Predicting the Future: What Does It Portend For Your Port?

M. John Vickerman

Norfolk, Virginia
The Year is 2020

Dubai Ports World’s Fast Transshipment Logistics Base
Agenda

- Port & Intermodal External Industry Pressures
- International Maritime Cargo Demand Trends
- The Growing Asian Import Trade Challenge
- Can North America Handle the Forecasted Volumes?
- International Port Productivity Comparisons
- Maritime Vessel Technology Trends
- North American Domestic Truck Growth
- North American Class I Rail & Intermodal Growth
- Growing Environmental Concerns for Marine Vessel Emissions
Global Trade: Current Course & Direction?

Cargo Demands, Capacity, Funding, Port Productivity & Environmental Challenges

North American Port Gateways
Vessel Cargo Handling Circa 1950
What We Know
Today... Will Be
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
Functional Classification of Global Maritime Cargoes

All Maritime Cargo

<table>
<thead>
<tr>
<th>General Cargo</th>
<th>Bulk Cargo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Break Bulk</td>
<td>Neo-Bulk</td>
</tr>
<tr>
<td>Sacks, Cartons, Crates, Drums, Pallets, Bags</td>
<td>Lumber, Paper, Steel, Autos</td>
</tr>
<tr>
<td>Containerized</td>
<td>Liquid Bulk</td>
</tr>
<tr>
<td>Containers, Lift On/Lift Off (Lo/Lo), Roll On/Roll Off (Ro/Ro)</td>
<td>LNG, Petroleum, Molasses, Chemicals, Vegetable Oil</td>
</tr>
<tr>
<td>Dry Bulk</td>
<td></td>
</tr>
<tr>
<td>Grain, Sand &amp; Gravel, Scrap Metal, Coal/Coke, Clinker, Fertilizer</td>
<td></td>
</tr>
</tbody>
</table>
The “Port”

One of the Many Diverse Constituencies in the Cargo Transportation Logistics Chain

Objective:
A multimodal “Seamless” integrated world wide cargo conveyance system.
Port & Intermodal External Industry Pressures
The North American Freight Paradox:
The Nation’s Ports and Their Intermodal Linkages are Experiencing the “Best of Times and the Worst of Times” in Terms of Growth and Demands on Capacity
At Current Productivity and Growth Levels by 2020, North American Ports & Their Associated Intermodal Systems Will Be Severely Congested
We do not have an “intermodal system” as such. Rather we have an aggregation of multiple, private and public modes, each of which are “stove-piped” within their own individual areas of interest with little or no true cross communication and collaboration.
Poll of the Top 1000 “Blue Chip” Multinational Shipper Priorities

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

“The customer wants more and is willing to pay less for it.”
Southeast Asian Manufacturing Centroid Shift

Current Inbound U.S. Cargo Flow

Western Centroid Shift

U.S. Intermodal Rail Flow

Eastbound: All Water Flow

Eastbound: US Intermodal Rail Flow

TranSystems
Southeast Asian Manufacturing Centroid Shift

Current Inbound U.S. Cargo Flow

Western Centroid Shift

U.S. Intermodal Rail Flow

Westbound All Water/Suez Flow

Westbound Intermodal U.S. Flow

TranSystems
Ports are Experiencing Dramatic Surges in Seaport Security Costs

Port of Miami’s Security Costs Today are 600% Higher Than that of 2001
US Port Security Breach: Supply Chain Disruption

PORT SECURITY WAR GAME—ECONOMIC IMPACT
Exhibit 4

Day 1: Ports of Los Angeles and Savannah shut down
Day 4: Customs closes all ports and border crossings
Day 12: U.S. ports reopen
Day 20: Railcar explodes in Chicago; 24 hour stand-down
Day 26: Ports return to normal schedule, inspection rate

$50 Billion Loss
Cargo Backlog Cleared in 60 Days

Source: Booz Allen Hamilton

Backlog | Loss

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International Maritime Cargo Demand Trends
World Bank’s 2010 “Global Economic Prospects”

World Output will Increase 33% in 10 years

- $30 Trillion in 2000
- $40 Trillion in 2010
Ocean Container Trade Volume Will Continue to Grow Faster than the World Economy

Global container growth has outpaced GDP growth by more than 300% in the past 5 years.

