# Transportation Research Board Innovations in Freight Data Workshop 17 May 2017

# Analysis and Display of Maritime Freight Data in Full Context

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# Agenda

- Introduction
- Port Intensity Methodology
- National Scores
- Freight Intensities
- Next Steps
- Summary
- Data Appendix

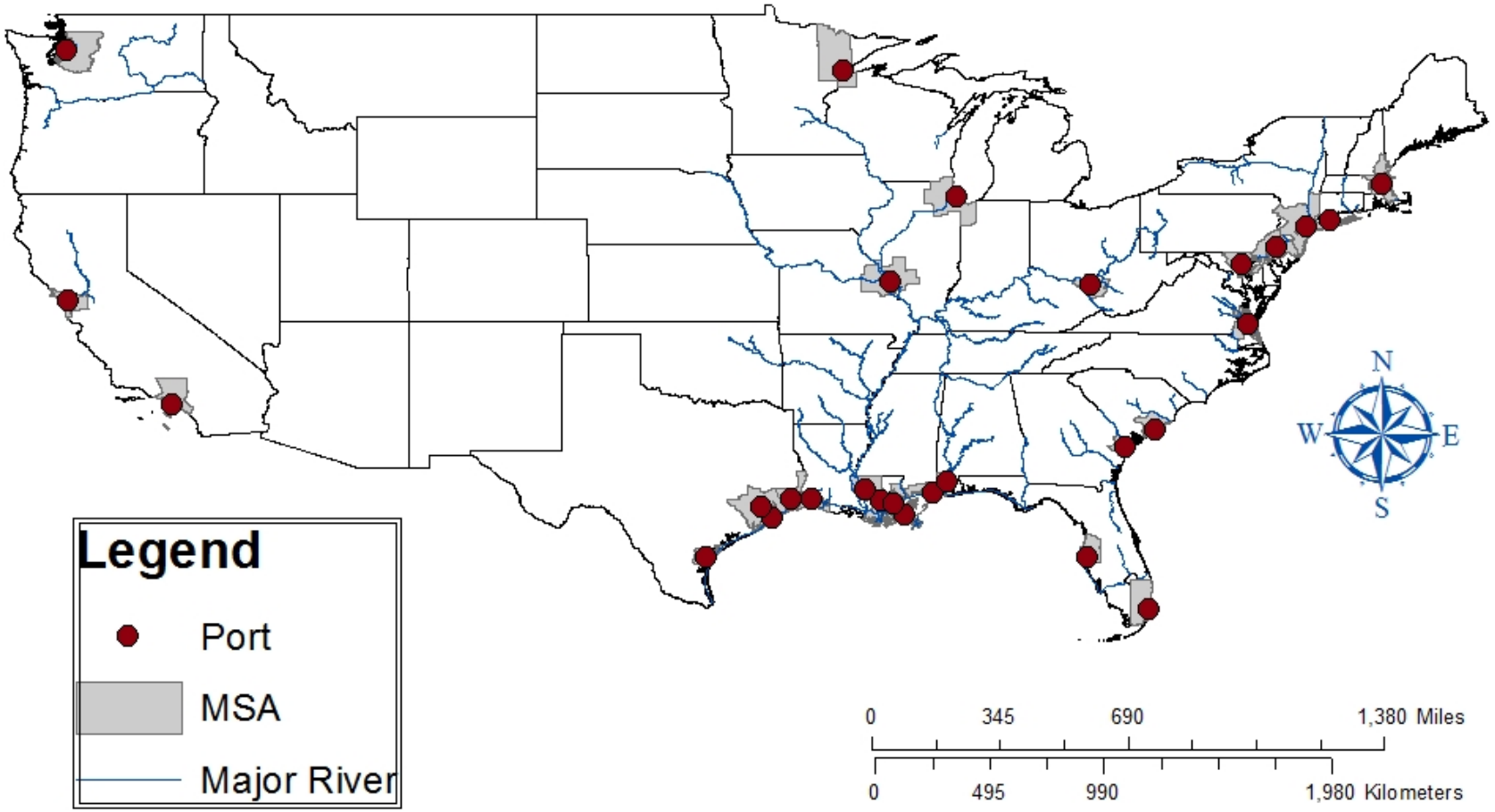
# Introduction

- USCG Port Supply Chain Model Project
- Contract for support services to E-Ternational Research Consulting

# Goals of the USCG Project

- Economic Impact Analyses
- Port Narratives
- Port Activity/Intensity Scores
  - Estimate the intensity of port activities combining data on both freight and passenger activities
  - Important for USCG mission of maintaining efficient ensuring safe and secured use of port waterways
- Targeted 25 MSAs & 51 ports

# Contract to Model Port Supply Chains
# Target Metropolitan Statistical Areas & Ports



# Indicators Used for Port Intensity Scores

| Indicator | Source |
|---|---|
| Dry Cargo Ship Trips | NDC Waterborne Commerce of United States |
| Tanker Ship Trips | NDC Waterborne Commerce of United States |
| Towing Vessel Trips | NDC Waterborne Commerce of United States |
| Dry Cargo Barge Trips | NDC Waterborne Commerce of United States |
| Tank Barge Trips | NDC Waterborne Commerce of United States |
| Cruise Passenger Trips | MARAD & American Association of Port Authorities |
| Recreational Vessels | USCG from vessel registrations |
| Ferry Passengers | BTS, National Census of Ferry Operators |

# Methodology – Unweighted Indicator Scoring

- For each indicator:
  - Execute univariate analysis
  - Assign break points for 0-5 scale

# Unweighted Indicator Scoring – Tank Ship Trips

Univariate Statistics → Intensity Scores

| Statistic | Value |
|---|---|
| Mean | 579 |
| Min | 0 |
| 20% | 2 |
| 40% | 50 |
| 60% | 345 |
| 80% | 791 |
| Max | 6,423 |

| Intensity Score | Break Point | Number of Ports |
|---|---|---|
| 0 | 0 | 10 |
| 1 | 51 | 11 |
| 2 | 251 | 9 |
| 3 | 501 | 6 |
| 4 | 1,001 | 7 |
| 5 | 6,423 | 8 |

