Infrastructure Requirements & Logistics
(Responding to the Way Products are Delivered to Customers)
Objective: Understanding The Drivers of Global Supply Chain Impacts on North American Transport & Distribution Systems
410 Years Ago: 1607
A Voyage of Three Vessels
Created the First Permanent
English Port in Jamestown, VA

13 Years Before the Pilgrims Landed at Plymouth,
Three Brigantine - Barque Vessels
(Forerunners of the Deep Water Cargo Vessel)
of the Virginia Company
of London Landed in Jamestown, Virginia
Godspeed Brigantine/Barque, Circa 1607
Deadweight Tonnage: 40 tons
LOA: 88 feet; Crew: 13, Passengers: 39
Cargo Handling Circa 2010
US Navy Fast Frigate Circa 2045
What We Know Today... Will Surely Be Different Tomorrow!
To Be Competitive Today...

Marine/Intermodal Terminals Must Reduce Throughput Cost & Increase Cargo Velocity Securely and as Stewards of the Environment
The Evolution of Today’s Global Shipping Lanes
The Maritime Silk Road Replaced the Overland Silk Road as the Primary Trading Route Across Eurasia After the Tang Dynasties (618 to 907)
The Marine Silk Road was a Precursor to:

Today’s modern supply chain logistics, distribution and shipping transportation networks
90% of Global Trade is Carried Out by Shipping

The Majority of Today’s Ocean Trade is Conducted on the Marine Silk Road
The World’s Primary Shipping Route: 

The Marine Silk Road
Maersk’s Global Trading Routes Today
Indian Ocean Electric Blue Shipping Lane Trails
From the Marine Silk Road
The World’s Largest Ports Are Connected Via The Marine Silk Road

Where are the Biggest Ports?

**KEY**

**WORLD’S LARGEST PORTS (BY CARGO VOLUME PER YEAR)**

- 10 MILLION TONS
- 100
- 500
The World’s Largest Ports Are Connected Inside This Circle Via The Marine Silks Road
Global Shipping Routes Plotted by AIS GPS

Today’s Busiest Shipping Routes:
(1) Panama Canal, (2) Suez Canal, (3) Offshore China

Shorter – Faster Arctic Ocean Route

2+ Months A Year Using Convoys

Half the Time & Distance
2030 Trends Generally Agreed Upon by the Top Global Economists...
More than 98% of everything we consume, wear, eat, drive and construct is brought to us via ships through the North American port system.
Expect the Global Maritime Trade Volume to Double by 2030

“In the next 10-15 years world trade is projected to grow significantly. It is estimated that this growth will result in a doubling of seaborne trade volumes from 10 billion tons of cargo annually today to 20 billion tons of cargo around 2030”.

Source: Danish Maritime Forum, 24-28 October 2016
Three Mega Trade Trends to 2030

Global population is likely to be 8.5 billion by 2030, with 96% of growth coming from developing countries. India will overtake China with the largest population.

Global GDP could grow THREE TIMES within 20 years. The countries with the largest growth in per capita GDP will be China, Vietnam, India and Indonesia. Purchasing power in developing Asia will rise 8 times between 2010 and 2030.

40% HIGHER ENERGY DEMAND in 2030. China oil consumption could triple, overtaking the USA to become the largest oil consumer. The USA will remain the biggest natural gas consumer, while China will see the largest growth in natural gas consumption.

Source: Global Marine Trends 2030 – QinetiQ – Lloyd’s Register
Growth in GDP and World Trade

World trade will grow by **73%** in the next 15 years. With merchandise trade volumes in 2025 hitting $43.6 trillion compared to today’s $27.2 trillion.

*CAGR = 4.5%*

Source: Oxford Economics 2013
World Trade’s Share of the Economy Grows Again

Globalization trend is shifting, not reversing, long-term.

(World imports, percent of GDP)

% INCR = 37%

Source: IHS Global Insight – World Trade Service
Long Term GDP Annual Growth Rates

Source: OECD Economic Forecast
What/Who Determines
Today’s Logistics
Trade Flows?
Who Owns & Controls Today’s Cargo?

