Using the Field Calculator to Estimate International Freight on Corridors

The Case Study of Texas

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Agenda

• Overview
• Methodology
• Results
• Conclusions
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Overview

• Timely movement of freight vital to national economy

• To anticipate infrastructure needs, must have accurate estimates of freight volumes

• This research is a methodology to estimate international freight flows on corridors in Texas
Federal Highway Administration’s Freight Analysis Framework (FAF)

- FAF³ is the most comprehensive publicly available dataset of freight movements
- FAF³ estimates commodity movements over specific highways including data for 2007 and forecasts for 2040
- Accurate information identifying and anticipating capacity shortfalls and congestion nodes is important for improving strategic investment decisions

While FAF³ provides reasonable estimates for national and multi-state corridor analyses, FAF³ estimates do not have the sufficient level of disaggregation to support more local, regional, or state planning.
The objectives of the research are:

• Disaggregate national FAF³ data
• Estimate tons of international freight through statewide roadways and railways
• Estimate current and future freight demand

Texas is used as a case study
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Methodology to Estimate Statewide Freight Flows

1. **FAF^3 Data**
   - Transportation data

2. **Disaggregation Filters**
   - Truck and rail data

3. **State Inbound and Outbound Control Points**
   - Unique identifier for each control point

4. **Shortest path through control points**
   - Control points aggregation filters

5. **Assignment to the network using ArcGIS®**
   - Truck and rail data

6. **Foreign (International) Freight Flows**
   - Foreign trade data

Additional data sources:
- BTS Transborder freight truck and rail data
- U.S. Army Corps of Engineers maritime ports data
FAF³ Zone Structure—Commodity Flows
Survey Zones

Source: Developed by TTI with data from the FHWA’s Freight Analysis Framework (FAF³). 2011
Created Database: Queries performed to export only O-D pairs within Texas zones

- Data filters applied in Excel to separate O-D pairs by:
  - Trade type
    - (imports/exports)
  - Domestic mode
    - (truck/rail)
  - Tons per year
    - (2007 & 2040 tons)
Control points were located where freight moved in-and-out of the state

<table>
<thead>
<tr>
<th>Interstate Highways (Truck Routes)</th>
<th>ID</th>
<th>Surface Ports of Entry</th>
<th>ID</th>
<th>Maritime Ports</th>
<th>ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-10 at El Paso TX to Los Angeles</td>
<td>1</td>
<td>El Paso</td>
<td>9</td>
<td>Houston</td>
<td>17</td>
</tr>
<tr>
<td>I-10 at Orange TX to Louisiana</td>
<td>2</td>
<td>Presidio</td>
<td>10</td>
<td>Corpus Christi</td>
<td>18</td>
</tr>
<tr>
<td>I-20 at Waskom to Louisiana</td>
<td>3</td>
<td>Del Rio</td>
<td>11</td>
<td>Beaumont</td>
<td>19</td>
</tr>
<tr>
<td>I-30 at Texarkana TX to Arkansas</td>
<td>4</td>
<td>Eagle Pass</td>
<td>12</td>
<td>Texas City</td>
<td>20</td>
</tr>
<tr>
<td>US 75 at Denison TX to Oklahoma</td>
<td>5</td>
<td>Laredo</td>
<td>13</td>
<td>Galveston</td>
<td>21</td>
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<tr>
<td>I-35 at Gainesville TX to Oklahoma</td>
<td>6</td>
<td>Hidalgo</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-40 East of Amarillo</td>
<td>7</td>
<td>Brownsville</td>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>I-40 West of Amarillo</td>
<td>8</td>
<td>Progreso</td>
<td>16</td>
<td></td>
<td></td>
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</tbody>
</table>
A Simplified Network using only major routes and Control Points
Our Shortest Path and Data Summary Approaches:

- Used Google’s “Get Directions”
- Where multiple options of similar travel time, route assigned to roads with larger capacity
- O-D Pair assigned to an inbound-outbound Control Point
- Unique ID for Control Points added to O-D Pairs in Excel
- Pivot tables used to summarize Flows from and to Texas through Control Points
Used Google’s “Get Directions”
Database Preparation

Control Points are Assigned to the O-D Pairs
Pivot Tables to Aggregate Data based on Control Points

