Optimizing Freight Transportation System Performance

Ed Strocko
FHWA Office Of Freight Management and Operations
- Why We Care
- Perspectives
  - System User v. Owner
- System Solutions
  - Freight Fluidity
- Operational Solutions
  - FRATIS
System Solution – Measuring Freight System Performance with Supply Chain Fluidity Measures

- **Objective**
  - Demonstrate and improve the measurement of freight transportation performance using a supply chain perspective

- **Case Study Sponsors**
  - U.S. Department of Commerce, Advisory Committee on Supply Chain Competitiveness
  - FHWA, Office of Freight Management
  - I-95 Corridor Coalition, Intermodal Committee
Supply Chain Case Studies

- Retail – Target® consumer goods
  - From Ports of Los Angles/Long Beach via Chicago to New York
- Autos – General Motors auto parts
  - From suppliers to auto assembly plant in Tennessee
- Food – Perdue processed chicken
  - From DelMarVa region to Mid-Atlantic markets
- Agriculture – Soybean exports
  - From Illinois farms to Louisiana port
- Electronics – Panasonic electronics
  - Between manufacturing and assembly facilities in San Diego and Tijuana
Scope

- Address performance of supply chains
  - But not the performance of modes, networks, etc., or environmental and economic impacts
- Address performance of public and quasi-public links and nodes
  - Include ports, highways, rail lines, airports, etc., but not private-sector manufacturing, warehousing or distribution nodes
- Use measures and metrics that are common across supply chains and “drill down”
- Focus on high-level performance of representative supply chains to inform national policy
  - Cover key industries, national regions, major trade lanes, but do not duplicate firm-, carrier- and agency-level analysis
## Performance Measures and Metrics

<table>
<thead>
<tr>
<th>Measure</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transit time</td>
<td>Travel time in days (or hours)</td>
</tr>
<tr>
<td>Reliability</td>
<td>95% travel time in days (or hours)</td>
</tr>
<tr>
<td>Safety</td>
<td>Fatality and injury rate</td>
</tr>
<tr>
<td>Cost</td>
<td>Dollars</td>
</tr>
<tr>
<td>Risk</td>
<td>Cargo loss and damage (accidents, poor handling, theft…)</td>
</tr>
<tr>
<td></td>
<td>Disruption (storms, labor, political forces…)</td>
</tr>
<tr>
<td></td>
<td>Capacity expansion delays (physical, regulatory limitations and delays</td>
</tr>
</tbody>
</table>
Retail Supply Chain (Target)
# Retail Supply Chain Measures

<table>
<thead>
<tr>
<th>Links and Nodes</th>
<th>Transit Time/Dwell Time (Hours)</th>
<th>Reliability (95% travel time)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>West Coast port (SEATTLE)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dray move</td>
<td>1.1</td>
<td>4.3</td>
</tr>
<tr>
<td><strong>Transload or Consolidation Center</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dray move</td>
<td>0.8</td>
<td>3.3</td>
</tr>
<tr>
<td>West Coast rail intermodal terminal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rail move</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Midwest rail intermodal interchange</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rail move</td>
<td></td>
<td></td>
</tr>
<tr>
<td>East Coast rail intermodal terminal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dray move</td>
<td>1.0</td>
<td>2.7</td>
</tr>
<tr>
<td><strong>East Coast Regional Distribution Center</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truck P&amp;D move</td>
<td>3.5</td>
<td>6.5</td>
</tr>
<tr>
<td><strong>Retail Store</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Estimated using Railinc, RSI Logistics or Transcore data.
## Retail Supply Chain Measures

<table>
<thead>
<tr>
<th>Links and Nodes</th>
<th>Transit Time/Dwell Time (Hours)</th>
<th>Reliability (95% travel time)</th>
</tr>
</thead>
<tbody>
<tr>
<td>West Coast port (LA/LB)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dray move</td>
<td>1.2</td>
<td>5.8</td>
</tr>
<tr>
<td><strong>Transload or Consolidation Center</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dray move</td>
<td>0.3</td>
<td>1.3</td>
</tr>
<tr>
<td>West Coast rail intermodal terminal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rail move</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Midwest rail intermodal interchange</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rail move</td>
<td></td>
<td></td>
</tr>
<tr>
<td>East Coast rail intermodal terminal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dray move</td>
<td>1.0</td>
<td>2.7</td>
</tr>
<tr>
<td><strong>East Coast Regional Distribution Center</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truck P&amp;D move</td>
<td>3.5</td>
<td>6.5</td>
</tr>
<tr>
<td><strong>Retail Store</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Agricultural Export Supply Chain (soybeans)
Agricultural Export Supply Chain Measures