Source: Global Insight World Service and World Trade Service
World Container Forecast to 2024 in TEUs
(186% Increase in Next 20 Years)

Growth Rate (CAGR)
1994 to 2004: 8.3 %
2004 to 2014: 6.1 %
2014 to 2024: 5.0%

Source: Global Insight, 2004
Approximately 83% of All General Cargo is Containerized
2003 World Container Gateways
“The World’s Top 10 Gateways”

Hong Kong Alone is Equal to the Top 15 US Container Ports

<table>
<thead>
<tr>
<th>Rank</th>
<th>TEUs in Millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hong Kong</td>
</tr>
<tr>
<td>2</td>
<td>Singapore</td>
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<td>3</td>
<td>Pusan</td>
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<td>4</td>
<td>Shanghai</td>
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<td>Kaohsiung</td>
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<td>8</td>
<td>Rotterdam</td>
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<td>9</td>
<td>Hamburg</td>
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<td>10</td>
<td>Antwerp</td>
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</table>

Source: Port Engineering Management, Vol. 22- Issue 6 - December 2004
The Growing Asian Import Trade Challenge
Global Interdependent Economics Have Resulted in a Major Product Sourcing Shift to Asia

Source: Clarkson Research Studies
<table>
<thead>
<tr>
<th>Year</th>
<th>2000</th>
<th>2010</th>
<th>2020</th>
<th>2030</th>
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<td>Italy</td>
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</tbody>
</table>

Source: Global Insight, 2005
China – US 25 Year Trade Growth
(Billions US $)

1979 $2.5 B

2004 $40.8 B

1,532 % Increase

China: Population Density

Uninhabited

Persons per square kilometer

0 1 10 100

0 24 25 266 533

Permits per square mile

Boundary representation is not necessarily authoritative.
Last 5 Years Asia-US Container Trade Increased 12% CAGR and China Accounted for 95% of the Increase

Source: PIERS, Port Reported Throughput, Norbridge
China-US: Twin Engines of the World

Population:
US: 298 million
China: 1,307 million
(1/5 World)

The number of Chinese children in elementary school is equivalent to the total US population.
China is Leading a Global Economic Rebound Becoming the World’s Manufacturing Powerhouse

• Global manufacturing is now centered in China.
• **GDP will double by 2010 and quadruple by 2020.**
• By 2008... the second largest global trading country.
• China’s cargo is **70% of the total Pacific cargo flows.**
• China’s container volumes will increase from 60 million TEUs to over **100 million TEUs by 2010.**
Mainland China Container Port Growth
(Compound Annual Growth Rates)

Mainland China Container Port Throughput

5 Yr Average = 27.2%
Increased Volume

Port Throughput,000TEU
China’s Ministry of Railways Signed a 5 year Cooperation Agreement with the US BNSF Railroad for Intermodal Rail Development

- Develop China’s high volume efficient intermodal network
- $242 billion program to 2020
- On-dock & near-dock intermodal transfer yards at ports
- Ministry to build 18 mega-terminals with 7 at seaports, 40 smaller Intermodal terminals
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
Shanghai Close-Port New City

New Port City

LINGANG CITY
Yangshan Deep Port Logistics Park

A new city
Integrating global freight logistics
To 2015 China & India Are Projected To Continue To Drive North American Container Trade

10 Year CAGR by Trade Lane: 2005-2015

- **9% Annual Growth** for China
- **7% Annual Growth** for India

Source: Global Insight, Norbridge
New North American Container Gateway

Prince Rupert Port Authority
the new world port
opening a new world of opportunity

[Map showing rail routes from Prince Rupert to various destinations including Canada, Mexico, and South America]

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The Emerging CN Transcontinental Land Bridge