- The “Shipper” or “Beneficial Cargo Owner” (BCO)
- BCO = Importer of record, the entity that physically takes possession of cargo at destination and does not act as a third party in the movement of such goods
- The person or company who is usually the supplier or owner of commodities shipped.
Key Success Factor:
Cargo Will Flow “Downhill” to the “Lowest Cost - Best Service Levels”
(Total Logistics Costs From Origin to Destination)

Above All Be MARKET DRIVEN
Poll of the Top 1000 “Blue Chip” Multinational Shipper Priorities

- 38% Competitive Freight Rate
- 43% Schedule Reliability & Consistency
- 12% Transit Time & Speed
Today’s Logistics Truth:

“The customer wants more and is willing to pay less for it.”
Functional Classification of Global Maritime Cargoes

- **All Maritime Cargo**
  - **General Cargo**
    - Break Bulk: Sacks, Cartons, Crates, Drums, Pallets, Bags
    - Neo-Bulk: Lumber, Paper, Steel, Autos
    - Containerized: Containers, Lift On/Lift Off (Lo/Lo), Roll On/Roll Off (Ro/Ro)
  - **Bulk Cargo**
    - Liquid Bulk: LNG, Petroleum, Molasses, Chemicals, Vegetable Oil
    - Dry Bulk: Grain, Sand & Gravel, Scrap Metal, Coal/Coke, Clinker, Fertilizer
The TEU (Twenty Foot Equivalent Unit)

“The Port & Container Shipping Unit of Measure”

1 TEU = One 20 ft. ISO Container
1 FEU = 2 TEUs = One 40 ft. Container
### How Much Can a Single Container Hold?

(Example 40 ft. Container)

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Total Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heineken Cases</td>
<td>1,890</td>
<td>$25.50/Case</td>
<td>$48,195</td>
</tr>
<tr>
<td>20” TVs</td>
<td>315</td>
<td>$299/TV</td>
<td>$94,185</td>
</tr>
<tr>
<td>Pairs</td>
<td>10,000</td>
<td>$30/pair</td>
<td>$300,000</td>
</tr>
<tr>
<td>Cigarettes Packs</td>
<td>432,000</td>
<td>$4.00/Pack</td>
<td>$1,728,000</td>
</tr>
</tbody>
</table>
2025 World Container Port Market Demand
(Millions of TEUs)

10% CAGR from 1990 - 2008
(9.1% ) global volume loss for 2009
Recovery in 2010 with 14.8% growth
50% projected rise 2009-2015

Source: Drewry Shipping Consultants

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International Maritime Cargo Demand & Logistics Trends
Historical Global Container Market Demand
(Millions of TEUs)

Source: Drewry Shipping Consultants

North American Growth Lags Other Global Regions

2009 Recession

Asia

Europe

N. America

m. TEU lifts
A Turning Point in Global Economic History

The Advanced Economies Will Decline From 2/3 share of the Global Economy to a 1/3 Global Share. The Global Economy Will See Higher Average Pace of Growth in the Future...

Source: IMF - Forecast by TD Economics, December 2009
Southeast Asian Manufacturing Centroid Shift

Current Inbound US Cargo Flow

U.S. Intermodal Rail Flow

Western Centroid Shift

Expanded Asian Panama Canal Post 2016 Flows

Eastbound: All Water Flow

Eastbound: US Intermodal Rail Flow
Southeast Asian Manufacturing Centroid Shift

With Manufacturing Centroid Shifts Into Vietnam and/or India, The North American East Coast will See Dramatically More Westbound Suez Traffic
Suez Canal’s $8.5 Billion Expansion Plan
(A New $4 Billion 45-mile-long parallel channel and Global Logistics Park)

3 Daily Convoys:
- 2 Northern Convoys
- 1 Southern Convoy
The Suez Canal’s $8.5 Billion Expansion of the Canal

Completed September 2015

New 45-mile-long parallel channel cutting waiting times to transit by 3 hrs. from 11 hrs.
Dredging 180 Million Cubic Meters (35-kilometers-long and 24-meters-deep) Shipping Route in Less than One Year
Egyptian Jet Fighter Escort Selfie
(Taken with the New Expanded Suez Canal in the Background)

