Florida Statewide Multi-Modal Freight Model

presented to
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Statewide Model Workshop

presented by
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Statewide Model Framework

1. Firm Synthesis
2. Supply Chain, Goods Demand, and Business Locations
3. Firms by Industry Type and Emp Size By County
4. Business Locations
5. Distribution Channels
6. Shipment Size and Frequency
7. Mode and Intermediate Transfers

- Networks (Line-haul distance, Access, Egress, Cost, Mode, Transfer Facilities)
- Shipment for each Buyer-Supplier Pair
- Shipment by Distribution Channel (4)
- Truck Flows
- Rail Flows
- Water Flows
- Air Flows

- Macro-economic I/O Tables
- Annual Commodity Flow Data for US
Firms and Commodity Flow Data

• Individual firms are synthesized in each traffic analysis zone (TAZ) based on employment data for each industry (County Business Patterns, InfoUSA, QCEW, and other local data)

• TAZs provide detailed spatial resolution, particularly in metropolitan areas, for firm locations and shipment origins and destinations

• Across the whole of Florida, the TAZs provide a significant level of detail

• FAF commodity flow data, a model input, uses large FAF zones. This is disaggregated down to TAZs based on the firm allocations and economic (input/output) data
Transportation Networks

- Model covers all of Florida and includes transportation networks across the USA and internationally
- Uses newest multi-modal transportation networks: highway, rail, seaports and waterways, airports, and intermodal connections
- Uses network information to understand transportation costs (including storage costs during transshipment), capacities, and resulting travel times
- Model outputs vehicle and commodity flows on networks and through intermodal/distribution centers
Sample Model Sequence #1

Mode: Air, Rail

- Shipment size: >10,000 lbs.
- Actual Weight: 20,000 lbs.
- Annual Frequency: 6
- Probability of delivery occurring on time: 95%

Seller in FAF3 zone 486325412 (Pharmaceutical preparation manufacturing)

Buyer in Tampa, FL 420000 (Wholesale trade)
Sample Model Sequence #2

Mode: Air, Rail

Shipment size: >10,000
Actual Weight: 100,000
Annual Frequency: 158
Probability of delivery

Buyer at FAF3 zone 486
Oatmeal manufacturing
(i.e., cereal breakfast food)

Seller in Miami, FL
Oilseed and Grain Farming

Freight Origin
County
Freight Origin
Miami
FAF Zones

TAZ
Inventory Costs

- ordering
- carrying
- damage
- Inventory in-Transit
- Safety Inventory

Total Costs = Transport Costs + Non-transport Costs

Adding inventory related costs

Inventory Costs

- ordering
- carrying
- damage
- Inventory in-Transit
- Safety Inventory
Mode Shares by Weight and Value

### Mode Shares by Weight (KTons)

<table>
<thead>
<tr>
<th>Destinations</th>
<th>Truck</th>
<th>Rail</th>
<th>Multiple modes &amp; mail</th>
<th>Other and unknown</th>
<th>Water</th>
<th>Pipeline</th>
<th>Air (include truck-air)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Florida-Florida</td>
<td>682,796</td>
<td>16,835</td>
<td>8,695</td>
<td>8,708</td>
<td>59</td>
<td>405</td>
<td>2</td>
<td>717,501</td>
</tr>
<tr>
<td>Florida-Rest of US</td>
<td>45,501</td>
<td>10,753</td>
<td>18,838</td>
<td>1,421</td>
<td>3,792</td>
<td>316</td>
<td>90</td>
<td>80,711</td>
</tr>
<tr>
<td>Rest of US-Florida</td>
<td>69,204</td>
<td>38,053</td>
<td>17,759</td>
<td>1,518</td>
<td>18,427</td>
<td>21,426</td>
<td>186</td>
<td>166,573</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>797,501</td>
<td>65,640</td>
<td>45,292</td>
<td>11,647</td>
<td>22,277</td>
<td>22,147</td>
<td>279</td>
<td>964,784</td>
</tr>
</tbody>
</table>

