Forecasting the Operational Impacts of Bus Rapid Transit Projects

A Survey of Current Practices in North America

SAN FRANCISCO COUNTY TRANSPORTATION AUTHORITY

May 19, 2015
Bus service enhancement in San Francisco
Bus service enhancement in San Francisco

- Future bus rapid transit corridors
  - Van Ness Ave
  - Geary Blvd
  - Geneva Ave
  - 16th St
- Muni Forward
BRT project planning
Considerations

- Cost
- Ridership
- Stakeholders
- Traffic and parking impacts
- Environmental
- Fleet management
- Economic development
- Travel time
- Reliability
BRT project planning

Purpose and needs

“Existing transit service” ... “is unreliable, slow, and crowded, and is in need of improvement in order to promote high ridership and competitiveness with other travel modes.”

Speed and reliability are key objectives
San Francisco CTA
BRT modeling framework

ABM w/ Static Assignment (CHAMP)

Land Use

Transportation System

Ridership forecasts

Bus travel time

Auto Demand in Subarea

Dynamic Assignment Model (Dynameq)

Intersection Volumes

Roadway Performance

Roadway Performance

Microsimulation (VISSIM)

Bus travel time

Auto Demand

Bus travel time

Transit & Non Motorized Demand

Analytical Traffic Assessment (Synchro)

Bus travel time

Auto Demand

Bus travel time

Intersection Volumes

Ridership forecasts

Bus travel time

Roadway Performance

Transit Performance
### Perceived Modeling Tradeoffs

<table>
<thead>
<tr>
<th>Simulation</th>
<th>Alternate Approaches</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pros</strong></td>
<td><strong>Cons</strong></td>
</tr>
<tr>
<td>• Analysis detail</td>
<td>• Higher cost</td>
</tr>
<tr>
<td>• Corridor specifics</td>
<td>• More data needs</td>
</tr>
<tr>
<td>• Interactive results</td>
<td>• Longer timeline</td>
</tr>
<tr>
<td>• Simplicity</td>
<td>• Black box parameter creep</td>
</tr>
<tr>
<td>• Empirically derived</td>
<td>• Not everything that matters included</td>
</tr>
</tbody>
</table>

- **Pros**:
  - Analysis detail
  - Corridor specifics
  - Interactive results

- **Cons**:
  - Higher cost
  - More data needs
  - Longer timeline
  - Black box parameter creep
  - Not everything that matters included

- **Alternate Approaches**:
  - Simplicity
  - Empirically derived

- **Cons**:
  - Hard to estimate interactive effects
  - Applicability and range uncertainty
BRT modeling investigation
Reconsidering SFCTA methodology

I’m going to:

- Inventory US BRT systems
- Review published guidance on BRT system planning
- Research planning and forecasting of operations benefits
- Interview planners at relevant agencies about transit operations forecasting
- Assess effectiveness of “simpler” approaches

Alex Grant
Bus rapid transit and bus priority Systems in the United States

Source: batchgeo.com
## BRT System Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage of Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special branding</td>
<td>84%</td>
</tr>
<tr>
<td>Dedicated bus lane</td>
<td>76%</td>
</tr>
<tr>
<td>Limited stations</td>
<td>76%</td>
</tr>
<tr>
<td>Off-board fare collection</td>
<td>68%</td>
</tr>
<tr>
<td>Amenities (WiFi, real time info)</td>
<td>68%</td>
</tr>
<tr>
<td>Transit signal priority (TSP)</td>
<td>68%</td>
</tr>
<tr>
<td>Level-boarding platforms</td>
<td>44%</td>
</tr>
<tr>
<td>Off-street guideway</td>
<td>32%</td>
</tr>
</tbody>
</table>
Guidance Organizations

- Transit Cooperative Research Program (TCRP)
- Federal Transit Administration (FTA)
- United States Department of Transportation (USDOT)
- Center for Urban Transportation Research (CUTR)
- National Bus Rapid Transit Institute (NBRTI)
- EMBARQ
- The Institute for Transportation and Development Policy (ITDP)
Guidance Documents

- **TCRP 90 V.2 (2003)**
  This report covers the main components of BRT and outlines the desirable conditions for implementation of a BRT system.