<table>
<thead>
<tr>
<th>Links and Nodes</th>
<th>Transit Time/Dwell Time</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Days, hours)</td>
<td>(95% travel time)</td>
</tr>
<tr>
<td><strong>Farm in vicinity of El Paso, IL</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truck move</td>
<td>0.8 hours</td>
<td>1.7 hours*</td>
</tr>
<tr>
<td><strong>ADM/Growmark Peoria Terminal Wharf Port</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barge move</td>
<td>8.2 days</td>
<td>14.5 days*</td>
</tr>
<tr>
<td><strong>Cargil Loading Facility, Reserve, LA</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>9.0 days</td>
<td>14.6 days</td>
</tr>
</tbody>
</table>

*Estimated using U.S. Army Corps of Engineers data for the period June 2012 through January 2014; TTI Mobility Report 2012 for 95% index for small urban areas.
Conclusions and Issues *(preliminary)*

- We can measure the high-level performance of representative supply chains
- Key measures and metrics are common across supply chains and can be scaled for national, multistate and metropolitan use
  - Travel time and travel time reliability are available from public and private sources, but “some assembly is required…”
  - Safety data are available, but not readily accessible
  - Cost data can be purchased from private suppliers
  - Risk data can be estimated, but are not readily available
- Data availability, access and cost
- Urban freight stages
- Representative market basket of supply chains
  - How much is enough?
    - Industries, supply chains, geographies, etc.
Operational Solutions - Freight Advanced Traveler Information (FRATIS)

- Technology is not used consistently by the trucking industry
- Trucks have unique operational characteristics
- Freight terminals do not always share queue information
- Existing public resources do not always provide freight-specific information
- System effectiveness is often limited by data availability and accuracy
The lack of Freight Advanced Traveler Information has negative effect on:

- Efficient Movement of Freight Transportation
- Planning of freight daily work activities
- Logistics Management Systems
- Environment of Neighboring Communities
- Energy Consumption
- Safety of the Traveling Public
Truck Drivers get their traveler information from a variety of traditional and technology based sources:

- CB Radio: 48%
- AM/FM Radio: 45%
- Dynamic Message Signs: 23%
- Smarth Phone App: 23%
- InVehicle GPS: 22%
Los Angeles/Long Beach Port User Survey Responses

<table>
<thead>
<tr>
<th>Decision</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change Route En Route Based on Traveler Information</td>
<td>47%</td>
</tr>
<tr>
<td>Change Route Before Departure Based on Traveler Information</td>
<td>42%</td>
</tr>
<tr>
<td>Accept/Decline Assignments Based on Traveler Information</td>
<td>11%</td>
</tr>
<tr>
<td>Change PickUp/Delivery Times Based on Traveler Information</td>
<td>11%</td>
</tr>
</tbody>
</table>

Source: Gateway Cities COG
## Los Angeles/Long Beach Port User Survey Responses

Dispatchers in the region rated the value of the following improvements to traveler information:

<table>
<thead>
<tr>
<th>Improvement</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queue Lengths at Port</td>
<td>4.0</td>
</tr>
<tr>
<td>Fastest Real-Time Routes</td>
<td>3.8</td>
</tr>
<tr>
<td>Bottleneck Locations</td>
<td>3.7</td>
</tr>
<tr>
<td>More Cameras in Port Area</td>
<td>3.7</td>
</tr>
<tr>
<td>Travel Times (Freeways)</td>
<td>3.7</td>
</tr>
<tr>
<td>Travel Time to Major Pickups</td>
<td>3.6</td>
</tr>
<tr>
<td>More Cameras on Freeway</td>
<td>3.4</td>
</tr>
<tr>
<td>Travel Times (Surface Streets)</td>
<td>3.1</td>
</tr>
<tr>
<td>More Cameras on Surface Streets</td>
<td>2.8</td>
</tr>
</tbody>
</table>

*Least Valuable to Most Valuable [Average Score]*

Source: Gateway Cities COG
Where are the Potential Port Locations for Application of FRATIS?
Freight Advanced Traveler Information System (FRATIS): Concepts and Potential Impacts

- **FRATIS Application: Freight-Specific Dynamic Travel Planning and Performance**
  - Enhances traveler information systems to address specific freight needs
  - Integrates data on wait times at intermodal facilities (e.g. ports), incident alerts, road closures, work zones, routing restrictions (hazmat, oversize/overweight)

- **FRATIS Application: Drayage Optimization**
  - Optimize truck/load movements between freight facilities, balancing early and late arrivals
  - Individual trucks are assigned time windows for pick-up or drop-off

- **10-year transformative impact targets**
  - Reduce truck travel times, 17%
  - Reduce bobtail (empty) trips, 15%
  - Reduce terminal wait times, 35%
  - Reduce freight-involved incidents, 35%
  - Reduce fuel consumption/emissions, 10%