### Mode Shares by Value (M$)

<table>
<thead>
<tr>
<th>Destinations</th>
<th>Truck</th>
<th>Rail</th>
<th>Multiple modes &amp; mail</th>
<th>Other and unknown</th>
<th>Water</th>
<th>Pipeline</th>
<th>Air (include truck-air)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Florida-Florida</td>
<td>492,858</td>
<td>2,008</td>
<td>16,001</td>
<td>15,704</td>
<td>153</td>
<td>110</td>
<td>144</td>
<td>526,979</td>
</tr>
<tr>
<td>Florida-Rest of US</td>
<td>84,470</td>
<td>3,843</td>
<td>57,715</td>
<td>3,421</td>
<td>561</td>
<td>85</td>
<td>6,125</td>
<td>156,221</td>
</tr>
<tr>
<td>Rest of US-Florida</td>
<td>171,236</td>
<td>13,840</td>
<td>82,911</td>
<td>5,730</td>
<td>8,736</td>
<td>8,246</td>
<td>13,230</td>
<td>303,928</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>748,563</td>
<td>19,691</td>
<td>156,627</td>
<td>24,855</td>
<td>9,450</td>
<td>8,442</td>
<td>19,500</td>
<td>987,128</td>
</tr>
</tbody>
</table>
Largest Freight Flows within Florida

<table>
<thead>
<tr>
<th>Top Commodities (by Weight)</th>
<th>Top Commodities (by Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravel</td>
<td>Machinery</td>
</tr>
<tr>
<td>21%</td>
<td>17%</td>
</tr>
<tr>
<td>Nonmetal min. prods.</td>
<td>Electronics</td>
</tr>
<tr>
<td>20%</td>
<td>9%</td>
</tr>
<tr>
<td>Waste/scrap</td>
<td>Mixed freight</td>
</tr>
<tr>
<td>9%</td>
<td>8%</td>
</tr>
<tr>
<td>Gasoline</td>
<td>Motorized vehicles</td>
</tr>
<tr>
<td>7%</td>
<td>6%</td>
</tr>
<tr>
<td>Natural sands</td>
<td>Gasoline</td>
</tr>
<tr>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Nonmetallic minerals</td>
<td>Pharmaceuticals</td>
</tr>
<tr>
<td>3%</td>
<td>6%</td>
</tr>
<tr>
<td>Logs</td>
<td>Articles-base metal</td>
</tr>
<tr>
<td>3%</td>
<td>4%</td>
</tr>
<tr>
<td>Other ag prods.</td>
<td>Misc. mfg. prods.</td>
</tr>
<tr>
<td>3%</td>
<td>4%</td>
</tr>
<tr>
<td>Other foodstuffs</td>
<td>Other foodstuffs</td>
</tr>
<tr>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Cereal grains</td>
<td>Precision instruments</td>
</tr>
<tr>
<td>3%</td>
<td>3%</td>
</tr>
</tbody>
</table>
Largest Commodity Flows to and from Florida

Top Commodities (by Weight)

Top Commodities (by Value)
<table>
<thead>
<tr>
<th>Commodity</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereal grains</td>
<td>Air (truck-air)</td>
</tr>
<tr>
<td>Fuel oils</td>
<td>Multiple modes &amp; mail</td>
</tr>
<tr>
<td>Basic chemicals</td>
<td>Other and unknown</td>
</tr>
<tr>
<td>Gasoline</td>
<td>Other and unknown</td>
</tr>
<tr>
<td>Nonmetallic minerals</td>
<td>Other and unknown</td>
</tr>
<tr>
<td>Coal-n.e.c.</td>
<td>Other and unknown</td>
</tr>
<tr>
<td>Plastics/rubber</td>
<td>Other and unknown</td>
</tr>
<tr>
<td>Other foodstuffs</td>
<td>Other and unknown</td>
</tr>
<tr>
<td>Articles-base metal</td>
<td>Other and unknown</td>
</tr>
<tr>
<td>Nonmetal min....</td>
<td>Other and unknown</td>
</tr>
<tr>
<td>Machinery</td>
<td>Truck</td>
</tr>
<tr>
<td>Base metals</td>
<td>Water</td>
</tr>
<tr>
<td>Chemical prods.</td>
<td>Water</td>
</tr>
<tr>
<td>Electronics</td>
<td>Water</td>
</tr>
<tr>
<td>Other ag prods.</td>
<td>Truck</td>
</tr>
<tr>
<td>Metallic ores</td>
<td>Truck</td>
</tr>
<tr>
<td>Other Commodities</td>
<td>Truck</td>
</tr>
</tbody>
</table>

