Parking vs. TOD
A Transit Provider’s Perspective

Rail~volution 2006

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Fehr & Peers Associates
Transit Provider Objectives
(Access BART)

• Higher ridership productivity
  ➢ Off-peak
  ➢ Reverse peak

• Lower auto-access mode shares
Factual Basis: Rail Station Analytics

Statistical analysis of the relative effects on ridership productivity and access shares, of:

- Station-area parking
- TOD housing
- TOD retail
- TOD employment
- Feeder transit
Conventional 4-Step Models

Regional Population, Employment

Trip Generation

Trip Distribution

Mode Choice

Route Assignment

Regional Transportation Networks
Conventional Ridership Modeling

Screen for Travelers
Conventional Ridership Modeling

Screen for Transit Travelers
Conventional Ridership Modeling

Screen for TT by Mode and Station
Conventional Ridership Modeling

Screen for Access Mode to Station
Conventional Ridership Modeling
Law of Small Numbers

Confidence:
Auto  $\pm 2\%$
Transit  $\pm 40\%$

93  95  97  100
“… 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.”
Direct Ridership Models

Comparable Existing Transit Lines and Stations

Land Use, Accessibility
Service Level, Connectivity

Ridership, Mode of Access

Statistical Relationships

Land Use, Accessibility
Service Level, Connectivity

Ridership, Mode of Access

Planned Transit Lines and Stations
Factors that Influence Ridership & Access Mode

- Land Use
- Catchment Area
- Technology
- Connecting Transit
- Bike Access
Factors (continued)

Use Mix

Parking

Walkability

Service Level
Comparison of Aggregate an Disaggregate DRM

<table>
<thead>
<tr>
<th>FTA Aggregate Model</th>
<th>Disaggregate DRM adds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total System Aggregation</td>
<td>Corridors and Stations</td>
</tr>
<tr>
<td>LRT and Commuter Rail</td>
<td>Heavy Rail</td>
</tr>
<tr>
<td>Daily Ridership</td>
<td>Peak, Off-Peak, Productivity</td>
</tr>
<tr>
<td>Work and Other Trips</td>
<td>School Trips</td>
</tr>
<tr>
<td>Auto or Non-Auto Access</td>
<td>Park-Ride, Kiss-Ride, Feeder Transit, Walk/Bike</td>
</tr>
</tbody>
</table>
Comparison of FTA Aggregate Model vs DRM

<table>
<thead>
<tr>
<th>FTA Aggregate Model</th>
<th>DRM adds</th>
</tr>
</thead>
<tbody>
<tr>
<td>No consideration of access planning</td>
<td>Considers: On-Site Parking, Neighborhood Parking, Feeder Bus, Bike/Ped</td>
</tr>
<tr>
<td>Not responsive to TOD</td>
<td>Responds to:</td>
</tr>
<tr>
<td></td>
<td>– Housing (Market Rate, BMR, Unit Size)</td>
</tr>
<tr>
<td></td>
<td>– Retail/Non-Retail Employment</td>
</tr>
<tr>
<td></td>
<td>– Walkshed Permeability</td>
</tr>
</tbody>
</table>
## Direct Ridership Models and R-squares

<table>
<thead>
<tr>
<th>Model</th>
<th>R-square</th>
</tr>
</thead>
<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>
</tr>
<tr>
<td>Daily Ridership</td>
<td>0.98</td>
</tr>
<tr>
<td>AM Walk/Bike Access Share</td>
<td>0.81</td>
</tr>
<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>
</tr>
</tbody>
</table>
Model 4 - Relationship Between Daily Boardings and the sum of variables in Models 1-3, Unadjusted R2=0.978
Model 8 - Relationship Between AM Peak % of Auto Access that are Park & Ride and Zero Parking Indicator, Catchment Population, and Station+Neighborhood Parking spaces, R²=.949
Other Station-Specific DRM

- Caltrain Commuter Rail
- Sacramento LRT
- Salt Lake City LRT
Expected Return on Investment: Daily Boardings

- Station parking x .99
- Off-site parking x .69
- Retail employment x .50
- Other employment x .09
- Peak buses x 60
- Bike parking x 2.5
- TOD population x .14
- Catchment pop. x .004
Daily Walk/Bike Access Share

- TOD Population x 0.12
- TOD Employment x 0.14
- Bikes x -9.7
- Bike Parking x 4.0
Findings / Rules of Thumb

- Trade-Offs between parking and TOD
- Effects of land-use mix
- Effects of housing type
- Effects of self-selection
- Differences among LRT, CRT, RRT
- Effects of Walkshed
Trade-Off Analysis of Parking versus TOD
San Leandro BART

![Graph showing predicted AM peak boardings versus acres, dwelling units added, and parking spaces reduced.]
Change in Daily Ridership Per 100 Parking Spaces Lost - Residential TOD, 1 New Bus

<table>
<thead>
<tr>
<th>New Residential DU Per Acre</th>
<th>Ridership Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>-20</td>
</tr>
<tr>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>60</td>
<td>20</td>
</tr>
<tr>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>100</td>
<td>60</td>
</tr>
</tbody>
</table>

- No Parking Replacement
- 80% Parking Replacement
Scenario 8: Change in Daily Ridership Per 100 Parking Spaces Lost - Mixed TOD, 1 New Bus

