Florida Freight Supply-chain Intermodal Model

Innovations in Travel Modeling 2014
April 29, 2014
Introduction

- **Support freight plan development**
  - Office of Freight Logistics and Passenger Operations
- **Evaluate potential large scale infrastructure investments**
  - FDOT Work Program
- **Provide inputs to more detailed project level evaluations**
  - Future Corridors
- **Provide inputs to regional transportation planning**
  - MPOs
  - District Freight Coordinators
  - Seaports
Acknowledgements and Outline

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• **Outline**
  – Model System Overview
  – Model Framework
  – Outputs from the Model
  – Next Steps
Model System Overview

Florida Statewide Model

- Passenger Model
- FreightSIM (Firms, Shipments, Modes)
- Conversion to modal trip tables
- National/Statewide Networks

Regional Model

- Regional Truck Touring Model
- Regional Networks

Regional Model
Model Integration: CUBE Application and R

R, an open source statistical programming platform, is used to run FreightSIM’s components.

R was used for the FHWA work that FreightSIM builds on.

Continuing work for CMAP is also in R; using a consistent platform retains the ability to transfer future improvements into the Florida model as work in other areas progresses.
Florida FreightSIM Model

**Inputs:**
- business locations
- transportation infrastructure
- commodity flows

**Firm Synthesis**

**Supplier Selection**

**Goods Demand**

**Distribution Channel**

**Shipment Size**

**Mode and Transfers**

**Network Assignment**

**Outputs:**
- freight demand
- vehicle flows

**Model:** simulates shipments and vehicle movements. Sensitive to policy, economic, and infrastructure changes.

**Vehicle volumes on the transportation network**

**Freight demand by commodity group**

**Individual business locations**
International Geography

Model uses the 8 international FAF zones (801-808) for International firm locations and commodity flows origins and destinations.
Domestic Geography

Combination of FAF zones and Counties
Allocation to TAZs in FL, AL, and GA
Networks and Network Skims

In addition to the Florida highway network, FreightSIM includes multimodal networks for rail, waterways, airports, and ports, and highways outside of Florida in the rest of the US, as well as distribution center locations.
FreightSIM Framework

- **Firm Synthesis**: Synthesizes a list of businesses in Florida, the rest of the US, and an international sample.

- **Supplier Selection**: Connects suppliers to buyers based on the commodities produced by the supplier and consumed by the buyer.

- **Goods Demand**: Distributes commodity flows amongst the paired suppliers and buyers.

- **Distribution Channel**: For each buyer/supplier pair, selects whether shipments are direct or involve intermediate handling (intermodal, distribution center).

- **Shipment Size**: For each buyer/supplier pair, converts an annual commodity flow to shipments by size and frequency.

- **Mode and Transfers**: Identifies the mode for each leg of the trip from supplier to buyer and the transfer locations.

- **Network Assignment**: Assign the trips to the multi-modal networks based on the mode(s) and transfer locations.
Sample Model Sequence

Mode: Air, Rail

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

Seller in FAF3 zone 486 325412 (Pharmaceutical preparation manufacturing)

Freight Destination
Buyer in Tampa, FL
420000 (Wholesale trade)
Gasoline imports arrive at ports and are mainly distributed in the region close to the port, with relatively small amounts trucked to other regions.
Firm Synthesis in Florida

- Synthesis in Florida is based on InfoGroup data
- Largest numbers of business establishment points are in the metropolitan counties

Establishments by County In Florida
Supplier Selection: Firms Pairs in Florida

The model build firms pairs, with significant detail within Florida itself to capture details of the within state movements

*Business connections between Metro Areas in Florida*

<table>
<thead>
<tr>
<th></th>
<th>Jacks.</th>
<th>Miami</th>
<th>Orlando</th>
<th>Tampa</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jacks.</td>
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<tr>
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</table>
Commodity Flows

• The model matches commodity flows by segment
• The within-Florida segment overall segment is the largest
• In terms of cross border flows, Florida is a net importer both domestically and internationally
Shipment Size Model

Example Commodity: Basic Chemicals

![Bar chart showing the percentage of tonnage for different shipment sizes. The chart compares observed data with the model predictions.]
Mode Choice Model

Calibration to the mode choice model resulted in a relatively good high level match to the mode choice observed from FAF (this will be a key item to revisit using the Transearch data)

Domestic freight

<table>
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<th>Mode</th>
<th>Model</th>
<th>FAF</th>
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<tbody>
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<td></td>
</tr>
<tr>
<td>Air</td>
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</table>
Model Outputs

FreightSIM is a simulation model and produces very detailed results – individual shipment records and a trip list for trucks. In addition, more aggregate results are produced

Types of output from FreightSIM:

• Shipment records – similar to the commodity flow survey or other shipment surveys, with details of origin, destination, commodity, mode, etc.
• Modal trip lists – shipment movements by mode, with truck based shipments also converted to truck trips
• Trip table list – aggregation of truck trips to zone to zone totals, ready for passing to CUBE, conversion to matrices, and assignment
• Summary outputs – tabular summaries output by each model component, primarily used so far for validation purposes so far, but could be used for scenario comparison
• Assignment results – loaded networks, and measures derived from loaded networks, e.g. VMT by functional class and area type
Next Steps for FreightSIM (rest of 2014)

RSG and FDOT are beginning work on final validation and calibration (in parallel with an update to the passenger model) and adding user functionality to the model.

**TASKS**

- Update Inputs Data
- Recalibrate Model Components
- Conduct Final Validation
- Conduct Sensitivity Tests
- Develop Forecast Year Inputs and Baseline Forecasts
- Add Reporting Capabilities
- Provide Training to FDOT Staff
Connections to Truck Touring Model

- **FreightSIM is designed to be integrated with regional truck touring model(s)**
  - FreightSIM develops shipment paths including transfer locations and modes, and intercity truck movements
  - FreightSIM outputs include a list of regional shipment pick-ups and deliveries that must be met in a given day: that can then be microsimulated in the regional model

- **Possible modes of operation**
  - Integrate complete statewide model with regional model and run models sequentially
  - Provide an extract from FreightSIM of regional shipment demand and run the regional model separately
• Implemented in Chicago region for CMAP as part of FHWA project
• Model links shipment deliveries and pick-ups together into truck tours
• Tours built for different truck types and for different patterns: single stop, single loops, several returns to warehouse
• Output is a trip schedule similar to that from an activity-based model of personal travel
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