# Methodology – Unweighted Port Scores

- For each port:
  - Derive scores for each indicator
  - Port score = Sum of indicator scores

Eq. 1:

P = Port vector, i = 1 – 51

I = Indicators vector, j = 1 – 8

Unweighted Port Score ($P_i$) = $\Sigma_j$ ($I_{ij}$)

# Unweighted Scores -- Baltimore

| Indicator | Data | Unweighted Score |
|---|---|---|
| Dry Cargo Ship | 3,476 | 3 |
| Tank Ship | 221 | 2 |
| Towboat | 1,948 | 2 |
| Dry Cargo Barge | 1,837 | 2 |
| Tank Barge | 1,352 | 2 |
| Cruise Passengers | 420,180 | 2 |
| Rec Vessels | 24,317 | 1 |
| Ferry Passengers | 0 | 0 |
| Total | | 14 |

# Port Intensity Methodology -- Weighted

- Weight each indicator for operations/impact
- Dry cargo ship as base, weight = 1
- Heuristic determination of weights

# Port Intensity Methodology -- Weights

| Indicator | Weight & Notes |
|---|---|
| Dry Cargo Ship Trips | 1 (base) |
| Tanker Ship Trips | 2 (vessel & pollution potential of cargo) |
| Towing Vessel Trips | 0.5 (size in comparison to dry cargo ship) |
| Dry Cargo Barge Trips | 0.5 (size in comparison to dry cargo ship ) |
| Tank Barge Trips | 0.75 (size &pollution potential of cargo) |
| Cruise Passenger Trips | 1 (size comparable to dry cargo ship) |
| Recreational Vessels | 0.2 (size & maneuverability) |
| Ferry Passengers | 0.5 (size & defined routes) |

# Port Intensity Methodology -- Weighted

- For each port:
  - Unweighted indicator score * Weight
  - Sum weighted indicator scores

Eq 2:

P = Port vector, i = 1 – 51

I = Indicators vector, j = 1 – 8

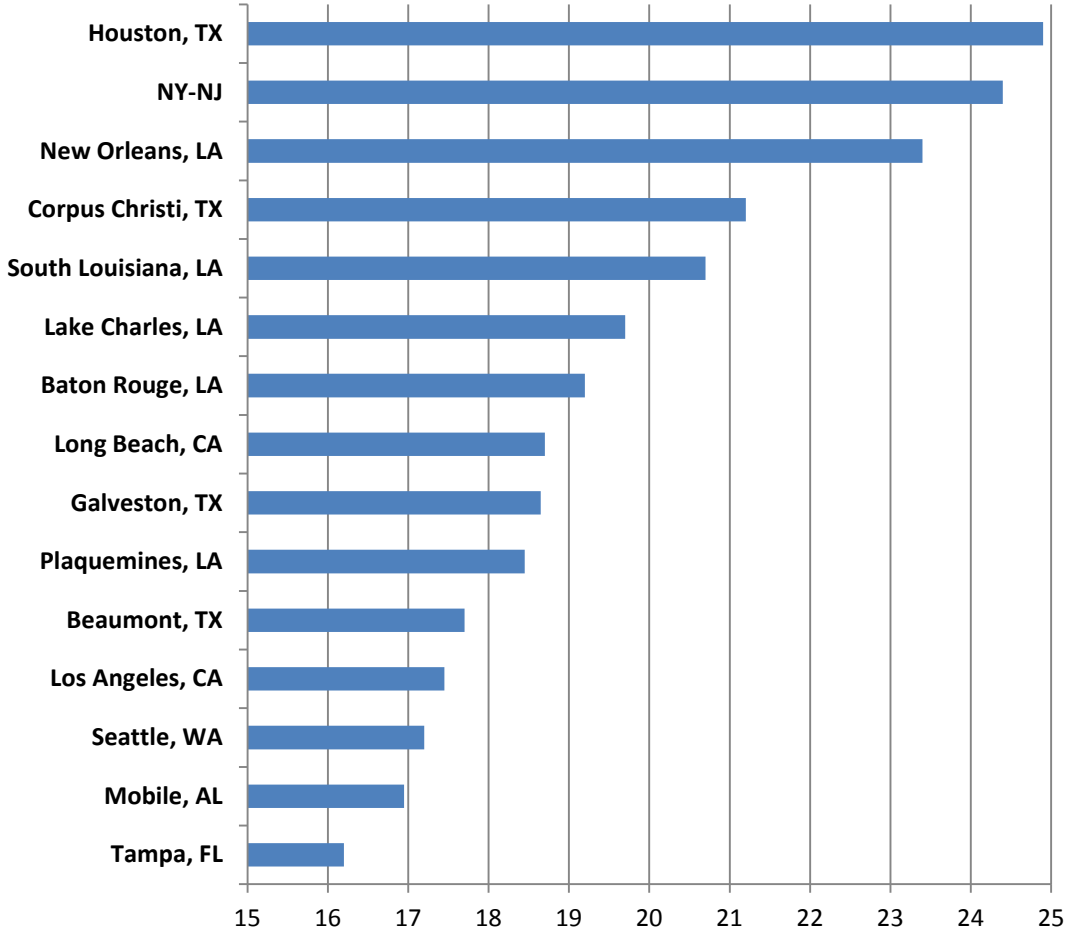
W = Weights for indicators, j = 1 – 8

Weighted Port Score ($P_i$) = $\Sigma_j$ ($I_{ij}$ * $W_j$)