Source: Photo Courtesy of MIRASCO, August 2015
The Number of Ships Able to Navigate the Suez Canal Simultaneously Has Increased from 23 to 97, Thus **Doubling the Suez Canal Capacity by 2023**
The Continuing Asian Import Trade Challenge
Of the 10 busiest ports in the world, Nine are in Asia, of the top 10, Six are on the Chinese mainland

The Port of Shanghai is No. 1, and The Port of Singapore is No. 2

These Two Ports are Larger Than All North American Ports Combined
China-US: Twin Engines of the World

2015 Population:
US: 325 million
China: 1,400 million
(1/5 World – 19%)

The number of Chinese children in elementary school is equivalent to the total US population.
Shanghai International Shipping Center
Yangshan Deep Port & Logistics Park

New Port City

New Logistics Park

20 Mile New Port Access Bridge Constructed in 3 yrs

54 New Berths
Shanghai International Shipping Center
Yangshan Deep Port - 20 Mile Bridge Access

“Second Longest Ocean Bridge in the World”
Shanghai Yangshan Deep-Water Harbour
Yangshan Deep Port – 54 Berths East China Sea
Shanghai Port Set a 2011 Record by Handling over 30 million TEUs
Maritime Vessel Technology Trends: Emergence of the Neo-Panamax Vessel
Largest Container Ship Yet to Call on the Port of Virginia – May 8, 2017

COSCO Development Container Ship – 13,092 TEUs
May 8, 2017 Largest Container Vessel to Call at the Port of Virginia

Containership COSCO DEVELOPMENT at 1,200 feet long and 158 feet wide, it is 100-plus feet longer than the U.S. Navy’s newest aircraft carrier the Gerald R. Ford
Relative Size of the Mega Container Vessel

COSCO DEVELOPMENT
Largest Ship to Call at the Port of Virginia, May 2017
50 Years of Container Vessel Evolutionary Growth

Old Panamax: 4,800 TEUs

Neo-Panamax: 12,600 TEUs

Near Term Mega Vessel: 22,000 TEUs

Source: Allianz Global Corporate & Specialty - Data: Container-Transportation.com
MSC Orders 11 New 22,000-TEU Vessels
CMA-CGM Orders 9 New 22,000-TEU Vessels

FUEL COST OPTIONS: $136 million per vessel if a conventional fuel system with scrubbers is chosen, or about $154 million should a dual-fuel alternative – which would allow for the use of LNG – be selected instead.

Source: American Shipper - Lloyd’s List
Vessel Sharing Alliances Were Restructured Late April 2017
(Ocean Alliance to Dominate the Overall Trans-Pacific Trade)

US ports will face unprecedented operational challenges.

Three alliances will control 91% of the US trade volume

Source: Alphaliner – JOC - IHS Maritime & Trade
‘Megamax’ Containership Deliveries of 18,000 to 22,000 TEUs

2018 – First delivery of a 22,000 TEU ship - The highest year on record for ULCV deliveries - 1.12 million TEU booked for delivery.
The massive Benjamin Franklin was turned in 56 hours of operations, averaging 29.1 lifts per crane, per hour, averaging total 200 container moves against the vessel each hour, for a total of 11,200 lifts..
The Biggest Ship Ever in San Francisco Bay
CMA CGM Benjamin Franklin
1,300 ft. LOA, 177 ft. beam, 18,000 TEUs

Source: CMA CGM, The SF Chronicle
The Biggest Ship Ever in San Francisco Bay

CMA CGM Benjamin Franklin
1,300 ft. LOA, 177 ft. beam, 18,000 TEUs

Source: CMA CGM, The SF Chronicle
South Korea’s Samsung Heavy Industries:

**OOCL Mega Ships 21,100 TEU** to be delivered November 2017

Six ordered at **21,100 TEU**, total cost of US$950 million. The contract also includes options for six additional units.
Vessel Size Expansion - Terminal Impacts

(Port Terminal Infrastructure & Equipment Geometry Impacts)

