Travel Forecasting for Corridor Alternatives Analysis

Purple Line Functional Master Plan Advisory Group
January 22, 2008
Purpose of Travel Forecasting

• **Problem Definition**
  – Market Analysis
    • Current
    • Future

• **Alternatives Definition and Refinement**

• **Analysis of Alternatives**
  – Transportation Impacts
  – Emissions and Other Environmental Impacts
  – Equity Impacts

• **Financial Analysis**

• **FTA New Starts Criteria Development**
Travel Forecasting

• What it is

• What it isn’t
What is a Travel Forecasting Model?

- **Demographics**
  - Population
    - Location in Traffic Analysis Zones (TAZs)
    - Socio-economic characteristics
  - Employment in Traffic Analysis Zones (TAZs)
    - Location
    - Employment Type

- **Transportation Networks**
  - Roadway & Transit
    - Facility Type
    - Volumes
    - Performance

- **Model Algorithms**
  - Trip: how many; where; by what means and route; and when
How is the Model Created?

• Information on Travel Behavior
  – Home Interview Surveys
  – Place of Employment Surveys

• Information on Travel Patterns
  – On Board Surveys
  – Vehicle Intercept Surveys

• Information on Transportation Systems Performance
  – Travel/Vehicle Counts
  – Speed Measurement
  – Vehicle Occupancy
How is the Model Created?

• Model Calibration
  – Trip Generation – How many trips
  – Trip Distribution – Where are they going
  – Mode Split – By what means
  – Path Assignment – By what route
  – Temporal Distribution – At what time of day

• Validation
Forecasting the Future

- **Demographic Forecasts**
  - Source: Regional Land Use and Population/Employment Forecasts from Metropolitan Planning Organization
  - For Purple Line Corridor
    - Metropolitan Washington Council of Governments (MWCOG)
    - Maryland National Capital Park & Planning Commission (M-NCPPC)
    - Local Jurisdictions

- **Transportation Networks**
  - State Transportation Capital Program
  - County Transportation Capital Program
  - Committed and Funded Projects

- **For Alternatives Analysis and NEPA**
  - Currently using 2030 Planning Horizon Year
Forecasting Effects of Alternative

• Define Transit Alternatives
  – Travel Times/Speeds
  – Service Frequencies
  – Fares

• Convert into Network Changes
  – Nodes (Stations)
    • Where travelers enter/leave transit system
    • Means of access and egress
    • TAZ access links & times
    • Wait Times
  – Links (Alignments)
    • How people travel between stations
    • How long does it take – travel times
    • Operating Speeds
    • Dwell times
    • Delay times
Determining Link Speeds

- **Exclusive Operating Conditions**
  - Transit Mode Characteristics
  - Acceleration/Maximum Speed/Deceleration

- **Mixed/Shared Operating Conditions**
  - Transit is affected by prevailing traffic conditions & legal speed limits
  - Synchro -- simulations of current/future traffic conditions
    - Traffic Surveys
    - Traffic Growth
  - Vissum – simulations providing transit/traffic effects
Purple Line Alternatives

• Transportation System Management (TSM)
• Bus Rapid Transit (BRT)
  – Low/Medium/High Investment Alternatives
• Light Rail Transit (LRT)
  – Low/Medium/High Investment Alternatives
• Degrees of Exclusive (High Capital Investment) versus Mixed (Lower Capital Investment) Operating Conditions
## What We Get Out of the Model - Times

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<thead>
<tr>
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<tbody>
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<td>SSTC UM campus</td>
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<td>37</td>
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<td>30</td>
<td>25</td>
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<tr>
<td>SSTC Bethesda</td>
<td>14*</td>
<td>19</td>
<td>21**</td>
<td>32</td>
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<td>17</td>
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<td>SSTC Takoma-Langley</td>
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<td>Takoma-Langley College Park Metro</td>
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<td>16</td>
<td>13</td>
<td>17</td>
<td>15</td>
<td>12</td>
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<tr>
<td>Bethesda New Carrollton</td>
<td>58***</td>
<td>80 (bus)</td>
<td>55 (metro)</td>
<td>88</td>
<td>108</td>
<td>73</td>
<td>64</td>
<td>57</td>
<td>59</td>
<td>52</td>
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</table>

Car travel times for 2007 were based on actual measured drive times. The times for east and westbound, and morning and evening peak hours were averaged together to come up with one number. The 2007 transit times are from published schedules. However many of these routes often run far longer than the published times because of the congestion on the roads.