<table>
<thead>
<tr>
<th>Row Labels</th>
<th>Sum of TOTAL 2007</th>
<th>Sum of TOTAL 2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austin</td>
<td>20.6944</td>
<td>82.1495</td>
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<tr>
<td>Beaumont</td>
<td>343.082</td>
<td>981.1608</td>
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<tr>
<td>Corpus Christy</td>
<td>650.8318</td>
<td>892.8932</td>
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<tr>
<td>Dallas</td>
<td>123.8864</td>
<td>374.0062</td>
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<tr>
<td>El Paso</td>
<td>1267.4544</td>
<td>3563.4782</td>
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<td>Houston</td>
<td>801.6922</td>
<td>2128.0101</td>
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<tr>
<td>Laredo</td>
<td>780.7518</td>
<td>2114.8547</td>
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<tr>
<td>San Antonio</td>
<td>19.83</td>
<td>73.7824</td>
</tr>
<tr>
<td>Grand Total</td>
<td>4008.223</td>
<td>10210.3351</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Row Labels</th>
<th>Sum of TOTAL 2007</th>
<th>Sum of TOTAL 2040</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austin</td>
<td>1,986.57</td>
<td>7,328.57</td>
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<tr>
<td>Beaumont</td>
<td>1,319.64</td>
<td>3,907.43</td>
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<td>Corpus Christy</td>
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<td>3,182.01</td>
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<tr>
<td>Dallas</td>
<td>12,361.64</td>
<td>29,077.63</td>
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<tr>
<td>Houston</td>
<td>20,998.64</td>
<td>56,509.31</td>
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<tr>
<td>Laredo</td>
<td>107.39</td>
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<tr>
<td>San Antonio</td>
<td>2,762.07</td>
<td>10,548.68</td>
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<tr>
<td>Grand Total</td>
<td>40,912.51</td>
<td>110,909.35</td>
</tr>
</tbody>
</table>
Freight Flows Assignment using ArcGIS

• Results from Google were adjusted to show flows only on truck routes
• The field calculator was used to assign freight to the links in the networks by selecting the shortest route & incrementally adding the values to the attribute fields
Assignment with the Field Calculator
Saved Selections for Quick Work

- Select By Location dialog box
- Options for selecting features based on location and spatial methods
- Texas map with major cities and highways
- Selections for Austin, Laredo, San Antonio, Dallas, and Houston

[Image of select by location dialog box and Texas map]
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Results: 2007 Trucks
Results: 2007 Trucks
Results: 2040 Trucks
Results: 2040 Trucks

- I-10 Houston & Louisiana
- I-35 Laredo & San Antonio
- I-10 San Antonio & Houston
- I-35 San Antonio & Dallas
- I-45 Houston & Dallas
- I-37 Corpus Christi & San Antonio
- US 59 US 77 & Houston
- I-10 El Paso & San Antonio
- US 281 Texas Valley & I-37
- US 77 I-37 & Victoria
- I-30 Dallas & Arkansas
- I-35 Dallas & Oklahoma
- I-40 Amarillo & Texas Panhandle
- US 287 Dallas & Amarillo
- US 59 Houston & Arkansas
- US 77 Brownsville & I-37
- US 75 Dallas & Oklahoma
- I-20 El Paso & Dallas on to Louisiana
- I-27/US 87/I-10, Amarillo & North
- US 69 Beaumont & US 75
- US 83 Laredo & Texas Valley

2040 Tons (Imports and Exports, Millions)

- I-10 El Paso & San Antonio
- I-35 San Antonio & Dallas
- I-35 Laredo & San Antonio
- I-10 San Antonio & Houston
- I-45 Houston & Dallas
- I-10 Houston & Louisiana
- I-20 El Paso & Dallas on to Louisiana
- US 287 Dallas & Amarillo
- I-30 Dallas & Arkansas
- US 59 US 77 & Houston
- US 281 Texas Valley & I-37
- I-37 Corpus Christi & San Antonio
- US 59 Houston & Arkansas
- US 77 I-37 & Victoria
- US 77 Brownsville & I-37
- US 69 Beaumont & US 75
- I-27/US 87/I-10, Amarillo & North
- I-35 Dallas & Oklahoma
- I-40 Amarillo & Texas Panhandle
- US 75 Dallas & Oklahoma
- US 83 Laredo & Texas Valley

2040 Ton-Miles (Imports and Exports, Millions)
Results: 2007 Rail
Results: 2040 Rail
Results: 2040 Rail

- I-35 Laredo & San Antonio
- I-10 San Antonio & Houston
- I-35 San Antonio & Dallas
- I-10 Houston & Louisiana
- US 59 Houston & Arkansas
- I-35 Dallas & Oklahoma
- I-45 Houston & Dallas
- I-10 El Paso & San Antonio
- I-20 El Paso & Dallas to Louisiana
- US 77 I-37 & Victoria
- I-37 Corpus Christi & San Antonio
- US 59 US 77 & Houston
- I-30 Dallas & Arkansas
- US 75 Dallas & Oklahoma
- US 77 Brownsville & I-37
- I-40 Amarillo & TX Panhandle
- US 287 Dallas & Amarillo
- US 83 Laredo & Texas Valley
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• Results from the case study demonstrate encouraging findings about this methodology and the application of ArcGIS along with data from FAF³

• Further refinements needed to improve the estimation of freight flows include:
  – Assign flows using a bi-directional method
  – Account for various vehicle types and commodity payloads in developing truck-trip estimates and route choices
  – Conduct traffic counts at control points to improve calibration
  – Increase the granularity of the FAF³ “TX Remaining FAZ 489” as it includes several major freight generators
  – Develop future scenarios to study the potential impacts of projected demand (examined in this report) upon current and planned infrastructure (the supply side)
Questions?