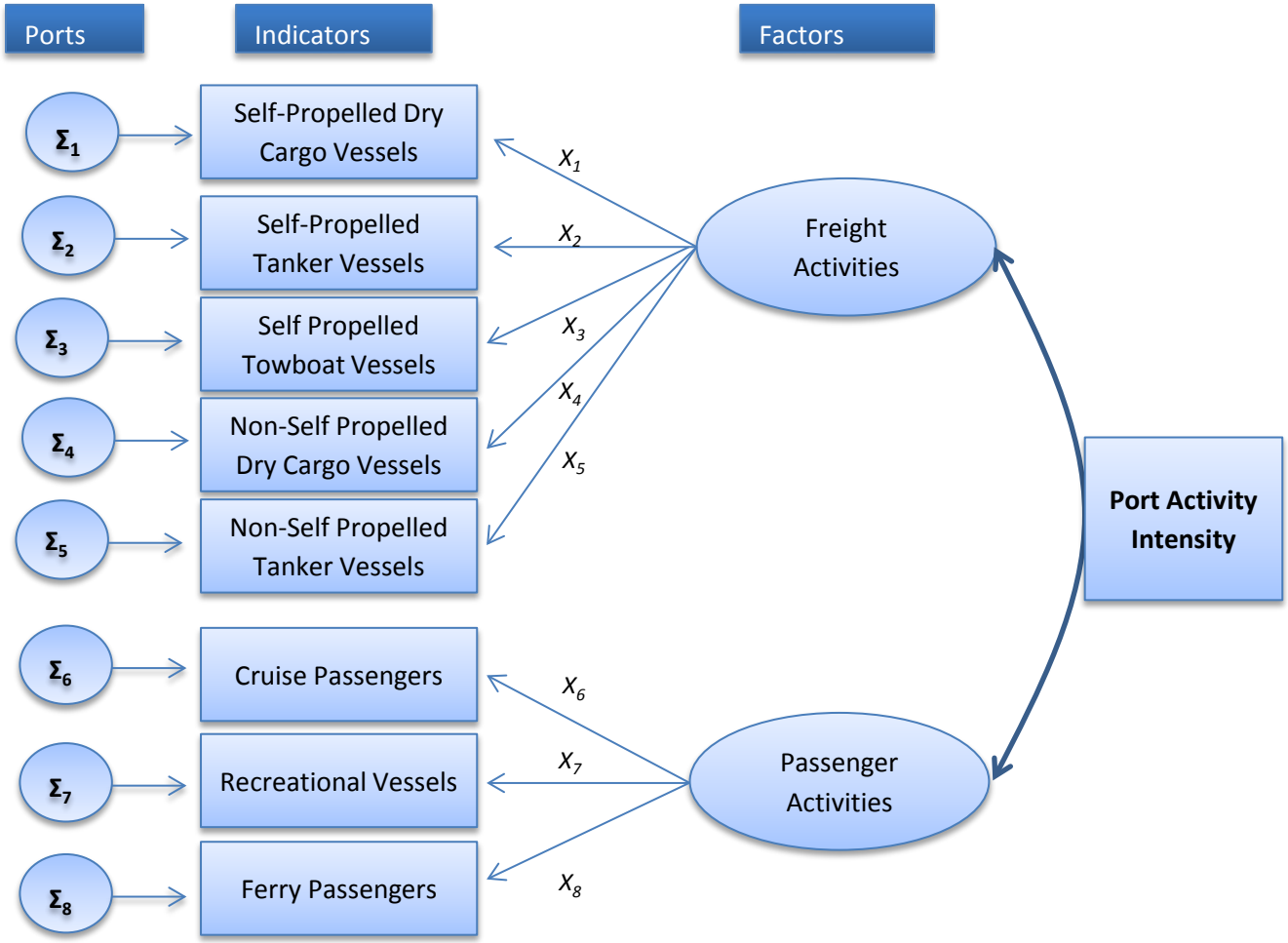
# Weighted Scores -- Baltimore

| Indicator | Data | Unweighted Score | Weighted Score |
|---|---|---|---|
| Dry Cargo Ship | 3,476 | 3 | 3 |
| Tank Ship | 221 | 2 | 4 |
| Towboat | 1,948 | 2 | 1 |
| Dry Cargo Barge | 1,837 | 2 | 1 |
| Tank Barge | 1,352 | 2 | 1.5 |
| Cruise Passengers | 420,180 | 2 | 2 |
| Rec Vessels | 24,317 | 1 | 0.2 |
| Ferry Passengers | 0 | 0 | 0 |
| Total | | 14 | 12.7 |