New Panamax (2014/15)
12,600 TEU

Current Panamax
4,800 TEU

Super Post Panamax
18,000 to 22,000 TEU

Increased Terminal Throughput

Storage Area Impacts

Depth 48 to 54 ft

Source: Georgia Ports Authority and Vickerman & Associates
Containership Orders – Country of Build
(Orders Since January 2010)

<table>
<thead>
<tr>
<th>Country</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>S Korea</td>
<td>139</td>
</tr>
<tr>
<td>China</td>
<td>64</td>
</tr>
<tr>
<td>Taiwan</td>
<td>16</td>
</tr>
<tr>
<td>Philippines</td>
<td>12</td>
</tr>
<tr>
<td>Romania</td>
<td>4</td>
</tr>
<tr>
<td>Japan</td>
<td>2</td>
</tr>
<tr>
<td>Germany</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Alphaliner Newsletter Volume 2011 Issue 21
North American Inland Waterway Vessel Evolution

Emerging Container On Barge (COB)
“Deck” Barge Loaded with Containers

“Hopper” Barge Loaded with Containers

Source: USDOT Maritime Administration MARAD
Proposed Domestic AMH/Short Sea Container Services

Proposed New England Marine Highway Project's articulated tug barge short sea container service connecting New York City and Portland, Maine - 900 TEUs

Proposed MARAD ATB Ro/Con – HEC Design - 886 TEUs, Design Draft 14.1 ft. – 14 Knots
American Patriot Holdings, LLC (APH) Prototype Container Vessel

A “State of the Art” Hull Design to Ensure Optimal Speed in All River Conditions Utilizing LNG as Main Propulsion Fuel
American Patriot Container Transport, LLC. (APCT) Vessel Fleet Characteristics

<table>
<thead>
<tr>
<th>LOA Feet</th>
<th>Beam Feet</th>
<th>TEU Capacity</th>
<th>Vessel Drafts</th>
</tr>
</thead>
<tbody>
<tr>
<td>592</td>
<td>100</td>
<td>1824</td>
<td>9.0 ft. 9.6 ft., &amp; 10.0 ft.</td>
</tr>
<tr>
<td>772</td>
<td>100</td>
<td>2392</td>
<td>9.0 ft. 9.6 ft., &amp; 10.0 ft.</td>
</tr>
<tr>
<td>952</td>
<td>100</td>
<td>2960</td>
<td>9.0 ft. 9.6 ft., &amp; 10.0 ft.</td>
</tr>
<tr>
<td>1042</td>
<td>100</td>
<td>3244</td>
<td>9.0 ft. 9.6 ft., &amp; 10.0 ft.</td>
</tr>
</tbody>
</table>
American Patriot Holdings, LLC (APH) Prototype Container Vessel

A “State of the Art” Hull Design to Ensure Optimal Speed in All River Conditions Utilizing LNG as Main Propulsion Fuel coupled with the Patented Z-Wake Bow Design.
Panama Canal Expansion: New Capacity is Not Sufficient for 2030 Trade Volumes
The first ceremony began on the Atlantic side at the new Agura Clara Locks, followed by the new Cocoli Locks on the Pacific side.
Panama Canal Historical Tonnage Traffic

Source: ACP Data
The Panama Canal Currently Accounts for 3% of the Volume of Global Trade, this Share Will Increase to 6 - 7 % over the next decade.

Source: ACP Expansion Project, Circle of Blue January 27, 2015
The United States Took Over the Original Canal Construction Project from the French in 1904 and completed it in 1914.

Source: ACP Expansion Project, Circle of Blue January 27, 2015
The Panama Canal Circa 1914
Panama Canal Pre-June 2016 (Old Panamax)
Panama Canal Third Lane Expansion

New Lane

Existing Lanes

Panama Canal Authority
Panama Canal Third Lane Expansion
Water-Saving Basin Reservoir System

WATER-SAVING BASIN SYSTEM

- The locks will have more efficient, easier to service rolling gates.
- The water-saving basins will enable using 7% less water than the existing lock system and reusing 60% of the water required for each transit.
A $5.25 Billion Investment in a 3rd Set of Locks Equating to 16% of Panama’s National GDP

Source: ACP Expansion Project, Circle of Blue January 27, 2015
Panama Canal Third Lane Expansion Capabilities

