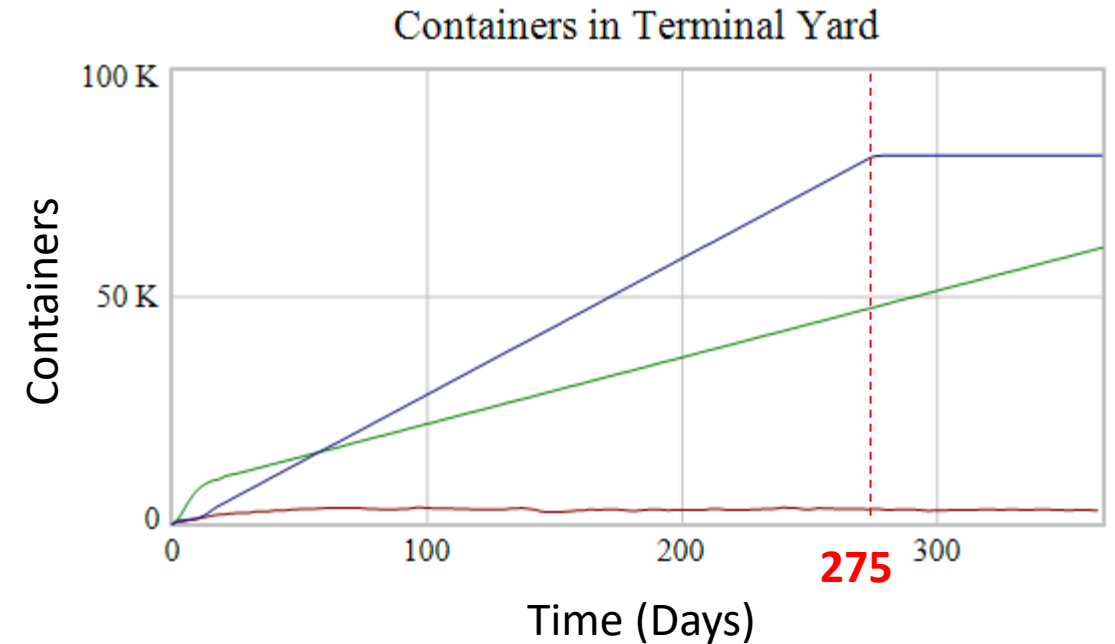
Simulation Output Rankings



Simulation Output – 365 Days



— Combo+
— Current



— Combo

Insights:

- Alternative **Combo** only outperformed the current for 275 days.
- Due to the high fleet utilization, **Combo** caused a massive congestion in the terminal.
- Alternative **Combo+** outperforms the **Current** case over the 365 day period.



Simulation Insights

- Dwell time as a KPI metric is short sighted.
- Short term vs. long term simulation runs provide different insights.
- When selecting a strategy, must consider impact on the other sub-systems and how that impact will affect desired outcome.
- Taking the impact of a strategy on the transport chain, as a whole, will benefit the overall system – making it more competitive.



Model's Contribution

- Provides a holistic view when assessing strategies.
- Encourages collaboration between different stakeholders.
- Support decision makers in selecting the decisions the will improve the overall container transport chain.
- Evaluate the current container transport chain under different scenarios.



Moving Forward

- Run the model with real-data and create a goodness of fit.
- Relax certain assumptions, to gain additional insights.
- Have model factor in costs.
- Create a web-base easy to use interface for decision makers.



Web-Base Interface

Beyond the Seaport:

The Container Transport Chain

The model allows users to assess the impact of different strategies relating to inland container movement on the container transport chain, under different scenarios. The model is based on Jordan's Container Transport System.

Your Role

You are assuming the role of a policy maker looking to improving the container the transport chain, by reducing the delivery time, container turnaround, and adding resilience to the system.

Delivery Time: the time it takes to deliver an import container from the terminal to the final destination.

Container Turnaround: The time from discharging a container in the terminal, to gating it out and delivering it to final destination and returning it back to the terminal.

Resilience: Ability for the transport chain to take on shocks in the system, like demand surges in import, or reduction in transport drivers.

The Team

The model has been developed by Mamoun Toukan and Hoi Ling Chan as part of their MASc capstone project at MIT.


[Alternatives](#)
[Enter Simulation](#)




Questions & Comments?



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