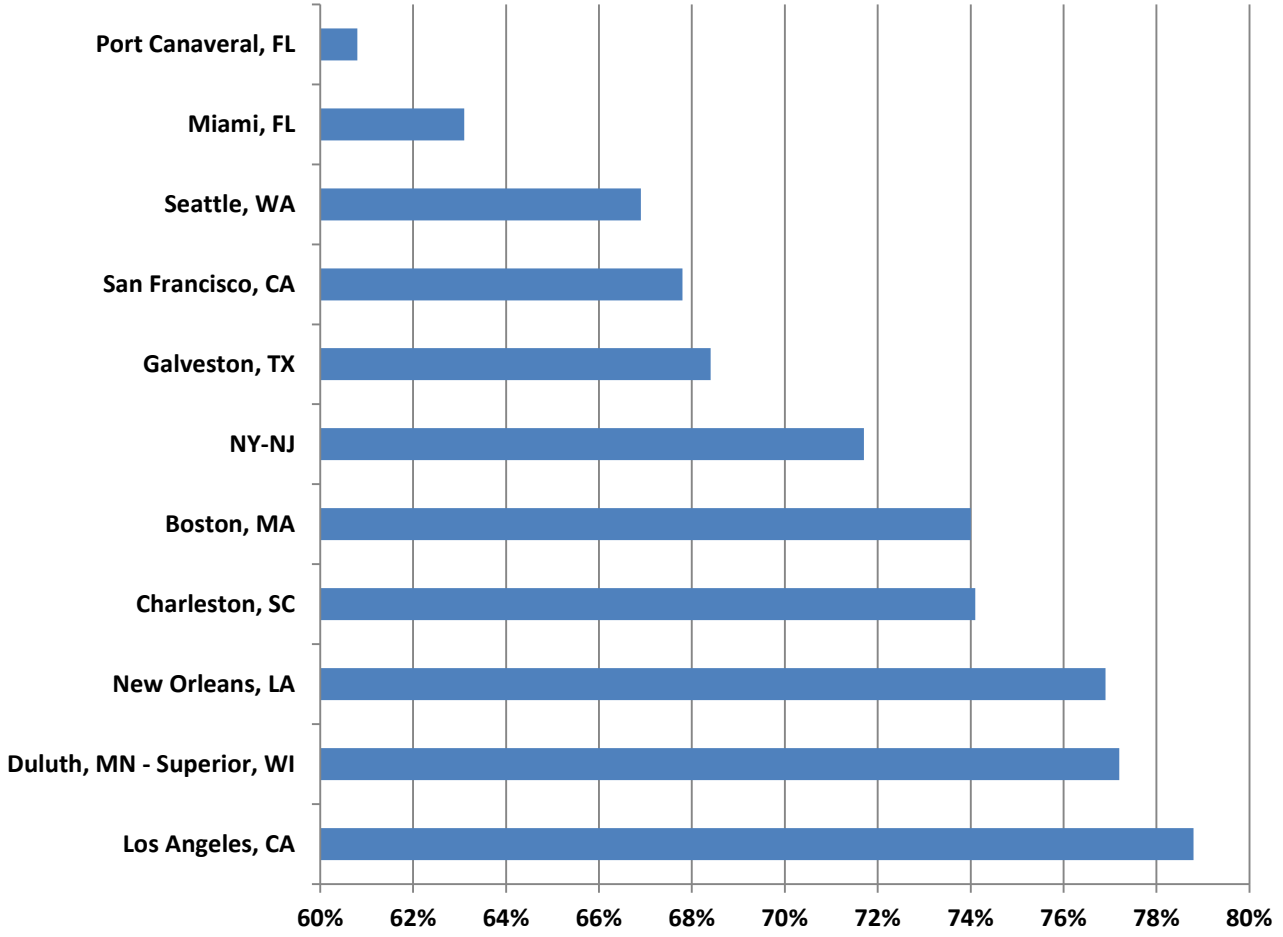
# Top 15 Weighted Port Scores



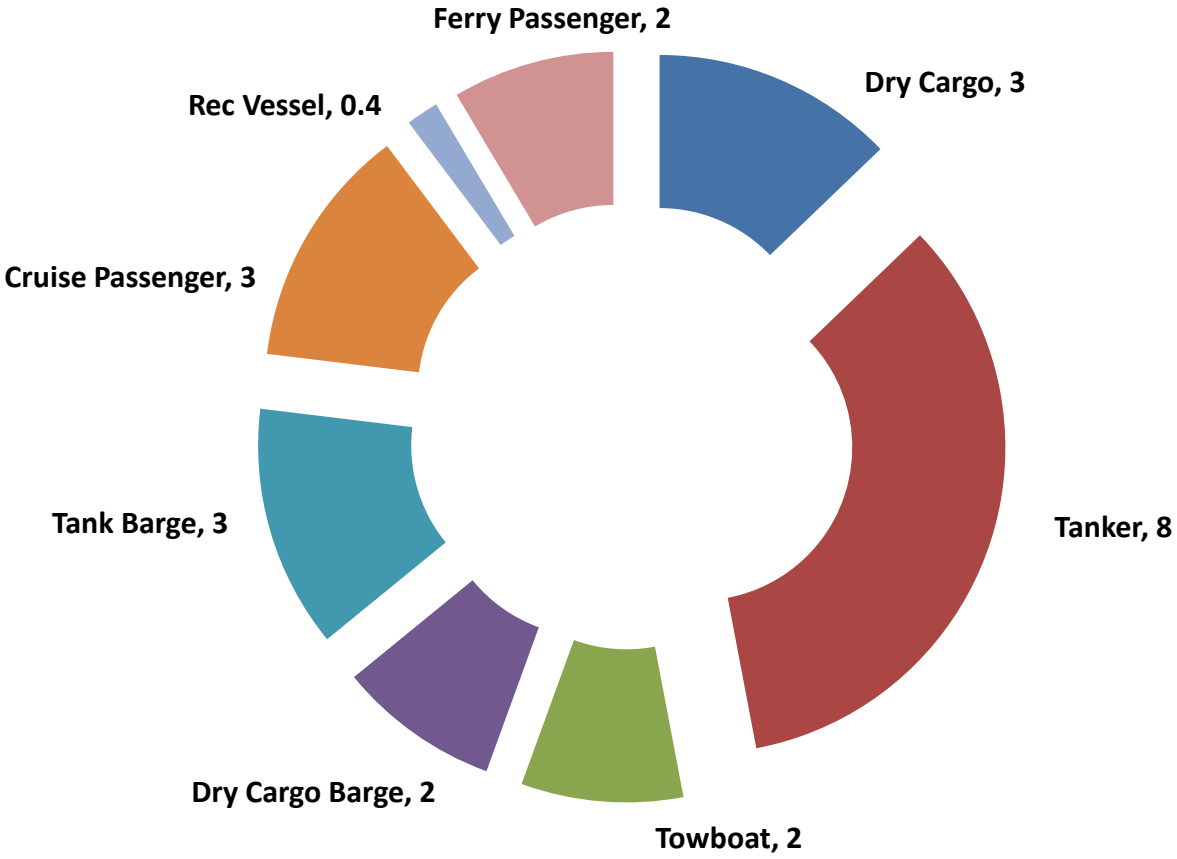
# Port Activity Intensity Estimation Method



# Freight Intensities Under 80%



# New Orleans Weighted Scores



# Next Steps

- Review components
- Review weights – statistical-based?
- Add historical data for time series analysis

