ELTOD Applications in Planning Studies:
A Case-Study of a PD&E Project Application in South Florida

June 16, 2017
Meeting Overview

What is ELToD and Why Use it?

Toll Choice Key Concepts

ELToD Applications

SW 10th Street

ELToD Future Enhancements
What is ELToD?

- ELToD (Express Lanes Time of Day) Model is a traffic assignment model built to forecast traffic volume and toll rates for Express Lanes.

Four-Step Model / Activity-Based Model:

1. Trip Generation
2. Trip Distribution
3. Mode Choice
4. Traffic Assignment

Subarea Corridor
Trip Table & Network

ELToD Model

Express Lanes

General Purpose Lanes
Model Parameters
- Assignment input
- Volume-Delay input
  - Akcelik
  - BPR
- Choice Model Coefficients
  - VTTS input
  - Reliability input

Traffic & Network Input
- O-D Traffic Matrix
- Hourly Distribution
- Highway Network & Geometry
  - GP link data
  - EL link data
  - Other links data
  - Assumed tolls

Pricing Input
- Toll Pricing Policy
- Minimum/Maximum tolls
- Toll escalation

ELToD Equilibrium Assignment

Output Data by Hour
- Volumes, toll rates, revenues
- Speeds, travel times
- V/C ratios

Report Output

Optional Feedback to Travel Demand Model

Notes:
- Blue boxes are input from travel demand model
- Green boxes are other ELToD inputs
- Orange boxes are ELToD applications
Why ELToD? - Manager’s View

• Proven to Be Effective and Low-Cost
• Comprehensive Guidance on Applying to New Projects
• Open Source Allowing Total Transparency
• Ensures Consistency on Projects Evaluation
• Convenient for Peer Review and Quality Assurance
• Widely Used State of Practice Methodology
Why ELToD? - Modeler’s View

• Advanced Embedded Binary Toll Choice Model
• Dynamic Toll Rates
• One-Hour Trip Tables
• Cube \(\square\) Software Platform
• Easy to Customize
• Detailed Log Files
• Short Run Time
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Express Lane Choices in ELToD

- **Express Lane Share Calculated for Each O-D**
  - X% of drivers use express lanes from A to B
- **Binary Logit Model**
  - Binary choice between Express and GU lanes
  - Share changes gradually as benefits/costs change
  - Simple formula for share:
    \[
    Share = \frac{1}{1 + e^{-\Delta U}}
    \]
    where: \( \Delta U \) describes the benefits vs. costs
Binary Logit Toll Choice Model

**Express Lane Share =**

\[
1 \div \left(1 + e^{(-1*(\beta_{Constant} + \beta_{Time}*Time + \beta_{Toll}*Toll + \beta_{Reliability}*Reliability))}\right)
\]

<table>
<thead>
<tr>
<th>Estimated Coefficients</th>
<th>Model Generated Inputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\beta_{Time}) ((beta\ time))</td>
<td>Time</td>
</tr>
<tr>
<td>(\beta_{Toll}) ((beta\ toll))</td>
<td>Toll</td>
</tr>
<tr>
<td>(\beta_{Reliability}) ((beta\ reliability))</td>
<td>Reliability</td>
</tr>
<tr>
<td>(\beta_{Constant}) ((beta\ constant))</td>
<td>(None)</td>
</tr>
</tbody>
</table>
Choice Model Advantages

- **Generalized Cost Method**
  - 0% or 100% of trips from A to B use tolled links
  - Generally considers only toll and time

- **Toll Choice Model**
  - Anywhere from 0% to 100% of trips from A to B use tolled links
  - Considers driver heterogeneity
  - Can capture unobserved factors
  - More realistic toll sensitivity
Choice Model vs. Generalized Cost Method

Toll Share vs. Utility

Utility ($\Delta U$)

0% 25% 50% 75% 100%

-4 -2 0 2 4

Toll Choice Model
Gen Cost Approach
ELToD vs. Other Choice Models

- Other Choice Models May Consider Only Time and Toll
- ELToD Considers Reliability and Discomfort
- Scenario testing is fast (runtime is about 10 minutes)
Meeting Overview

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ELToD Future Enhancements
ELToD Applications

• Traffic and Revenue Studies
  • Express Lane Traffic
  • Projected Toll Rates
  • Sensitivity Testing – Toll Policy, Value-of-Time

• Planning and PD&E Studies
  • Ingress/Egress Location Analysis
  • Express lane project traffic for operational analysis
Model Forecast Process

SERPM (period model)
- Base & Future AADT/Period Design Traffic
- Project Sub-Area

Cube Analyst (Matrix Estimation)

Period Trip Matrices
- Hourly Directional Distribution of traffic
- Other EToD Model required input

ELToD Model
- EL Toll Rate
- EL & GUL Traffic
- Speed & V/C Ratio
- Revenue Estimate
- Corridor DDHV based on EL/GUL split

Bluetooth OD Check/Adjustment
Meeting Overview

1. What is ELToD and Why Use it?
2. Toll Choice Key Concepts
3. ELToD Applications
4. SW 10th Street
5. ELToD Future Enhancements
Project Overview

- Possible EL Direct Connects
- No Turnpike Ramps to/from the East
- Major Intersections
- Express Lanes
SW 10th Street Forecast Alternatives

No-Build
No Interchange (NBNII)

No-Build (NB)