**Prince Rupert Transit Times**
- Chicago: 107 hours
- Toronto: 108 hours
- Montreal: 115 hours
- Memphis: 135 hours

**Better grades across CN network**

**Unconstrained, fluid rail line**

**Strait of Canso Transshipment Hub**

Initial Transit Times

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Major West Coast Mexican Port Developments Planned To Avoid Port of LA/LB Congestion

$L1.2 Billion in Port Infrastructure

Punta Colonet 1 mil TEU Throughput

Lazaro Cardenas APM 1.5 mil TEU
Can North American Marine Terminals Handle the Forecasted Freight Volumes ?...
By 2020 Most US Container Port Gateways Will Double or Triple in Volume

U.S. Containerized Tonnage Forecast

Source: DRI/McGraw Hill

<table>
<thead>
<tr>
<th>Year</th>
<th>Total</th>
<th>NE (Maine to Virginia)</th>
<th>SE (NC to Tampa)</th>
<th>Gulf (Mobile to El Paso)</th>
<th>SW (San Diego to Oakland)</th>
<th>NW (Oregon to Alaska)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>79.2 M</td>
<td>6.3%</td>
<td></td>
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<tr>
<td>1995</td>
<td>119.5 M</td>
<td>6.6%</td>
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<tr>
<td>2000</td>
<td>188.7 M</td>
<td>7.6%</td>
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<td></td>
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<tr>
<td>2005</td>
<td>236.6 M</td>
<td>7.2%</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>2010</td>
<td>355.6 M</td>
<td>7.8%</td>
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</tr>
</tbody>
</table>

CAGR

Total 79.2 119.5 188.7 236.6 355.6

100 80 60

0 1,000,000


Source: DRI/McGraw Hill

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North American Maritime Container Current and Future Trade Growth

By 2020 demand will exceed current capacity of many U.S. ports by as much as 200%.

Forecast figures based on 6 year linear regression
2010 Projected Public Port Capacity Shortfall

75% of the 16 Ports Studied will have Significant Capacity Problems by 2010
San Pedro Bay Ports of
Ports of Los Angeles and Long Beach
Container Growth Implications:

“At current growth and per acre
productivity, in 18 years the two
Ports will require 3,624 new acres of
container terminal”*

* Source: Port of Long Beach
Explosive Southern California Port Container Growth Forecasted

North America’s future economic and environmental health is at risk as a result of declining transportation efficiency and reliability.
International Port Productivity Comparisons
Global Port Terminal Productivity

North American Ports Are Not As Productive As The Most Productive International Ports By a Factor Of More Than 4 To 1
## Global Marine Terminal Productivity

(Circa 1999 to 2004)

(Throughput measured in TEUs/Acre/Year)

<table>
<thead>
<tr>
<th></th>
<th>1999</th>
<th>2004</th>
<th>5YR CAGR</th>
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</thead>
<tbody>
<tr>
<td>Asian Ports</td>
<td>9,272</td>
<td>16,595</td>
<td>15.3%</td>
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<tr>
<td>European Ports</td>
<td>4,284</td>
<td>6,396</td>
<td>15.4%</td>
</tr>
<tr>
<td>United States Ports</td>
<td>2,894</td>
<td>4,028</td>
<td>7.7%</td>
</tr>
<tr>
<td>US West Coast Ports</td>
<td>3,543</td>
<td>4,944</td>
<td>7.5%</td>
</tr>
<tr>
<td>US Gulf Coast Ports</td>
<td>3,149</td>
<td>4,635</td>
<td>9.4%</td>
</tr>
<tr>
<td>US East Coast Ports</td>
<td>2,021</td>
<td>2,661</td>
<td>6.8%</td>
</tr>
</tbody>
</table>

Source: 1999 - 2004 CI Database, Seaports of the Americas, Port Data
US Port Productivity Is A Concern

Port Productivity (U.S. vs Asia)

Source: APL, Transportation Research Board

10 GM/Hour Increase

Source: APL, Transportation Research Board

GM/hr

NY/Newark
Pedro
APL San Pedro
APL Oakland
APL Seattle
Tacoma
Long Beach
Kao-Fu
Hong Kong
APL Kobe
Hi-T
Chiwan
West Coast Port Productivity Is A Major Concern

