Transit and TOD Planning with Direct Ridership Models

Vehicle Trip Reduction at Mixed-Use Sites

Rail~Volution 2008

Jerry Walters
Fehr & Peers
Transit and TOD Planning with Direct Ridership Models

Vehicle Trip Reduction at Mixed-Use Sites
Conventional 4-Step Models

Regional Population, Employment

Trip Generation

Trip Distribution

Mode Choice

Route Assignment

Regional Transportation Networks
Confidence:

Auto  +/-  2%
Transit  +/-  40%

93  95  97  100
FTA Report on Conventional Forecasting

• “... ridership projections for New Starts are often highly inaccurate in terms of both total ridership and the characteristics of the markets that are actually served”

Particular problems:

• rely on high transfer rates by choice riders
• very broad service areas
• unrealistic modes of access
Direct Ridership Modeling

• Independent estimator for validating conventional models

• Efficient tool for project screening

• Detail sufficient for station and TOD planning, and ridership development programs
Direct Ridership Models

Comparative Existing Transit Lines and Stations
- Land Use, Accessibility
- Service Level, Connectivity
- Ridership, Mode of Access

Statistical Relationships

Planned Transit Lines and Stations
- Land Use, Accessibility
- Service Level, Connectivity
- Ridership, Mode of Access
Factors that Influence Ridership and Access Mode

- Land Use
- Catchment Area
- Technology
- Bike Access
- Connecting Transit

Focus on station amenities:
- Service levels
- Parking availability
- Surrounding land uses
- Connecting transit
- Station area demographics
Factors (continued)

- Use Mix
- Walkability
- Parking
- Service Level
Model 1- Relationship Between PM Peak Boardings and 1/2 mile Non-Retail Employment, 1/2 mile Population, and Downtown SF Indicator, R²=.985
## Direct Ridership Models and R-squares

<table>
<thead>
<tr>
<th>Model</th>
<th>R-square</th>
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<tbody>
<tr>
<td>PM Peak Boardings</td>
<td>0.98</td>
</tr>
<tr>
<td>Off-Peak Boardings</td>
<td>0.92</td>
</tr>
<tr>
<td>AM Peak Boardings</td>
<td>0.88</td>
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<tr>
<td>Daily Ridership</td>
<td>0.98</td>
</tr>
<tr>
<td>AM Walk/Bike Access Share</td>
<td>0.81</td>
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<tr>
<td>Daily Walk/Bike Access Share</td>
<td>0.99</td>
</tr>
<tr>
<td>AM Auto Access Share</td>
<td>0.93</td>
</tr>
<tr>
<td>AM Park-Ride Access Share</td>
<td>0.95</td>
</tr>
<tr>
<td>AM Parking Occupancy by Time of Day</td>
<td>0.99</td>
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</tbody>
</table>
Reasonableness tests

- Comparable existing stations
- Comparable regional rail corridors
- Trends in a connected rail corridor
- Mode shares in comparable rail-served O/D’s
- Relationship between market area growth and ridership growth
- Ridership on comparable existing US rail systems
- Forecasts produced by official models
Other Station-Specific DRM

- Caltrain Commuter Rail
- Sacramento LRT
- Salt Lake City LRT
Access BART and A-Line Study Objectives

Forecast effects of changes in station-area land use and intermodal access efficiency on:

- BART ridership and productivity
- BART access mode shares
Expected Return on Investment: Daily Boardings

- Station parking: $0.99
- Off-site parking: $0.69
- Peak buses: $60
- Bike parking: $2.5
- TOD population: $0.14
- Catchment population: $0.004
Trade-Off Analysis of Parking versus TOD
San Leandro BART
Effects of Walkshed
<table>
<thead>
<tr>
<th>Walkability Rating</th>
<th>Station Footprint</th>
<th>Pedestrian Network</th>
<th>Walkshed Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Underground</td>
<td>Urban Grid</td>
<td>395</td>
</tr>
<tr>
<td>2</td>
<td>&lt; 10 acres</td>
<td>Urban Grid</td>
<td>370</td>
</tr>
<tr>
<td>3</td>
<td>&lt; 10 acres</td>
<td>Suburban Grid</td>
<td>340</td>
</tr>
<tr>
<td>4</td>
<td>10 - 20 acres</td>
<td>Suburban Grid</td>
<td>295</td>
</tr>
<tr>
<td>5</td>
<td>10 - 20 acres</td>
<td>Suburban Spread</td>
<td>265</td>
</tr>
<tr>
<td>6</td>
<td>&gt; 20 acres</td>
<td>Suburban Spread</td>
<td>215</td>
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Potential Uses of DRM

- Screening corridors, station locations, technologies
- Ridership development policies
- Station planning sessions
- Supplement conventional model for direct assessment of trade-offs between station-area land use and access priorities
Transit and TOD Planning with Direct Ridership Models

Vehicle Trip Reduction at Mixed-Use Sites
7D factors that influence trip generation:

- **Density** dwellings, jobs per acre
- **Diversity** mix of housing, jobs, retail
- **Design** connectivity, walkability
- **Destinations** regional accessibility
- **Distance to Transit** rail, bus proximity
- **Demographics** household size, income
- **Development Scale** critical mass
Nationwide Survey of MXD Trips

- 240 MXD’s
- 36,000 Trips
- Boston, Atlanta, Houston, Sacramento, Portland, Seattle
Gateway Oaks, Sacramento
River Place, Portland
Factors correlated with reduced trip generation

**Internal and Walk**
- MXD Population and Employment (scale)
- Population and Employment Density
- Jobs / Housing Diversity - index of jobs/housing vs ideal
- Building Mix - balance of commercial, office, and public
- Intersections per square mile
- Jobs within 1 mile

**Transit**
- Rail station within MXD
- Transit stops per square mile
- Employment within a 30 minutes by transit
15 Nationwide Validation Sites

- 6 Florida sites from ITE *Trip Generation Handbook*
- 6 California sites
- Prelim data from 3 sites in Texas and Georgia from NCHRP 8-51
Estimated vs. Observed MXD External Trips

Preliminary

(Pseudo R² = 0.93)
### Comparison of MXD Model to ITE Methods

#### Errors in Estimates

<table>
<thead>
<tr>
<th></th>
<th>ITE Raw</th>
<th>ITE With Internal Capture</th>
<th>MXD Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External Vehicle Trips</strong></td>
<td>44%</td>
<td>31%</td>
<td>0%</td>
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<tr>
<td><strong>Internalization Percent</strong></td>
<td>-27%</td>
<td>-18%</td>
<td>1%</td>
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</table>
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