Build
2040 SERPM Impacts

Build SW 10th minus
No-Build No-Interchange

Traffic Increase
Traffic Decrease
2040 AADTs

No-Build

No-Interchange

Build
ELToD Traffic Profile Output

Volume (vph)

Hour

SW10th St. between Powerline Road and Military Trail

K Factor (EL AM) = 13.7%

K Factor (GUL AM) = 7.8%
Sawgrass Expwy/Turnpike Options

**Option 1**  
No direct connect  
No braided ramps

**Option 2**  
Braided ramps

**Option 3**  
Direct connect

**Option 4**  
Direct connect +  
Braided ramps
Sawgrass Expwy/Turnpike DDHVs

<table>
<thead>
<tr>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
<th>Option 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,670</td>
<td>1,670</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>7,000</td>
<td>7,000</td>
<td>950</td>
<td>950</td>
</tr>
<tr>
<td>1,000</td>
<td>6,200</td>
<td>460</td>
<td>280</td>
</tr>
<tr>
<td>720</td>
<td>720</td>
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<td></td>
</tr>
</tbody>
</table>
Sawgrass Expy/Turnpike – Option 1

2040 Build HCS Analysis

Segment LOS F
Segment LOS F
Weaving LOS F
Weaving LOS F
Sawgrass Expwy/Turnpike – Option 2

2040 Build HCS Analysis

- LOS A
- LOS B
- LOS C
- LOS D
- LOS E
- LOS F

- Segment LOS F
- Merge LOS F
- Weaving LOS F
- Segment LOS F

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Sawgrass Expwy/Turnpike – Option 3

2040 Build HCS Analysis
Sawgrass Expwy/Turnpike – Option 4

2040 Build HCS Analysis

Segment LOS E
Segment LOS D
Merge LOS C
LOS A
LOS B
LOS C
LOS D
LOS E
LOS F
## Option Evaluation Summary

<table>
<thead>
<tr>
<th>Option 1</th>
<th>Option 2</th>
<th>Option 3</th>
<th>Option 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>• SB Turnpike Mainline North of Sawgrass Expressway – LOS F.</td>
<td>• SB Turnpike Mainline North of Sawgrass Expressway – LOS F.</td>
<td>• SB Turnpike Mainline North of Sawgrass Expressway – LOS E.</td>
<td>• SB Turnpike Mainline North of Sawgrass Expressway – LOS E.</td>
</tr>
<tr>
<td>• NB Turnpike Mainline North of Sawgrass Expressway – LOS F.</td>
<td>• NB Turnpike Mainline North of Sawgrass Expressway – LOS F.</td>
<td>• NB Turnpike Mainline North of Sawgrass Expressway – LOS D.</td>
<td>• NB Turnpike Mainline North of Sawgrass Expressway – LOS D.</td>
</tr>
<tr>
<td>• EB Sawgrass Expressway C-D Road to Turnpike – LOS F.</td>
<td>• EB Sawgrass Expressway C-D Road to Turnpike – LOS F.</td>
<td>• EB Sawgrass Expressway C-D Road to Turnpike – LOS C.</td>
<td>• EB Sawgrass Expressway C-D Road to Turnpike – LOS C.</td>
</tr>
<tr>
<td>• EB Sawgrass Expressway Mainline – LOS F.</td>
<td>• EB Express Lane Egress braided ramp to C-D – LOS E.</td>
<td>• Fewer destinations</td>
<td>• Additional destination</td>
</tr>
</tbody>
</table>

**Option 1**
- Eliminate From Further Consideration

**Option 2**
- Eliminate From Further Consideration

**Option 3**
- Proceed Further in PD&E Process

**Option 4**
- Eliminate From Further Consideration

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**FDOT**

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Benefits of ELToD model application for PD&E/Planning

- Complete multiple alternative scenarios in a short time
- More direct calculations of EL and GP design hour volumes than traditional approaches
- Minimizes post processing efforts
- Consistent assignment in controlled environment
- Design team can eliminate undesirable alternatives through comparison
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ELToD Future Enhancements
ELToD v3.0 Goals

1. Model a network of express lanes
   - Multiple express lane projects
   - Include regular toll roads and arterials
2. Improve multiple segment modeling
3. Maintain reasonable run times
4. Include Dynamic Traffic Assignment
5. Improve Toll Rate Calculations
Route Choices

1. Origin-destination pairs are not strictly required to use the express or general purpose lanes.
2. Arterial-only paths are possible.
### Static vs. Dynamic Assignment

- **What is Dynamic Traffic Assignment (DTA)?**
- **What are the advantages of DTA?**

<table>
<thead>
<tr>
<th>Static (ELToD 2.0)</th>
<th>Dynamic (ELToD 3.0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver decision before trip.</td>
<td>Driver decision during trip.</td>
</tr>
<tr>
<td>Smallest Time Interval = 1 hour.</td>
<td>Smaller Time Interval = 15 minutes.</td>
</tr>
<tr>
<td>Not designed for modeling static toll roads and express lanes together.</td>
<td>Designed for modeling both static toll roads and express lanes.</td>
</tr>
</tbody>
</table>
South Florida Network

Base Year: 2010 Network

Future Year: 2040 Network

- I-95 Phase 1
- Turnpike Mainline
- I-595 Express
- HEFT
- Sawgrass
- I-75 Express
- 826 Palmetto Express
Thanks!

Questions?