San Pedro Bay Productivity (lifts/gang hr)

Source: APL, Transportation Research Board
2005 International Port Productivity
Top 10 Ports
(in Millions of TEU Throughput)

Source: Computed from Seaports of the Americas – 2005,
Containerization International Yearbook - 2005 and port-provided data bases/interviews
2005 North American Port Productivity
Top 10 Ports
(in Millions of TEU Throughput)

Source: Computed from Seaports of the Americas – 2005, Containerization International Yearbook - 2005 and port-provided data bases/interviews
Maritime Vessel Technology Trends
April 26, 1956

58 Modified 35-foot Truck Containers

The deck of the Ideal X at Port Newark preparing for the historical sailing of the world’s first containership.

In 1955 Malcom McLean, sold McLean Trucking, and secured a bank loan of US$42 million to build the world's first container ship.
World Container Ship Evolution

1st Generation (Pre-1960 - 1970) 1,700 TEU
2nd Generation (1970 - 1980) 2,305 TEU
3rd Generation (1985) 3,220 TEU
4th Generation (1986 - 2000) 4,848 TEU
5th Generation (2000 - 2005) 8,600 TEU
Madison Maersk (3,928 TEUs) in the Panama Canal
(Current Max Panamax = 5000 TEUs)
Today’s Mega Ships - Measuring Up

Eiffel Tower – 990 feet

Regina Maersk – 1043 Ft, 140 Ft wide, 6000+ TEUs
Today’s Mega Ships - Measuring Up
How Wide, How Deep?

Pre-1970
1,700 TEU
<10
Containers Wide

1970-1980
2,305 TEU
10-11
Containers Wide

1985
3,220 TEU
11-13
Containers Wide

1986-2000
4,848 TEU
13-17
Containers Wide

2000-2005
8,600+ TEU
17-24
Containers Wide

How Wide, How Deep?

- Pre-1970: 1,700 TEU, <10 Containers Wide
- 1970-1980: 2,305 TEU, 10-11 Containers Wide
- 1985: 3,220 TEU, 11-13 Containers Wide
- 1986-2000: 4,848 TEU, 13-17 Containers Wide
- 2000-2005: 8,600+ TEU, 17-24 Containers Wide

Today's Mega Ships - Measuring Up
2005 COSCO Orders Four 10,000 TEU Vessels

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>LENGTH OVERALL</td>
<td>349 M (1145 FT.)</td>
</tr>
<tr>
<td>BREADTH</td>
<td>45.6 M (149.6 FT.)</td>
</tr>
<tr>
<td>MAX. DRAFT</td>
<td>17.2 M (56.4 FT.)</td>
</tr>
<tr>
<td>OPERATING SPEED</td>
<td>25.8 KNOTS</td>
</tr>
</tbody>
</table>

Source: Lloyd’s Register, February 2005
The Hatch-Less Container Vessel

Per P&O Nedlloyd:
• 15% Faster Port Productivity
• 84% Less Re-Stows
• Less Damaged Boxes
Containerships & Recent Cruise Vessel Technological Advances...What’s Next?

**SSP Propulsor**
Schottel / Siemens

**Azipod**
Eagle Class Cruise Vessel
The 15,000 TEU Containership

“...the ship is a flight of fancy... but such a ship is within the current state of the shipbuilder’s art...”

R. G. McLellan, P&O Containers
The 15,000 TEU Containership

LOA. = 400 m (1,312 ft.)
Draft = 14 m (46 ft.)
BEAM = 69 m (226 ft.)