# Contact Information

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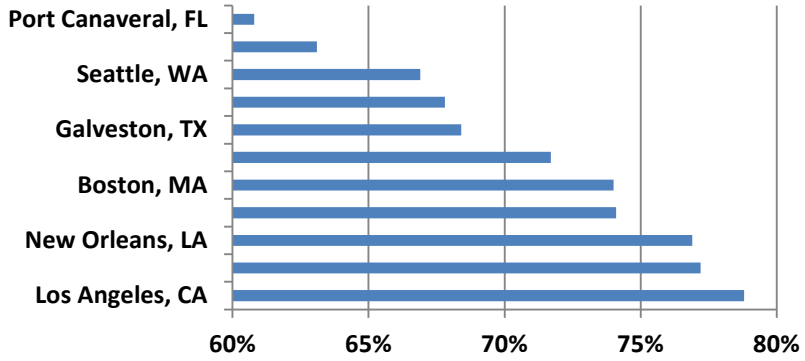
# Summary—Port Intensities

- Non-proprietary data & software
- Extensible & editable
- Provide context for Workshop
- Long-term—Analysis tool for port operations & economics




# Data Appendix

1. Selected major ports, by region
2. Indicator statistics
3. Indicator breakpoints for scoring
4. Port intensity scores, by region
5. Methodology – Recreational vessels
6. Methodology – Ferry Passengers

- Additional regional analyses for Great Lakes and Pacific Northwest

# Selected Major Ports -- Atlantic

- Baltimore, MD
- Boston, MA
- Camden-Glouster, NJ
- Charleston, SC
- Chester, PA
- Marcus Hook, PA
- Miami, FL
- Newport News, VA
- Norfolk, VA
- New York & New Jersey
- Paulsboro, NJ
- Penn Manor, PA
- Philadelphia, PA
- Port Canaveral, FL
- Port Everglades, FL
- Port Jefferson, NY
- Savannah, GA
- Wilmington, DE

# Selected Major Ports – Great Lakes

- Buffington, IN
- Burns Waterway Harbor, IN
- Chicago, IL
- Duluth, MN & Superior, WI
- Gary, IN
- Indiana Harbor, IN

# Selected Major Ports – Inland

- Huntington – Tristate
- St. Louis, MO & IL

# Selected Major Ports -- Gulf

- Baton Rouge, LA
- Beaumont, TX
- Corpus Christi, TX
- Galveston, TX
- Houston, TX
- Lake Charles, LA
- Mobile, AL
- New Orleans, LA
- Pascagoula, MS
- Plaquemines, LA
- Port Arthur, TX
- Port Fourchon, LA
- Port Manatee, FL
- South Louisiana, LA
- St. Petersburg, FL
- Tampa, FL
- Texas City, TX

# Selected Major Ports – Pacific

- Long Beach, CA
- Los Angeles, CA
- Oakland, CA
- Redwood City, CA
- Richmond, CA
- San Francisco, CA
- Seattle, WA
- Tacoma, WA

# Indicator Statistics

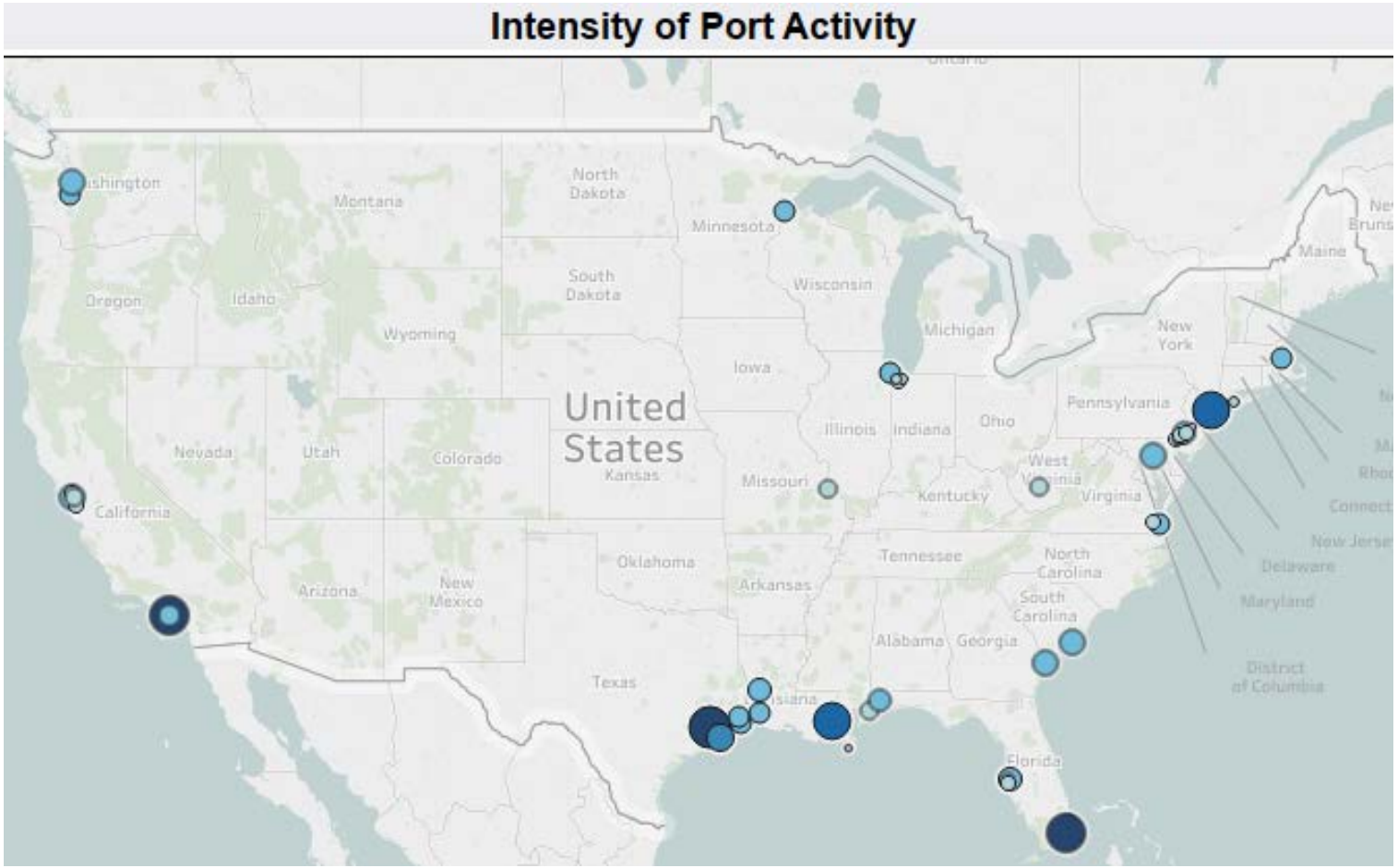
| Statistic | Dry Cargo Ship | Tank Ship | Towboat | Dry Barge | Tank Barge | Cruise Ship | Rec Vessel | Ferry |
|---|---|---|---|---|---|---|---|---|
| Min | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 |
| Max | 124,496 | 6423 | 29,970 | 72,893 | 45,941 | 4,078,529 | 190,840 | 40,225,521 |
| Median | 2,836 | 186 | 1,980 | 294 | 1,412 | 0 | 29,947 | 0 |
| Mean | 19,402 | 567 | 5,115 | 5,092 | 4,501 | 299,293 | 49,718 | 1,845,372 |
| 10 Pct | 83 | 0 | 88 | 2 | 19 | 0 | 5 | 0 |
| 20 Pct | 302 | 2 | 262 | 12 | 69 | 0 | 1,588 | 0 |
| 30 Pct | 551 | 9 | 771 | 103 | 266 | 0 | 6,788 | 0 |
| 40 Pct | 1,309 | 43 | 1,423 | 180 | 870 | 0 | 11,732 | 0 |
| 60 Pct | 4,976 | 328 | 3,827 | 617 | 1,996 | 0 | 42,950 | 0 |
| 70 Pct | 11,306 | 435 | 6,421 | 1,046 | 2,862 | 0 | 67,124 | 48,064 |
| 80 Pct | 33,520 | 774 | 8,054 | 2,191 | 4,855 | 213,020 | 105,760 | 681,744 |
| 90 Pct | 88,807 | 1,380 | 11,156 | 21,585 | 12,703 | 870,997 | 134,577 | 4,831,568 |