* Via East-West Highway
** Increase in 2030 estimated based on percent increase along other corridors
*** Route represents East-West Highway from Bethesda to SS, Wayne Avenue, Piney Branch, MD 193, Campus Drive, Paint Branch Pkwy, River Rd, Kenilworth, East-West Highway, Veterans Pkwy and Ellin Rd. (Total distance of ~16 miles).
Ridership

- Based on Future Year 2030 Population & Employment Forecasts
- “Travel times” are between New Carrollton and Bethesda
- “Boardings” are the number of riders who would use the Purple Line on a typical weekday
- Ridership (boardings) estimates do not yet include expected trips by University of Maryland students and special event visitors. These forecasts are under development.

Capital Costs

- Estimates in 2007 Dollars; subject to inflation to the time when a project is implemented
- Includes costs to design, manage and construct facilities, acquire right-of-way, and purchase equipment including transit vehicles

Operating and Maintenance (O&M) Costs

- Estimates in 2007 Dollars; subject to inflation to the time when a project starts operating
- Includes costs to operate transit services and maintain the vehicles, facilities, and equipment
- Accounts for adjustments to local bus services
## Purple Line Alternatives Preliminary Travel Demand Forecasts & Cost Estimates

<table>
<thead>
<tr>
<th>Alternative</th>
<th>End to End Peak Period Travel Time (minutes)</th>
<th>Ridership (Daily Boardings)</th>
<th>Capital Costs (Millions -2007$)</th>
<th>Operating &amp; Maintenance Costs (Millions -2007$)</th>
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</thead>
<tbody>
<tr>
<td>Alternative 2: TSM</td>
<td>108</td>
<td>N/A</td>
<td>$105</td>
<td>$8</td>
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<tr>
<td>BRT</td>
<td></td>
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<tr>
<td>Alternative 3: Low Investment BRT</td>
<td>73</td>
<td>29,000 - 35000</td>
<td>$450 - 520</td>
<td>$9</td>
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<td>Alternative 4: Medium Investment BRT</td>
<td>64</td>
<td>38,000 - 41000</td>
<td>$650 - 750</td>
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<td>Alternative 5: High Investment BRT</td>
<td>57</td>
<td>42,000 - 45000</td>
<td>$1,170 - 1,340</td>
<td>$8</td>
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<tr>
<td>LRT</td>
<td></td>
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<tr>
<td>Alternative 6: Low Investment LRT</td>
<td>59</td>
<td>38,000 - 41,000</td>
<td>$1,160 - 1,330</td>
<td>$20</td>
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<tr>
<td>Alternative 7: Medium Investment LRT</td>
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<td>42,000 - 45,000</td>
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<td>$18</td>
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<tr>
<td>Alternative 8: High Investment LRT</td>
<td>46</td>
<td>44,000 - 47,000</td>
<td>$1,580 - 1,790</td>
<td>$17</td>
</tr>
</tbody>
</table>

Preliminary estimates; subject to change based on possible refinements to the alternatives.

The Ridership (Daily Boardings) estimates do not yet include expected trips by University of Maryland students and special event visitors. These forecast are under development.
What We Get Out of the Model

- For Various Purposes and Peak/Non-Peak
  - Home Based Work
  - Home Based Other
  - Non-Home Based
- Total Transit Trips
- New Transit Trips (Diverted from Autos)
- Station Boardings / Alightings
- Stations Mode of Access and Egress
- Farebox Revenue
- Transportation System User Benefits (TSUB)
- Transit Route and Highway Volumes
Transportation System User Benefits for Travel Produced in Each Zone
What is Not In Model Yet?

- All University of Maryland Student Trips
- Special Generators Trips
What FTA Is Looking For?

• A “Good” Model
  – Developed from Survey Data
  – Industry Standard Structure & Calibration/Validation
  – Based Metropolitan Planning Organization Regional Model
    • Refined for Corridor Level Transit Analysis

• Market Analysis
  – Mobility Needs Definition
  – Various Travel Markets

• Alternatives that Respond
  – Mobility Needs
  – Corridor Conditions & Features

• Explainable Forecasts
  – Change in Travel Patterns
  – Change in Transit Riders

• Explainable Measures of Effects
  – Transportation System User Benefits
  – Distribution of Benefits/Effects
Why It Is Important

- Support Development and Evaluation of Alternatives
- Support Explanation of Effects of Alternatives
- Support to Decision Making
- Input to Funding Request
  - FTA New Start Program
FTA New Starts Program
Key Historical Principles of the New Starts Program

- Discretionary transit capital program
  - Federal highway funding is a programmatic allocation
- Legal requirement of alternatives analysis
- Multiple measures for project justification
- Local financial commitment
Program Goals