Panamax Dimensions
Container Ship-in-a-Slip Concept
The 18,000 TEU Malaccamax
Reported Predictions/Benefits

• By 2010 on Asia-Europe Trade Route
  • 30% Cheaper than 4800 TEU Panamax Vessel, primarily due to “Economies of Scale”
  • US$40/TEU Savings

Source: Dynamar Consultancy, Rotterdam
Emergence of North American Fast Feeder Short-Sea Coastal Vessels

The New Frontier: Transshipment and Short Sea

10,000 to 15,000 TEU Mega Ship

2,000 - 3,000 TEU Feeder Ship
Short Sea Shipping
Coastwise Maritime Trade

Taking Freight off of Congested Roads
Emerging Viable Container On Barge Coastal Shipping Concepts & Inland Intermodal Port Potential
High-Speed, Low Wake, Intermodal Float Technology
North American Domestic Truck Growth and Congestion
2020 Truck Freight Flows
High-Value & Time Sensitive Products

Source: USDOT FHWA Freight Analysis Framework
2020 NAFTA US Truck Traffic Flows

US/Mexico Truck Traffic
US Highway Network (Tons)

US/Canada Truck Traffic
US Highway Network (Tons)

Source: USDOT FHWA Freight Analysis Framework
North American Class I Rail & Intermodal Growth
North American Intermodal Rail Freight Movement Trends
The Railroad Industry...
Since the US Staggers Act:

- 35% less track
- 32% fewer locomotives
- 27% fewer railcars
- 60% fewer employees

But:
well over 50% more freight!
Weekly Eastbound Double-Stack Services — April 1984 (1 Set)

Source: Mercer Management Consulting
U.S. Double-Stacked Train System

East-West 10,000 ft Train Bypass
Emerging New North-South Double Stack Intermodal Rail Corridors

Existing Port Intermodal Volumes

- **4.1** Millions of TEUs
- **2.2** Seattle
- **1.4** Oakland
- **4.1** Los Angeles/Long Beach
- **0.4** Houston
- **0.8** Charleston/Savannah
- **0.3** Miami/Everglades
- **0.9** Hampton Roads
- **2.1** New York/Baltimore
- **0.1** Boston

Future US Rail Traffic Flows

Today

2020
A 10,000 TEU Mega-Container Vessel Can Produce High Intermodal Rail Volumes (One Weekly Vessel Call)

Vessel Capacity
10,000 TEU
(5,892 Units)

Double Stacked Trains
13.4

75% Intermodal Split
Rail & Intermodal Performance
(March 2004 through November 2005)

(Average Velocity - MPH)
Growing Environmental Concerns for Marine Vessel Emissions
Global Freight Energy Use is on the Rise

Source: 2005 Haagen Smit Worldwide Emissions Overview & NRDC “Harboring Pollution”
Global Diesel PM & NOx Baseline Projections

Land Based Pollutants Have Declined with Regulation, but the Unregulated Marine Based Pollutants are Increasing

Absent New Standards and Regulations the Pollutant Baselines Are Forecast to Rise
Pollution Sources
US Ports vs Other Industries…
We Need To Do Better

Source: 2005 Haagen Smit Worldwide Emissions Overview & NRDC “Harboring Pollution”
Transportation Diesel Pollutants are Putting Our Health in Jeopardy

Progress has stalled and diesel emissions from ships, locomotives and port complex are projected to increase.

Source: SCAQMD, Multiple Air Toxics Exposure Study II, March 2000
Cost-Effective Air Quality Emission Reduction Improvement Measures

Modernize truck fleet:
- Scrap dirty old trucks
- Retrofit all other pre-2007 trucks

Use clean marine fuels
- Provide onshore electric power for ships at berth (Cold Iron)

Upgrade all cargo handling equipment with electric equipment or clean fuels

Replace locomotives with cleaner technologies, fuels, and explore rail electrification

Source: Southern California Association of Governments
POLA/POLB PierPass

Use of Peak Traffic Period Pricing to Better Align Freight System Costs and Benefits

Photo courtesy of PierPass
MAGLEV Cargo Conveyor Demonstration Project

Transrapid Freight Vehicle Concept
Port Competitive Mandates

• Ports & intermodal linkages must change the current cost versus value relationship in the logistics chain. Become Value Added Multipliers...

• Successful ports & intermodal terminals in the next decade must invest in and leverage technology to improve terminal productivity, cost, effectiveness and reliability for all modes of transportation...securely as environmental stewards.
Predicting the Future:
What Does It Portend For Your Port?

M. John Vickerman

Norfolk, Virginia