2011: 4,800 TEU

2014-2015: 12,600 TEU

Source: ACP Expansion Project
Panama Canal Third Lane Expansion Capabilities

Neo-Panamax: 12,600 TEUs

Old Panamax: 4,800 TEUs

Source: ACP Expansion Project, Circle of Blue January 27, 2015
The Recent Mega Container Vessels are Too Large for the New Panama Canal Third Lane Expansion

**EXISTING LOCKS**
- 33.5 m wide / 12.8 m deep / 304.8 m long

**NEW LOCKS**
- 55 m wide / 18.3 m deep / 427 m long

**EARLY CONTAINER SHIP**
- 17 meters wide
- 137 m long
- 9 m draft
- 800 containers

**MAXIMUM SHIP SIZE, EXISTING LOCKS**
- 32.3 m wide
- 294.1 m long
- 12 m draft
- 4,500 containers

**MAXIMUM SHIP SIZE, NEW LOCKS**
- 49 m wide
- 366 m long
- 15.2 m draft
- 12,500 containers

**THE LARGEST CONTAINER SHIP, MAERSK’S TRIPLE E**
- 59 m wide
- 400 m long
- 14.5 m draft
- 18,000 containers

Source: A.P. Moeller-Maersk, Panama Canal Authority
Panama Canal Vessel Deployments Will Determine New US Logistics Patterns

The Distance to New Orleans and Savannah Via the Panama Canal

A Competitive & Robust Landside Access to the Gateway Port’s Inland Market will be a Key Success Factor!
Today Only The Port of Virginia Can Handle The New 2016 NeoPanamax Vessels Fully Loaded

Source: Virginia Port Authority (VPA) October 2011
Port Authority of New York & New Jersey Entrance Channel & Harbor Dredging Program
($1.6 Billion Program, Completion December 2014)
Raising of the Bayonne Bridge
(Estimated at $1 billion)

**Future** Clearance: 214 ft

**Current** Clearance: 155.3 ft

Maximum Vessel: 7,000 TEUs

Existing Level: 64 feet
Emerging New Caribbean Transhipment Center
(Large Ship to Feeder Vessel Transfer)
Panama Ports Annual *Transhipment Growth*  
“*The Singapore of Latin America*”

Proposed New Port Projects Would Double the Total in 5 Years
Panama Ports Container Transhipment Growth

6.8 Million TEUs – 18.5 % Growth Rate
The Panama Canal Expansion Will Move the Caribbean Transhipment Center Point to Panama
New Panama Canal Pacific Entrance Ports

More Capacity than all of the Port of Los Angeles
New Panama Canal Atlantic Entrance Port

More Capacity than all of the Port of Houston

The Autoridad Del Canal de Panama
North American Vessel Transshipment:
(Globally Transshipment accounts between 25 and 50% of all container volumes – In the US it’s < 15%)

Induced Transshipment/Feeder Ship Operations
Large Container Vessel Market Penetration into the US Midwest
New State of Marine & Intermodal Competition

Source: NW Seaport Alliance Strategic Business Plan, May 6, 2015
New Container Port Battleground Region
(Representing 15% of the US GDP)

Source: Boston Consulting Group & C.H. Robinson
Prior to June 2016 - US Market Penetration

Panama Canal Economies of Scale with permit
deeper market penetration into the US

Reachable Market:
46% of US Population

4,000 TEU ship, all-water.

Source: PB Consultants - CSX Transportation May 12, 2011 - Director of Strategic Analysis
Dramatic US Market Penetration after June 2016

Panama Canal **Economies of Scale** with permit
deeper market penetration into the US

Reachable Market:
63% of US Population

8,000 TEU ship, all-water.

Source: PB Consultants - CSX Transportation May 12, 2011 - Director of Strategic Analysis
Dramatic US Market Penetration after June 2016

Panama Canal Economies of Scale with permit
deeper market penetration into the US Midwest

The Midwest & the Mississippi River Valley Could be the Real Beneficiaries!

