Florida Freight Supply-chain Intermodal Model: FreightSIM

presented by
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Outline

• Model development: project overview
• Applications and policy sensitivity
• Model structure
• Preliminary validation
• Case study
• Next steps
Project Overview and Status

2012-2013: FreightSIM development
2014 Q2: Calibration and validation, in parallel with passenger model, 2040 forecasts, and integration
2014 Q3 and Q4: Sensitivity testing, interim forecasts, and reporting capabilities

Florida FreightSIM Model

 Inputs: business locations, transportation infrastructure, and commodity flows

 Firm Synthesis
 Supplier Selection
 Goods Demand
 Distribution Channel
 Shipment Size
 Mode and Transfers
 Network Assignment

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

 Outputs: freight demand and vehicle flows to support policy development and project evaluation

 individual business locations

 Freight demand by commodity group

 Vehicle volumes on the transportation network

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

 Outputs: freight demand and vehicle flows to support policy development and project evaluation
Model Applications

• **Infrastructure Investments in Strategic Intermodal System (SIS)**
  - Highway Capacity Projects – adding general purpose lanes
  - Managed Lane Projects – adding truck-only lanes or managed lanes prohibiting trucks
  - Rail Capacity projects – adding service or terminals/routes, improving access/egress to rail terminals
  - Airport capacity projects – adding terminals, improving access/egress to airports
  - Seaport capacity projects – adding terminals, improving access/egress to ports
  - Intermodal projects – adding terminals, improving access/egress to terminals

• **Congestion Management**
  - Corridor studies, alternative analysis
  - Congestion management studies
  - Accessibility to manufacturing and industrial centers
  - Operational studies, impact on speeds and travel times

Model Applications

• **Transportation Policies**
  - Statewide transportation plans
  - Tolls, user fees, or pricing studies, traffic and revenue studies
  - Congestion pricing studies
  - Value of time/Value of Reliability studies

• **Performance Metrics And Outreach**
  - Evaluate MAP21 metrics
  - Evaluate FTP metrics
  - Freight infrastructure and commodity movement brochures

• **Private Sector Decisions**
  - Impact studies of logistics decisions e.g. just-in-time delivery or night delivery
  - Adding or moving warehouse and distribution centers

• **Regional Projects**
  - Regional transportation plans
  - Regional corridor, congestion, pricing studies
Model Structure Overview

Florida Statewide Model

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

Regional Model

- Passenger Model
- Regional Truck Touring Model
- Regional Networks

Model Integration: CUBE Application
Domestic Geography

Combination of FAF zones and Counties

Allocation to TAZs in FL, AL, and GA
**Networks and Network Skims**

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.

**International Geography**

Model uses the 8 international FAF zones (801-808) for international firm locations and commodity flows origins and destinations.
Gasoline imports arrive at ports and are mainly distributed in the region close to the port, with relatively small amounts trucked to other regions.

**FreightSIM Structure**

- **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
  - For each buyer/supplier pair, selects whether shipments are direct or involve intermediate handling (intermodal, distribution center)
- **Distribution Channel**: For each buyer/supplier pair, converts an annual commodity flow to shipments by size and frequency
- **Shipment Size**: Identifies the mode for each leg of the trip from supplier to buyer and the transfer locations
- **Mode and Transfers**: Assign the trips to the multi-modal networks based on the mode(s) and transfer locations
- **Network Assignment**
Sample Model Sequence

Mode: Air, Rail

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
Case Study: Intercity Planning

One policy or investment evaluation that FreightSIM is designed to support is new highways in intercity corridors, for example Tampa to Jacksonville.

CONSIDERATIONS

• Which inputs changes are required to develop the scenario?
• What is the model sensitive to?
• What types of results does the model produce?

Networks and Network Skims

To evaluate system investments, network changes are required. Other inputs would be static. This might be just highway network changes in the case of highway investments.
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>FL Jacks.</th>
<th>FL Miami</th>
<th>FL Orlando</th>
<th>FL Tampa</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>FL Jacks.</td>
<td>25,593</td>
<td>24,018</td>
<td>40,156</td>
<td>12,864</td>
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<td>FL Miami</td>
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<td>12,625</td>
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<td>FL Orlando</td>
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<td>42,270</td>
<td>78,379</td>
<td>67,728</td>
<td>224,536</td>
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<tr>
<td>FL Tampa</td>
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<td>35,089</td>
<td>59,529</td>
<td>69,518</td>
<td>174,432</td>
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<tr>
<td>Grand Total</td>
<td>78,900</td>
<td>362,653</td>
<td>192,211</td>
<td>162,735</td>
<td>796,499</td>
</tr>
</tbody>
</table>

Commodity Flows: Between Metros

- Largest flows are within Metro Areas, followed by flows between proximate metros, e.g. Orlando and Tampa
- Corridor flows highlighted

Commodity flows between Metro Areas in Florida

<table>
<thead>
<tr>
<th></th>
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<th>FL Miami</th>
<th>FL Orlando</th>
<th>FL Tampa</th>
<th>Grand Total</th>
</tr>
</thead>
<tbody>
<tr>
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<td>6,142</td>
<td>1,617</td>
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<td>2,117</td>
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<td>FL Orlando</td>
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<td>FL Tampa</td>
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<td>3,308</td>
<td>10,961</td>
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<td>191,500</td>
<td>87,845</td>
<td>88,346</td>
<td>407,233</td>
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</table>
These are ATRI data showing the current truck paths southwest of Jacksonville

Next Steps: Validation and Forecasting

The purpose of the final validation and forecasting effort is to complete the development and testing of FreightSIM and prepare future year forecast model runs for use in planning activities.

**TASKS**
- Update and Review Data
- Final Calibration of Model Components
- Conduct Final Validation
- Conduct Sensitivity Tests
- Develop Forecasts
- Add Reporting Capabilities
- Provide Training to FDOT Staff
Integrated Modeling Framework

FreightSIM is designed to connect to a regional truck touring model, which is a sequence of models that takes shipments from their final transfer point to their final delivery point.

Sample Touring Model Sequence

- 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