- **TCRP 118 (2007)**
  A practitioner's guide that serves as a holistic approach to planning, designing and implementing a Bus Rapid Transit system.

- **FTA/USDOT: Characteristics of BRT for Decision Making (2009)**
  Contains basic information and data that supports the development and evaluation of BRT systems.

  Comprehensive guide for planning, designing and implementing a BRT system.

- **EMBARQ: Social, Environmental and Economic Impacts of BRT Systems (2013)**
  Synthesizes information regarding costs and impacts and aims to contribute new evidence from case studies.
**Travel Times by Running-Way Type**

<table>
<thead>
<tr>
<th>Running Way Type</th>
<th>Travel Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade-Separated Busway</td>
<td>1.58 minutes / mile</td>
</tr>
<tr>
<td>At-Grade Busway</td>
<td>2.7 minutes / mile</td>
</tr>
<tr>
<td>Median Arterial Busway</td>
<td>3.13 minutes / mile</td>
</tr>
<tr>
<td>Dedicated Bus Lane</td>
<td>3.43 minutes / mile</td>
</tr>
<tr>
<td>Mixed Traffic Operations</td>
<td>3.93 minutes / mile</td>
</tr>
<tr>
<td>Dedicated Bus Lane in CBD</td>
<td>7 minutes / mile</td>
</tr>
</tbody>
</table>
BRT modeling elsewhere
What have others done?

- Traffic operational
  - Regional travel demand model
  - Synchro, VISSIM

- Ridership
  - Regional travel demand model, STOPS
  - Spreadsheet-based calculations, elasticities

- Transit operational
  - Detailed analysis of existing travel time
  - Spreadsheet-based calculations (simulation highly uncommon)
  - Avoided publicly announced expectation
  - Used experience from previous corridors
U.S. BRT systems
Forecasted run time performance

Preexisting Run Time

Bus Run Time (min)

Forecasted or Post Project Run Time

- Forecasted
U.S. BRT systems
Actual run time performance

Bus Run Time (min)

<table>
<thead>
<tr>
<th>Preexisting Run Time</th>
<th>Forecasted</th>
<th>Post Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>15:00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30:00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45:00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60:00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>75:00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90:00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Forecasted
- Post Project
U.S. BRT systems
Travel time reduction

Actual TT Reduction
Forecasted TT Reduction
U.S. BRT systems
Simplified run time estimation

One-way Run Time (min)

U.S. BRT Systems
Preexisting  Post Project  Forecasted  Quick Estimate
San Francisco BRT scenarios
Simulated travel times

One-way Run Time (min.)

- Existing
- Baseline
- Simulation
San Francisco BRT scenarios
Run time comparison

One-way Run Time (min.)

Baseline Simulation Quick Estimation (High, Medium, Low)
What next?  
Do we change anything?

► For current projects
  ► Build some bus rapid transit
    Several SF Bay Area projects opening 2015-2020
  ► Document performance and assess forecasting success

► For future projects
  ► Seriously consider alternatives to simulation
  ► Try multiple methods and cross validate estimates
Words of wisdom
Lessons from BRT implementers

- Understand your delay
  - Every corridor is different
  - Features, designs, treatments only effective if they address existing causes of delay
  - (While not adding new sources of delay)

- Avoid overpromising in the face of uncertainty
  - Lots of unknowns
  - Regardless of forecasting, won’t know until buses on ground

- Specific TT savings not important if customer is happy
  - In some cases, travel time savings failed to meet expectations,
  - But ridership exceeded forecasts
  - If the ride feels fast and customers are happy → success
Words of wisdom
Lessons from BRT implementers

- Need proof of concept
  - Some cities started with less controversial corridor
  - Many cities with BRT are working on new corridors

- Coalition building
  - BRT meant to be cheaper and faster, but still challenging to implement
  - Need coalition of support including community, politicians, businesses, etc.
Thank you.

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