# Indicator Breakpoints

| Score | Dry Cargo Ship | Tank Ship | Towboat | Dry Barge | Tank Barge | Cruise Ship | Rec Vessel | Ferry |
|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 501 | 51 | 501 | 501 | 501 | 100,001 | 100,001 | 200,001 |
| 2 | 2,501 | 251 | 2,501 | 2,501 | 2,501 | 499,001 | 490,001 | 1,000,001 |
| 3 | 10,001 | 501 | 10,001 | 10,001 | 10,001 | 999,001 | 990,001 | 5,000,001 |
| 4 | 50,001 | 1001 | 50,001 | 50,001 | 50,001 | 2,500,001 | 1,500,001 | 10,000,001 |
| 5 | 567 | 5,115 | N/A | 4,501 | 299,293 | 49,718 | N/A | 0 |

Note: Towboat and Rec Vessel scores are capped at 4 to account for their smaller sizes relative to the larger vessels.

# National Weighted Scores



# Port Intensity Scores
# Northeast Atlantic

| Port | Unweighted | | | Weighted | | | Percent |
|---|---|---|---|---|---|---|---|
| | Freight | Pass | Total | Freight | Pass | Total | Freight |
| Boston, MA | 6 | 3 | 9 | 6.25 | 2.2 | 8.5 | 74.0% |
| NY-NJ | 16 | 11 | 27 | 17.5 | 6.9 | 24.4 | 71.7% |
| Port Jefferson, NY | 8 | 1 | 9 | 7.75 | 0.2 | 8.0 | 97.5% |

# Port Intensity Scores - Delaware River

| Port | Unweighted Freight | Unweighted Pass | Unweighted Total | Weighted Freight | Weighted Pass | Weighted Total | Percent Freight |
|---|---|---|---|---|---|---|---|
| Camden-Glouster, NJ | 8 | 1 | 9 | 7 | 0.2 | 7.2 | 97.2% |
| Chester, PA | 3 | 1 | 4 | 2.25 | 0.2 | 2.5 | 91.8% |
| Marcus Hook, PA | 9 | 0 | 9 | 9.5 | 0 | 9.5 | 100.0% |
| Paulsboro, NJ | 9 | 1 | 10 | 10 | 0.2 | 10.2 | 98.0% |
| Penn Manor, PA | 5 | 0 | 5 | 4.75 | 0 | 4.8 | 100.0% |
| Philadelphia, PA | 10 | 1 | 11 | 9.75 | 0.2 | 10.0 | 98.0% |
| Wilmington, DE | 6 | 1 | 7 | 6 | 0.2 | 6.2 | 96.8% |

# Port Intensity Scores – Mid Atlantic

| | Unweighted | | | Weighted | | | |
|---|---|---|---|---|---|---|---|
| Port | Freight | Pass | Total | Freight | Pass | Total | Percent Freight |
| Baltimore, MD | 11 | 3 | 14 | 10.5 | 2.2 | 12.7 | 82.7% |
| Newport News, VA | 8 | 1 | 9 | 7.75 | 0.2 | 8.0 | 97.5% |
| Norfolk, VA | 15 | 1 | 16 | 14.5 | 0.2 | 14.7 | 98.6% |

# Port Intensity Scores
# Southeast Atlantic

| | Unweighted | | | Weighted | | | |
|---|---|---|---|---|---|---|---|
| Port | Freight | Pass | Total | Freight | Pass | Total | Percent Freight |
| Charleston, SC | 10 | 6 | 16 | 9.75 | 3.4 | 13.2 | 74.1% |
| Miami, FL | 9 | 7 | 16 | 9.25 | 5.4 | 14.7 | 63.1% |
| Port Canaveral, FL | 7 | 5 | 12 | 7.75 | 5 | 12.8 | 60.8% |
| Port Everglades, FL | 10 | 2 | 12 | 12.75 | 0.4 | 13.2 | 97.0% |
| Savannah, GA | 11 | 3 | 14 | 12 | 1.2 | 13.2 | 90.9% |