Commodities by Mode (Weight in KTons in 2007)
Florida to Houston

Top 20 Destinations (KTons)
- 1,000
- 10,000

Total Freight Flow (KTons)
- 1 - 100
- 101 - 500
- 501 - 1,000
- 1,001 - 2,500
- 2,501 - 5,000
- 5,001 - 10,000
- 10,001 - 12,500
<table>
<thead>
<tr>
<th>Commodity</th>
<th>2007 Freight Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal-n.e.c.</td>
<td></td>
</tr>
<tr>
<td>Nonmetal min...</td>
<td></td>
</tr>
<tr>
<td>Plastics/rubber</td>
<td></td>
</tr>
<tr>
<td>Articles-base metal</td>
<td></td>
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<tr>
<td>Basic chemicals</td>
<td></td>
</tr>
<tr>
<td>Other foodstuffs</td>
<td></td>
</tr>
<tr>
<td>Chemical prods.</td>
<td></td>
</tr>
<tr>
<td>Fertilizers</td>
<td></td>
</tr>
<tr>
<td>Other ag prods.</td>
<td></td>
</tr>
<tr>
<td>Base metals</td>
<td></td>
</tr>
<tr>
<td>Milled grain prods.</td>
<td></td>
</tr>
<tr>
<td>Wood prods.</td>
<td></td>
</tr>
<tr>
<td>Machinery</td>
<td></td>
</tr>
<tr>
<td>Meat/seafood</td>
<td></td>
</tr>
<tr>
<td>Textiles/leather</td>
<td></td>
</tr>
<tr>
<td>Mixed freight</td>
<td></td>
</tr>
<tr>
<td>Other Commodities</td>
<td></td>
</tr>
</tbody>
</table>

Commodities by Mode (Weight in KTon in 2007)
Houston to Florida

Top 20 Origins (KTons)
- 1,000
- 10,000
Total Freight Flow (KTons)
- 1 - 100
- 101 - 500
- 501 - 1,000
- 1,001 - 2,500
- 2,501 - 5,000
- 5,001 - 10,000
- 10,001 - 12,500
Gasoline imports arrive at ports and are mainly distributed in the region close to the port, with relatively small amounts trucked to other regions.
Growth in Freight Flows to 2040

- FHWA’s FAF includes forecasts out to 2040
- High growth forecast in outbound flow from Florida
MODEL DATA AND ANALYSIS
Data Needs

- Freight Flows
  - By commodity group
  - By weight and value
  - By mode
  - By origin and destination

- Employment
  - By firm size
  - By industry

- Distribution Centers
  - By size
  - By type

- Economic Data
  - By producer/consumer industry

- Networks and Counts
  - By mode
  - By time period
  - By facility type

- Costs
  - By mode
  - By time period
  - By facility type
Traffic Count - Vehicular Classification

Count Stations

SIS Highway Network

I-95, Duval county

I-75, Sumter county

Count Stations

SIS Highway Network
Traffic Count - Vehicular Classification

Week day traffic, October 2010
SR9/I-95 South of I-295 (Duval County)
Week day traffic, October 2010
I-75- South of Florida's Turnpike (Sumter County)