Source: ACP Expansion Project – Rodolfo Sabonge AAPA January 24, 2013
Dramatic US Market Penetration

Panama Canal *Economies of Scale* with permit
deeper market penetration into the US Midwest

The Panama Canal will prove to be a strong contender for Asian trade serving not only the US East Coast, but ALL of the Gulf and the Most of the Midwest by 2018.

Source: *Potential Effects of the Panama Canal Expansion on the Texas Transportation System, Texas DOT, Cambridge Systematics October 2011*
America’s New Energy Self Sufficiency
US oil production recently hit a 20-year high and could surpass Saudi Arabia’s output by 2019.

The US has a 100-year supply of natural gas, & will be the world’s largest natural gas producer by end of 2017.

Source: US Energy Information Administration, US Department of Energy
### Panamax LNG Vessel Dimensions

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>345 m (1,132 ft.)</td>
</tr>
<tr>
<td>Beam</td>
<td>53.8 m (177 ft.)</td>
</tr>
<tr>
<td>Height</td>
<td>34.7 m (114 ft.)</td>
</tr>
<tr>
<td>Draft</td>
<td>12 m (39 ft.)</td>
</tr>
<tr>
<td>Capacity</td>
<td>266,000 cubic meters</td>
</tr>
<tr>
<td></td>
<td>9,400,000 cu ft.</td>
</tr>
</tbody>
</table>

The first **Q-Max** LNG carrier, **Mozah**, was built in November 2007.
US Natural Gas Production by Source
(Trillion Cubic Feet)

Source: Derived from US Energy Information Administration: EIA AE 02014
There is Enough Recoverable Domestic Natural Gas to Meet America’s Needs for at Least 100 years at Current Consumption Rates.

Source: Derived from US Energy Information Administration: EIA AE 02014
By 2020, U.S. is Projected to Be a Net Exporter of Natural Gas

Source: Derived from US Energy Information Administration: EIA AE 02014
Marcellus/Shale: 1,925 billion cubic feet

Utica Shale: 38.2 trillion cubic feet – **20 Times Larger** than Marcellus
US LNG Exporters Target Marcellus Shale as Feed Gas
(Liquefaction Participants are Now in the Market for Dedicated Pipeline Supply to Match Their Exporting Needs)

US LNG Exporters Target Marcellus Shale as Feed Gas
(Liquefaction Participants are Now in the Market for Dedicated Pipeline Supply to Match Their Exporting Needs)

July 25, 2016 First Ever LNG Vessel Transits the New Panama Canal Locks

The Expanded Canal can accommodate 90 percent of the world’s LNG tankers, which will have a major impact on global LNG flows and offer numerous benefits to shippers.
Global energy market trends are set to transform the maritime industry, with major investments to be ploughed into new LNG terminals and huge projected growth in exports expected in the coming years.

**Consider:** The United States is poised to become one of the world’s top LNG exporters in the next five years, the Canal will allow vessels departing the U.S. East and Gulf Coast for Asia to enjoy significant reductions in voyage times (up to 22.8 days roundtrip), making U.S. gas deliveries to major Asian importers very competitive. Vessels departing the U.S. Gulf Coast for the West Coast of South America will similarly experience generous time savings.
Inland Ports Defined
A Convergence of Logistics Trends

Short Sea Shipping Technology
Intermodal Rail
Logistics
Automation
Distribution Center
Emerging Major Inland Port Logistics Centers

Throughput Capacities in Millions of TEUs
A New Model For Freight Logistics Centers

Wal-Mart’s New 3.4 million SF (78 acres under roof) Import Distribution Center

The Cost of This Import Distribution Center was Paid for by the Savings in Truck Drayage Between the Warehouse & the Intermodal Rail Terminal
The Inland Port:

“With Integrated JIT Delivery: The Inland Port Can Greatly Increase a Regions Freight System Capacity”
ASCE 2017 Report Card for America’s Infrastructure

Ports: C+
Inland Waterways: D
Roads: D

Failure to Act: It Costs Each US Family $3,400 per year

Cost to Improve

$4.6 TRILLION
International Gross Fixed Capital Formation as a Percent of GDP

(US is 32nd in the World - Below OECD Nations)

Organization for Economic Co-operation and Development (OECD)