# Port Intensity Scores – Great Lakes

| Port | Unweighted | | | Weighted | | | Percent Freight |
|---|---|---|---|---|---|---|---|
| | Freight | Pass | Total | Freight | Pass | Total | |
| Buffington, IN | 4 | 1 | 5 | 2.75 | 0.2 | 3.0 | 93.2% |
| Burns Harbor, IN | 7 | 1 | 8 | 5.75 | 0.2 | 6.0 | 96.6% |
| Chicago, IL | 8 | 4 | 12 | 6.75 | 1.4 | 8.2 | 82.8% |
| Duluth, MN – Superior, WI | 7 | 3 | 10 | 4.75 | 1.4 | 6.2 | 77.2% |
| Gary, IN | 4 | 1 | 5 | 2.75 | 0.2 | 3.0 | 93.2% |
| Indiana Harbor, IN | 7 | 0 | 7 | 5 | 0 | 5.0 | 100.0% |

# Port Intensity Scores – Gulf Coast-East

| | Unweighted | | | Weighted | | | |
|---|---|---|---|---|---|---|---|
| Port | Freight | Pass | Total | Freight | Pass | Total | Percent Freight |
| Mobile, AL | 17 | 3 | 20 | 15.75 | 1.2 | 17.0 | 92.9% |
| Pascagoula, MS | 14 | 1 | 15 | 14.75 | 0.2 | 15.0 | 98.7% |
| Port Manatee, FL | 5 | 1 | 6 | 4.75 | 0.2 | 5.0 | 96.0% |
| St. Petersburg, FL | 2 | 1 | 3 | 1.25 | 0.2 | 1.5 | 86.2% |
| Tampa, FL | 11 | 4 | 15 | 13 | 3.2 | 16.2 | 80.2% |

# Port Intensity Scores
# Gulf Coast-Louisiana

| | Unweighted | | | Weighted | | | |
|---|---|---|---|---|---|---|---|
| Port | Freight | Pass | Total | Freight | Pass | Total | Percent Freight |
| Baton Rouge, LA | 20 | 1 | 21 | 19 | 0.2 | 19.2 | 99.0% |
| Lake Charles, LA | 18 | 1 | 19 | 19.5 | 0.2 | 19.7 | 99.0% |
| New Orleans, LA | 19 | 9 | 28 | 18 | 5.4 | 23.4 | 76.9% |
| Plaquemines, LA | 18 | 4 | 22 | 16.75 | 1.7 | 18.5 | 90.8% |
| Port Fourchon, LA | 12 | 1 | 13 | 11.5 | 0.2 | 11.7 | 98.3% |
| South Louisiana, LA | 21 | 1 | 22 | 20.5 | 0.2 | 20.7 | 99.0% |

# Port Intensity Scores – Gulf Coast-Texas

| | Unweighted | | | Weighted | | | |
|---|---|---|---|---|---|---|---|
| Port | Freight | Pass | Total | Freight | Pass | Total | Percent Freight |
| Beaumont, TX | 16 | 1 | 17 | 17.5 | 0.2 | 17.7 | 98.9% |
| Corpus Christi, TX | 19 | 2 | 21 | 20.5 | 0.7 | 21.2 | 96.7% |
| Galveston, TX | 13 | 9 | 22 | 12.75 | 5.9 | 18.7 | 68.4% |
| Houston, TX | 21 | 7 | 28 | 21.5 | 3.4 | 24.9 | 86.3% |
| Port Arthur, TX | 14 | 1 | 15 | 14.75 | 0.2 | 15.0 | 98.7% |
| Texas City, TX | 13 | 0 | 13 | 15.25 | 0 | 15.3 | 100.0% |

# Port Intensity Scores – Inland

| Port | Unweighted | | | Weighted | | | Percent |
|---|---|---|---|---|---|---|---|
| | Freight | Pass | Total | Freight | Pass | Total | Freight |
| Huntington - Tristate | 11 | 1 | 12 | 6.25 | 0.2 | 6.5 | 96.9% |
| St. Louis, MO & IL | 11 | 2 | 13 | 6.25 | 0.4 | 6.7 | 94.0% |

# Port Intensity Scores – Pacific Coast

| | Unweighted | | | Weighted | | | |
|---|---|---|---|---|---|---|---|
| Port | Freight | Pass | Total | Freight | Pass | Total | Percent Freight |
| Long Beach, CA | 16 | 2 | 18 | 18 | 0.7 | 18.7 | 96.3% |
| Los Angeles, CA | 14 | 6 | 20 | 13.75 | 3.7 | 17.5 | 78.8% |
| Oakland, CA | 11 | 3 | 14 | 9.5 | 1.2 | 10.7 | 88.8% |
| Redwood City, CA | 4 | 1 | 5 | 2.75 | 0.2 | 3.0 | 93.2% |
| Richmond, CA | 11 | 1 | 12 | 12.5 | 0.2 | 12.7 | 98.4% |
| San Francisco, CA | 10 | 8 | 18 | 9.25 | 4.4 | 13.7 | 67.8% |
| Seattle, WA | 14 | 9 | 23 | 11.5 | 5.7 | 17.2 | 66.9% |
| Tacoma, WA | 12 | 3 | 15 | 10 | 1.2 | 11.2 | 89.3% |

# Methodology – Recreational Vessels

1) Extracted recreational vessel data from USCG vessel data base (public file is Merchant Vessels of the U.S. at https://homeport.uscg. Mil
2) Obtained county information by matching home port city & state to Census Bureau's place file (www.census.gov)
3) Clerical review (hand search) of non-matches from (3)
4) Combine (2) & (3) into master list
5) Assigned vessels from (4)to MSA with county data
6) Calculate MSA percentage of state from (5)
7) Apply percentage from (6) to state totals, published by USCG Boating Division's Annual Report.