**FRATIS USDOT Lead:** Randy Butler (FHWA Office of Operations)
Benefits to Trucking/Drayage Company and Drivers

- Improve productivity and efficiency of the fleet
- Empower dispatchers with real-time information for faster and better decisions
- Generate near optimal trucks itinerary taking into consideration travel times with traffic, waiting times at the terminal, weather conditions, driver availability, etc.
- Dispatcher will have access to real time Terminal Waiting Times and Turn-Times
- Drivers will be able to navigate to their destinations and be rerouted in case of heavy traffic, incidents and congestion in their current route
Benefits to Intermodal Facilities

- Receive pre-notifications containing details for trucks coming to perform transactions in their facilities
- Receive real time notifications of trucks heading towards their facilities with estimated time of arrival
- Reduce waiting time and turn around time at the facility
- Reduce unproductive pickups/drop-offs by enabling better container turns and reuse.
- Communicate directly with dispatcher to notify about terminal closures, incidents, or any other operational status in order to mitigate congestion in their facilities.
Public Benefits

- Promote better transportation planning and policy
- Improve air quality by reducing CO2 emissions
- Provides a platform to support economic development in the region
- Improve quality of life of the region
- Better utilization of existing infrastructure and capacity
- Provides capabilities for safer routes for trucking operations.
FRATIS High-Level System Concept Focuses on Data Integration and Dissemination

**Regional ITS Data**

**Sources**
- Regional 511 Systems
- MPO
- State DOT
- Cities

**Types**
- Real-Time Freeway Speeds and Volumes
- Real-Time Key Arterial Speeds and Volumes
- Incident Information
- Road Closure Information
- Route Restrictions/Bridge Heights

**Third Party Truck-Specific Movement Data**

- Real-Time Speed Data from Fleet Management Systems GPS Data
- Cell Phone and/or Bluetooth Movement/Speed Data
- Truck Parking Availability

**Future U.S. DOT Connected Vehicle Data**

- Road Weather Management – Route Specific Conditions and Forecasts
- “Probe Data” From V-V and V-I Connected Vehicle Technologies
- V-IV & V-I Safety Applications Data

**FRATIS IT Toolkit**

- ConOps, Architecture, Use Cases
- FRATIS Baseline API’s
- FRATIS Baseline Web and AED Apps
- FRATIS Testing Best Practices Guide and Performance Criteria
- FRATIS Business Plan

**Intermodal Terminals Data**

- Queue Length (Including Video)
- Container Availability Status

**FRATIS Basic Applications**

- Dynamic Travel Planning and Performance
- Intermodal Drayage Operations Optimization
  - Based on Open Source Data and Services

**FRATIS Commercial Applications**

- Dynamic Travel Planning and Performance
- Intermodal Drayage Operations Optimization
  - Value Added Services with Target Markets (For Profit)

**API’s and/or Web Services**

**USDOT Open Source Web Portal**
Planning Execution and Monitoring

– Capture Drayage Operation Constraints
– Receive and Enter jobs into FRATIS
– Run the optimization algorithm
– Generate optimal plan
– Review the optimal plan and approve
– Communicate the plan details
– Drivers receive and execute Jobs
– Monitor the daily operations
Memphis Drayage Optimization Algorithm

Pre-deployment vs. Post-deployment pairwise comparison of average performance measures using clustered data sets:

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Pre vs. Post using clustered data sets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bobtail Miles Reduction</td>
<td>13%</td>
</tr>
<tr>
<td>Total Miles Reduction</td>
<td>9%</td>
</tr>
<tr>
<td>Average Miles per Truck Increase</td>
<td>14%</td>
</tr>
<tr>
<td>Required Fleet Size Reduction</td>
<td>21%</td>
</tr>
</tbody>
</table>
Three Initial FRATIS Prototypes Under Development

- **Los Angeles-Gateway Region:**
  - Develop FRATIS applications to address dynamic travel planning around the marine terminals and queues to move cargo out of the ports more efficiently

- **Dallas-Fort Worth, Texas:**
  - Incorporate integrated corridor management capability along with size and weight permitting
  - Test Connected Vehicle Basic Safety Message (SAE Standards J2735-2009)
  - Optimize drayage opportunities in coordination with rail and local truck drayage companies

- **South Florida:**
  - Similar focus as the other two sites, but includes emergency response capability to FRATIS that would integrate FRATIS functionality into Emergency Operations Center activity during an emergency such as a hurricane
FRATIS Project Status

- FRATIS Prototype
  - Architecture Complete
  - Baseline data for before and after complete
  - Development of the Application Complete
    - External Traffic Information
    - Devices Installed in 50 trucks
    - Optimization Algorithm designed for Marine Terminal Operations
    - Waiting times will be collected to measure queues at the gates
- Los Angeles FRATIS went live on December 11, 2013
- Dallas live for six month test being February 28, 2014
- South Florida begin six month test on April 1, 2014
Thank You