Fund meritorious projects

- Develop reliable information on project benefits and costs
- Ensure projects treated equitably nationally
- Facilitate communication between FTA, transit industry and Congress
New Starts Evaluation and Oversight

• Among most rigorous in government
• Starts with Request to Initiate PE
• Increasingly credible and important to Congress and local communities
• Program Management Oversight recommended by GAO and OIG
Overall Project Ratings

• “Highly Recommended”, “Recommended”, or “Not Recommended” Rating

• Applied for FTA approvals of Preliminary Engineering, Final Design, and FFGA’s

• Updated for the Annual Report on New Starts
  – Administration’s budget recommendations for congressional appropriations
New Starts Project Development Process

Systems Planning

Alternatives Analysis

Locally Preferred Alternative

FTA Decision On Entry into PE

Preliminary Engineering

FTA Decision On Entry into Final Design

Final Design

Construction

Project Management Oversight

We are Here

Major Development Stage

FTA Decision Point

Full Funding Grant Agreement

Full Funding Grant Agreement
Previous New Starts Evaluation and Rating Framework

Summary Rating

Project Justification Rating
- Mobility Improvements
- Environmental Benefits
- Operating Efficiencies
  - Cost Effectiveness
  - Land Use
    - Capital Cost
    - O&M Cost
    - User Benefits

Financial Rating
- Non-Section 5309 Share
- Capital Finances
- Operating Finances

Other Factors

Minimum Project Development Requirements:
- Metropolitan Planning and Programming Requirements
- Project Management Technical Capability
- NEPA Approvals
- Other Considerations
Proposed New Starts Evaluation and Rating Framework

Summary Rating

Project Justification Rating

Other Factors

Cost Effectiveness

Land Use

Economic Development

Forecast Reliability

Financial Rating

Non-Section 5309 Share

Capital Finances

Operating Finances

New Criteria
New Starts Ratings

• HIGHLY RECOMMENDED
  – Project rated at least "medium-high" for both finance and project justification

• RECOMMENDED
  – Project rated at least "medium" for both finance and project justification

• NOT RECOMMENDED
  – Project not rated at least "medium" for both finance and project justification
Key Issues

• Ridership Forecasts
  – Quality of regional model and input data
  – Alternatives definition including baseline
  – Transportation System Users Benefit (TSUB)
    • SUMMIT Program

• Capital Costs
  – Risk analysis
  – Reporting format

• Funding levels and commitment
Cost Effectiveness Measure

Cost per unit of benefit:

- Annualized incremental capital (federal and local) plus annual operating cost
- Old benefit measure: new transit trips
- New benefit measure: hours of user benefits
Transportation System User Benefits

- Mobility benefits for all travelers
  - Existing transit users
  - New transit users
- Expressed in terms of travel time savings – hours
- Composed principally of travel time savings
Purpose of the Baseline Alternative

- Basis for comparing New Starts criteria
- Allows for isolation of New Starts project’s benefits and costs
- Insures consistency nationally
FTA’S Purpose for Baseline

Project

Future
Baseline

Future
No Build

Total Project Benefits

User Benefit Difference

Benefits of
Guideway
Investment

Benefits of
Service
Improvements
FTA Cost Effectiveness Formula

\[ \frac{\Delta \text{Annualized Costs}}{\Delta \text{User Benefits}} \]

Annualized Costs = Equivalent Annualized Capital Cost + Annual Operating Cost

\( \Delta \) = Difference between Build Project and Baseline Alternative
FTA Cost Effectiveness Formula

\[
C/E = \frac{\Delta \text{Annualized Costs}}{\Delta \text{User Benefits}}
\]

As User Benefits Goes Down, C/E Goes Up

Annualized Costs = Equivalent Annualized Capital Cost + Annual Operating Cost

\(\Delta\) = Difference between Build Project and Baseline Alternative
FTA Cost Effectiveness Formula

\[ \frac{\triangle \text{Annualized Costs}}{\triangle \text{User Benefits}} = \frac{\triangle \text{Annualized Costs}}{\triangle \text{User Benefits}} \]

As Cost Goes Up, C/E Goes Up

Annualized Costs = Equivalent Annualized Capital Cost + Annual Operating Cost

\[ \triangle = \text{Difference between Build Project and Baseline Alternative} \]
Cost-Effectiveness

• Rating Values:
  – Low > $30.00 per hour
  – Medium-low $24.00 - $30.00 per hour
  – Medium $15.50 - $24.00 per hour
  – Medium-high $12.00 - $15.50 per hour
  – High < $12.00 per hour
Local Financial Commitment

Performance Measures:

– Proposed Local Share of Project Costs
– Stability and Reliability of Capital Financing
– Stability and Reliability of Operating Funds