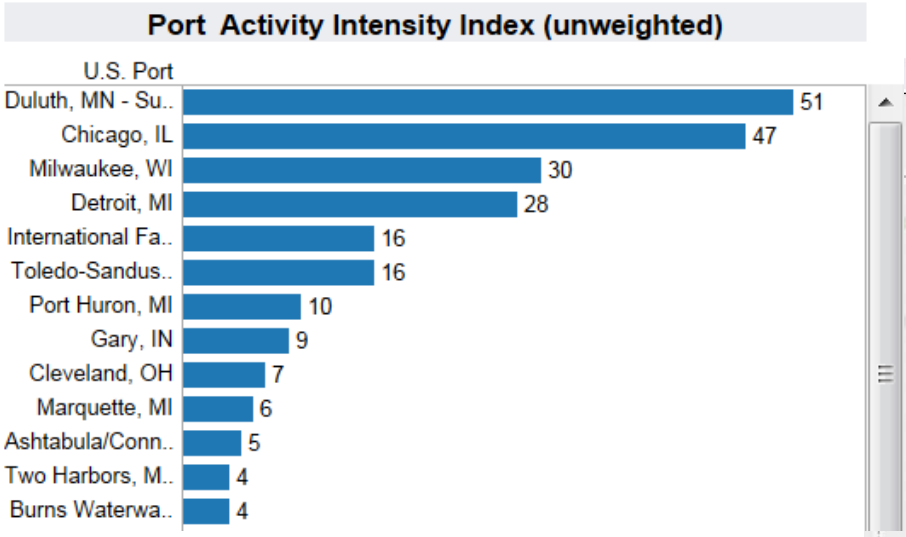
# Methodology – Ferry Passengers

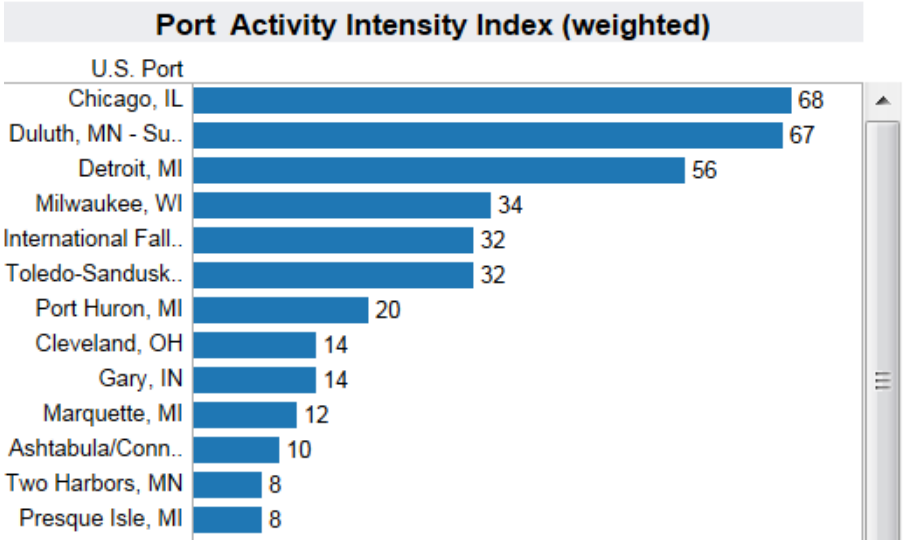
1) Download National Census of Ferry Operators database from www.bts.gov

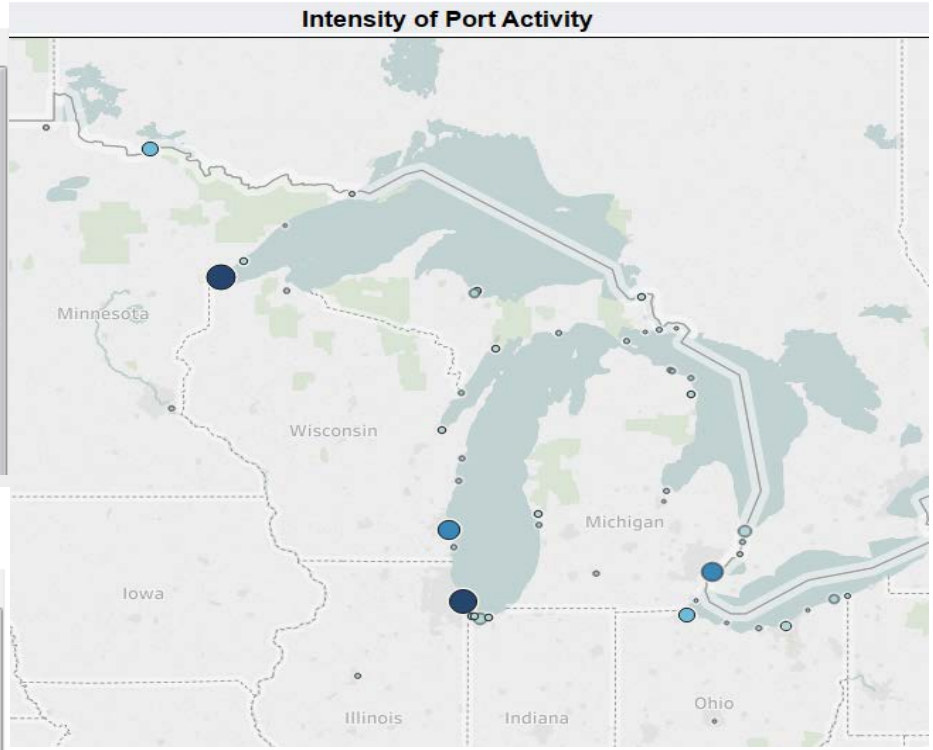
2) Match ferries to ports in target MSAs:
   - Origin & destination ports outside MSA
   - Both origin and destination ports inside MSA
   - Only origin or destination port in MSA

3) Assign NSFO passenger counts to appropriate ports

# Regional Case: Great Lakes



# Regional Case: Pacific Northwest