Measuring Supply Chain Performance: Fluidity Metrics and Bottlenecks

Findings from I-95 Corridor Coalition Freight Fluidity Measures Pilot Project

5th International Transportation Systems Performance Measurement & Data Conference
Denver, CO

Joseph G.B. Bryan, Parsons Brinckerhoff
Christopher Lamm, Cambridge Systematics, Inc.

June, 2015
Project

• **Objective**
  – Demonstrate and improve the measurement of freight transportation performance using a supply chain perspective
  ➔ *End to end* conception of performance and measurement, across modes and stages

• **5 Supply Chain Case Studies**
  – Retail, Automotive, Food, Electronics, Export Grain

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

Performance Bottlenecks Linked to Stage Transfers
Points of Vulnerability

Performance Bottlenecks are Public-Private: “Joint” Pain

- Driver shortages
- HOS restrictions limiting productivity
- Fuel volatility
- Disparate State TL weight restrictions
- Limited asset utilization
- Significant urban congestion
- Chicago, NY, LA, Atlanta
- Lack of a single communication portal on traffic and road conditions

- Limited ice rated vessels for cold weather ports
- Volatile bunker fuel costs
- Limited pre-clearance processes delay unload and transfer times
- Worker shortages

- Speed & in-transit delays
- Limited effective short haul times
- Insufficient rail siding
- Too few transload hubs
- Limited infrastructure in key hubs
- South East, Dakotas
- Limited visibility for in-transit products

- Limited infrastructure at some ports restrict vessel & cargo types
- Labor disputes impede flow and cause unscheduled delays
- Difficulty managing seasonal spikes
- Significant congestion at major ports with little or no visibility to bottlenecks
- Systems and infrastructure limitations impede efficiency, resulting in unloading delays
- Facility and infrastructure improvements needed to capitalize on Panama Canal expansion to pull freight out of Central American ports
- Lack of common performance metrics to forecast choke points for effective redirection of cargo

- Falling lock systems
- Dredging needs for key freight conduits
- Limited intermodal transfer infrastructure
- Limited asset availability
- Limited interconnectivity to major ground transportation hubs

- Lack of systems integration cause clearance delays and status updates
- Lack of expedient issue escalation and resolution process
- Limited physical infrastructure to accommodate volumes
- Detroit, Port Huron, MI, El Paso, TX, Buffalo
- Current infrastructure has difficulty processing oversized cargo
- Short and unpredictable hours of operations
- Lack of carrier interchange agreements cause significant delays in trailer exchanges into and out of Mexico and Canada
- No preferred shipper status to expedite the flow of high volume O/D pairs
- Lack of inter-agency integration increases processing times for: Duty drawback, FTZ approvals, shipment in bond

- Weight restrictions limit asset utilization
- Rail speed
- Lack of robust transloading infrastructure make modal selection a non option for many shippers
- Limited capacity of drivers and equipment

- Limited transload and logistics parks / infrastructure reduces mode selection and increases costs
- Weak workforce training contributing to worker skill set gaps
- Limited FTZ and Bonded Facility zones
- No streamlined FTZ and Bond processes

- Kaizen A
- Kaizen B

- Limited transload and logistics parks / infrastructure reduces mode selection and increases costs
- Weak workforce training contributing to worker skill set gaps
- Limited FTZ and Bonded Facility zones
- No streamlined FTZ and Bond processes

A = Domestic Ground Transportation
B = Domestic Rail
C = Inland Water Transport
D = Intermodal
E = Domestic Air
F = Global Ocean
G = US Ports
H = US Customs & Border Crossing
I = International Air
J = Transload Facilities
## Performance Measures and Metrics

### Market-Driven Factors

<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>Cost</td>
<td>Dollars</td>
</tr>
<tr>
<td>Safety</td>
<td>Fatality and injury rate</td>
</tr>
</tbody>
</table>
| Risk       | Disruption  
(storms, labor, infrastructure failure, political forces…)
|           | Capacity expansion delays  
(physical, regulatory limitations and delays…) |
Automotive Supply Chain/TL (General Motors)
## Automotive Supply Chain Measures/TL

<table>
<thead>
<tr>
<th>Links and Nodes</th>
<th>Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parts Supplier Plant, Warren, Michigan</strong></td>
<td></td>
</tr>
<tr>
<td>Truckload move (through)</td>
<td>ATRI, Chainalytics</td>
</tr>
<tr>
<td><strong>General Motors Plant, Spring Hill, TN</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Links and Nodes</th>
<th>Data Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parts Supplier Plant, Chatham, Ontario</strong></td>
<td></td>
</tr>
<tr>
<td>Truckload move</td>
<td>ATRI, Chainalytics</td>
</tr>
<tr>
<td>International border crossing</td>
<td></td>
</tr>
<tr>
<td>Truckload move</td>
<td>ATRI, Chainalytics</td>
</tr>
<tr>
<td><strong>General Motors Assembly Plant, Spring Hill, TN</strong></td>
<td></td>
</tr>
</tbody>
</table>
## Automotive Supply Chain Performance/TL

<table>
<thead>
<tr>
<th>Links and Nodes</th>
<th>Transit Time/Dwell Time (Hours)</th>
<th>Reliability (95% travel time)</th>
<th>Cost (2014 $’s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parts Supplier Plant, Chatham, Ontario</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truckload move</td>
<td>1.5</td>
<td>3.0</td>
<td>$1,052</td>
</tr>
<tr>
<td>International border crossing</td>
<td>▼</td>
<td>▼</td>
<td></td>
</tr>
<tr>
<td>Truckload move</td>
<td>18.4</td>
<td>23.2</td>
<td></td>
</tr>
<tr>
<td><strong>General Motors Assembly Plant, Spring Hill, TN</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>19.9</td>
<td>26.2</td>
<td>$1,052</td>
</tr>
</tbody>
</table>

Buffering Affects Productivity

Productivity Affects Cost
Hours of Service Effect (499 Miles)

Bi-Modal Distribution in No-Tolerance Environment
Types of Performance Risk

Disruption Risks

1. **System interruptions** stem from such causes as natural disasters, infrastructure failure, and labor actions
   - Infrequent but serious, and facing “new normal”

2. **Acceleration** is risk that conditions **may rapidly** grow much worse
   - Phase transition/state change in traffic flow, or energy supply loss

3. **Deterioration** is risk that conditions **gradually** grow worse

Planning Risks

4. **Institutional** risks are uncertainties in implementation of improvements

5. **Process** risks are immediate challenges to daily logistics planning
Risk Management

• Long term disruption risks mainly handled in supplier/plant location decisions
  – Chronic short term = long term

• Process risks actively managed
  – Weather, customs, work zones, other local conditions
  – 2-3 day horizon
  – Premium on information and time to adjust
  – Adjustments: ship early, expedite, reroute
  – Performance tracking by route, TOD, carrier
    ➔ Buffering built in

• Sensitive process: 2-hour trigger

Source: NCHRP 8-99
Considerations for Discussion

• We can measure supply chain fluidity
  – End-to-end, across modes, stages and jurisdictions
  – In critical dimensions, for critical sectors of the economy

• Bottlenecks are performance vulnerabilities
  – Pain points, not just capacity pinch points
  – Key focus: stage transfer process and conditions
  – Public-private problem
  – Time series improves diagnostics

• Vulnerabilities intertwined with risk management
  – Unsolved process and conditions failures are buffered
  – Buffering reduces productivity, increases structural cost
  – Long term consequence: businesses move or fail
Thank You!

- BryanJG@pbworld.com
- clamm@camsys.com