- Total Vehicles
- Autos
- Service Trucks
- Freight Trucks
Two Sites

- **Site 729905 - SR9/I-95, 2 Mi South of I-295 S interchange (Duval County)**
  - Facility Type – Urban Interstate
  - Number of Lanes – 6
  - Area Type - Urban

- **Site 189920 – SR93/I-75, 3.5 Mi South of Florida’s Turnpike (Sumter County)**
  - Facility Type – Rural Interstate
  - Number of Lanes – 4
  - Area Type - Rural
Traffic Count - Vehicular Classification

Week day Traffic, October 2010
SR9/I-95 South of I-295 (Duval County)

Week day Traffic, October 2010
I-75- South of Florida’s Turnpike (Sumter County)
Truck Probe Data

• American Transportation Research Institute (ATRI)
  – Unique Access to Trucking Industry Data
    • Massive Truck GPS Database

• Customized Processing System/Methods for Producing Freight Performance Measures
  – Multiple Industry Data Sources
  – 7+ Years of Continuous Data
  – Billions of Unique Truck Positions Received & Processed Annually
  – Several Hundred Thousand Individual Trucks in the Population
ATRI’s Data Within Florida

• The ATRI database contains continuous data in the State of Florida from 2005 through the most recent month of 2012.

• At a minimum each record within the database contains the following information:
  – Unit Information: A unique identifier for the transponder/truck.
  – Geographic Information: The latitude and longitude data that identify where a truck position record was recorded.
  – Temporal Information: The time at which a truck position record was recorded, in the following format - MM-DD-YYYY HH:MM:SS.

* Additionally, approximately half of the records currently contain information such as spot speed and heading.
Applications of ATRI’s Data

• Performance Measurement
  – Average Highway Speeds and Travel Times
  – Reliability Measurements
  – Analysis of Chokepoints/Bottlenecks

• Travel Time/Route Planning
  – Addresses short term congestion issues
  – Real time and historic data
    • Allows for quick fixes

• Truck Flow Analysis

• Origin and Destination – Trip (length, duration), TOD & TOW
Time-of-day Profile of Trips Derived from 4 weeks of ATRI Data

Weekdays (all data, all trips)

Weekend (all data, all trips)

(one week in each of the following months: April, May, June, July 2010)
Time-of-day Profile of Trips Derived from 4 weeks of ATRI Data

Weekdays (all data, trips > 50 miles)

Weekend (all data, trips > 50 miles)

Note: The weekend data shows a hike (dip) after...
Trips Extracted from ATRI data within Florida: Trip Length Distribution

Mean = 29.83
Std. Dev. = 38.214
N = 52,526
Trips Extracted from ATRI data within & outside Florida:
Trip Length Distribution

Mean = 57.6
Std. Dev. = 75.408
N = 137,378

Length of trip (in miles)
Observing 1,000 Trucks Movements from Miami-Dade county
1,000 Trucks Movements from Miami-Dade county after 24 hrs
1,000 Trucks Movements from Miami-Dade county after 2 days
1,000 Trucks Movements from Miami-Dade county after 3 days
1,000 Trucks Movements from Miami-Dade county after 5 days
1,000 Trucks Movements from Miami-Dade county after 7 days
North of Ocala – based on 2,999 trips
South of Ocala – based on 3,329 trips
(difference due to trips with O/D in Ocala area)
Where did southbound trucks come from before passing Ocala on I-75 in 2010?
Where did trucks come from that used US 301 southbound to get to I-75 southbound in 2010?
Commodity Flow Data

• Transearch
  – Most up to date commodity flow data available
  – Available at county and sub county geographies
  – FDOT procuring Transearch data
  – Will be used in the model
    • Disaggregated down to TAZ level
    – Commodities classified as STCC
• PIERS (seaport) & Waybill (rail) data
• Shared with FDOT offices and Florida MPOs
FDOT Freight Model Use

- Support freight plan development
- Evaluate potential large scale infrastructure investments
- Provide inputs to more detailed project level evaluations
- Provide inputs to regional transportation planning
Thank you

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