Mixed-Use Density Residential / Non-Retail / Retail

- 8 / 80 / 4
- 16 / 160 / 8
- 24 / 240 / 12
- 32 / 320 / 16
- 40 / 400 / 20

Ridership Change

No Parking Replacement
80% Parking Replacement
Effect of Housing Type -- Work-Trip Mode Share

Model 10a - Relationship Between Average HH BART Share and Household Distance from BART and Neighborhood Density - Home-Based Work, Low Income, Non-Family
Other-Trip Mode Share

Model 12a - Relationship Between Average HH BART Share and Household Distance from BART and Neighborhood Density - Home-Based Other, Low Income, Non-Family

<table>
<thead>
<tr>
<th>Distance from BART / Neighborhood Density Type</th>
<th>Average HH BART Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1/2 mile</td>
<td>4.7%</td>
</tr>
<tr>
<td>1/2 - 1 mile</td>
<td>3.3%</td>
</tr>
<tr>
<td>&gt;1 mile, urban</td>
<td>1.1%</td>
</tr>
<tr>
<td>&gt;1 mile, suburban</td>
<td>0.7%</td>
</tr>
</tbody>
</table>
School-Trip Mode Shares

Model 11 - Relationship Between Average HH BART Share and Household Distance from BART and Income - Home-Based School

Distance From BART

- <1 mile
  - High Income: 4.1%
  - Low Income: 0.3%

- >=1 mile
  - High Income: 6.1%
  - Low Income: 0.7%
Mode Share relation to Quality of Service

Model 10e - Relationship Between Average HH BART Share and Household Distance from BART and Station Quality of Service - Home-Based Work, High Income

Distance from BART

- 1/2-1 mile: 11.6%
- 1-5 miles: 8.5%
- >5 miles: 0.6%

High Service

Low Service
## Transit Ridership Productivity

**Housing within \( \frac{1}{2} \) Mile of BART**

<table>
<thead>
<tr>
<th></th>
<th>Daily Ridership</th>
<th>Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Below Market</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Family</td>
<td>.29</td>
<td>11.2</td>
</tr>
<tr>
<td><strong>Below Market</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family Units</td>
<td>.58</td>
<td>11.2</td>
</tr>
<tr>
<td><strong>Market Rate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Family</td>
<td>.48</td>
<td>11.1</td>
</tr>
<tr>
<td><strong>Market Rate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family Units</td>
<td>.71</td>
<td>10.0</td>
</tr>
</tbody>
</table>
## Transit Ridership Productivity

### Housing between ½ Mile and 1 Mile of BART

<table>
<thead>
<tr>
<th></th>
<th>Daily Ridership</th>
<th>Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Below Market</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Family</td>
<td>.22</td>
<td>10.8</td>
</tr>
<tr>
<td><strong>Below Market</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family Units</td>
<td>.46</td>
<td>10.9</td>
</tr>
<tr>
<td><strong>Market Rate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Family</td>
<td>.30</td>
<td>11.3</td>
</tr>
<tr>
<td><strong>Market Rate</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family Units</td>
<td>.43</td>
<td>9.8</td>
</tr>
</tbody>
</table>
Trade-Off between Parking and Housing

- 100 Parking Spaces
- 260 Dwelling Units
Trade-Off between Parking and TOD Housing
Trade-Off between Parking and Employment

100 Parking Spaces

1000 Office Employees
Trade-Off between Parking and Retail

100 Parking Spaces 200 Retail Employees
Trade-Off between Parking and Feeder Bus

100 Parking Spaces

2 Productive Bus Routes
Observations from Scenario Testing

1. Increasing the population growth rate in TOD by 15% would:
   - Increase corridor ridership by 3%, and
   - Reduce corridor auto access shares by 2%
Observations from Scenario Testing

2. Without any expansion of parking or feeder bus, allowing TOD’s to grow at twice the rate of general growth would:
   – Allow BART to capture 2/3 of potential ridership growth
   – Reduce auto access shares by 10%

3. Increasing parking at half the rate of population growth, but increasing TOD at twice the rate:
   – Allows BART to capture 100% of potential ridership growth
   – Reduce auto access shares by 11%
### Effectiveness of Parking and TOD for LRT, CRT

#### Daily Ridership Elasticities

<table>
<thead>
<tr>
<th></th>
<th>Light Rail</th>
<th>Commuter Rail</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOD Population</td>
<td>19%-30%</td>
<td>19%</td>
</tr>
<tr>
<td>TOD Employment</td>
<td>19%-21%</td>
<td>19%</td>
</tr>
<tr>
<td>Parking Spaces</td>
<td>11%</td>
<td>10%</td>
</tr>
<tr>
<td>Bus Service</td>
<td>40%-47%</td>
<td>37%</td>
</tr>
</tbody>
</table>
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>
</tr>
</tbody>
</table>
Uses Ridership Analytics and DRM

Conclusions

• Evaluate trade-offs between parking and TOD

• Considers different housing types

• Considers employment and retail uses

• Effects on ridership productivity, access shares
Uses Ridership Analytics and DRM

Conclusions

• Screening corridors, station locations, technologies

• Ridership development policies

• Station planning sessions
Thank you