Rapid Implementation and Validation of DTA in the Doyle Drive Corridor

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Overview

1. Presidio Parkway / Doyle Drive Replacement Project
2. Stakeholder Concerns
3. Modeling Approach
4. Model Development and Validation
5. Responses to Stakeholder Concerns
6. Model Evaluation
7. Conclusions
Project Overview
Location

San Francisco County Transportation Authority

Closed: Early 2010 to 2011

Map showing the location of Doyle Drive Project Area in the San Francisco Bay area, including Golden Gate Bridge, Sausalito, Alcatraz, Golden Gate National Recreation Area, Lincoln Park, Golden Gate Park, Alameda, Berkeley, and Oakland.
Setting

Closed: 2010 to 2013
Closed: Early 2010 to 2011
# Phase I

<table>
<thead>
<tr>
<th>Year</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

- Closed: Jan 10, 2010 to 2013
- Closed: Feb 17, 2010 to 2011
Weekend Closure

<table>
<thead>
<tr>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
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<tbody>
<tr>
<td></td>
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Phase II

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>orange</td>
<td></td>
</tr>
</tbody>
</table>

Tempoary Signal

Reopens
Presidio Parkway -- Completed

<table>
<thead>
<tr>
<th>Year</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
</table>

[Diagram showing the timeline of Presidio Parkway from 2009 to 2013]
Transportation Management Concerns During Construction
Approach & Schedule
Discussions with Stakeholders

Decision Makers
Count Assembly

Calibration of Demand

Network Preparation

Validation
## Timeline

<table>
<thead>
<tr>
<th>Month</th>
<th>July</th>
<th>August</th>
<th>September</th>
<th>November</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>![Fire Alarm]</td>
<td>Data Assembly</td>
<td>Network Preparation</td>
<td>Ramps close!</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data Assembly</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Calibrations</td>
<td>Calibration</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Alternatives Analysis</td>
<td>Alternatives Analysis</td>
<td>Alternatives Analysis</td>
</tr>
</tbody>
</table>
Model Development: Networks
DTA Study Area
By the numbers....

<table>
<thead>
<tr>
<th>Category</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zones</td>
<td>240</td>
</tr>
<tr>
<td>Links</td>
<td>7,000</td>
</tr>
<tr>
<td>Nodes</td>
<td>2,000</td>
</tr>
<tr>
<td>Signals</td>
<td>240</td>
</tr>
<tr>
<td>Transit Lines</td>
<td>84</td>
</tr>
<tr>
<td>Vehicles</td>
<td>160,000</td>
</tr>
<tr>
<td></td>
<td>in 3-hour PM Peak</td>
</tr>
</tbody>
</table>
Model Development: Demand Calibration
Traffic Counts

Counts Used

- 74 Mainline Counts
- 700+ Turn Counts
Adjusted OD Matrix

Slope: 1.02
R-Squared: 0.93
## Demand Validation Summary

<table>
<thead>
<tr>
<th>Demand Matrix</th>
<th>Slope</th>
<th>R-squared</th>
<th>%RMSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Original CHAMP</td>
<td>0.81</td>
<td>0.80</td>
<td>49</td>
</tr>
<tr>
<td>Calibrated Demand</td>
<td>1.02</td>
<td>0.94</td>
<td>29</td>
</tr>
<tr>
<td><em>Improved CHAMP</em></td>
<td>0.93</td>
<td>0.86</td>
<td>45</td>
</tr>
</tbody>
</table>
Improved CHAMP Demand

\[ y = 0.9274x - 3.1668 \]

\[ R^2 = 0.86 \]

Slope: 0.93
R-Squared: 0.86
Problem:
Too many turns in paths
Solution:
Use a Generalized Cost with Turn Penalties
Link Cost Function – Time versus Generalized Cost
Link Cost Function – Time versus Generalized Cost

<table>
<thead>
<tr>
<th></th>
<th>Time</th>
<th>Generalized Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slope</td>
<td>0.89</td>
<td>0.95</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.81</td>
<td>0.86</td>
</tr>
<tr>
<td>RMSE</td>
<td>0.49</td>
<td>0.44</td>
</tr>
</tbody>
</table>
Problem:

Many vehicles waiting at one connector while adjacent one is free flowing
Solution: Ghost links
Ghost links – Effect on Vehicles Waiting

![Graph showing the effect of ghost links on vehicles waiting over time. The graph compares two scenarios: one with ghosts and one without ghosts. The number of vehicles waiting increases and then decreases over time, with the scenario without ghosts showing a steeper increase and decrease compared to the scenario with ghosts.]
Model Development: Travel Time Validation
Validation of Travel Time/Speed
All Routes

\[ y = 1.0104x - 0.2295 \]

\[ R^2 = 0.915 \]

Source: SFCTA
Spring 2009
LOS Monitoring
Validation of Travel Time/Speed Important Routes

\[ y = 1.0132x + 0.4232 \]
\[ R^2 = 0.949 \]

Source: SFCTA
Spring 2009
LOS Monitoring
Model Development:
DTA Solution Quality
### Computational Resources

<table>
<thead>
<tr>
<th></th>
<th>DTA</th>
<th>SUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor</td>
<td>3.3 Ghz Nehalem Xeon</td>
<td>2.5 Ghz AMD Opteron</td>
</tr>
<tr>
<td>Iterations</td>
<td>150</td>
<td>24</td>
</tr>
<tr>
<td>Relative Gap</td>
<td>2.5-6%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Time (sec) /Iteration</td>
<td>120</td>
<td>38</td>
</tr>
</tbody>
</table>
Now about those stakeholders....
Getting back to the stakeholders…”

DTA Predicted Volume Differences and Diversions
Travel Time Changes

Golden Gate Bridge to Lombard/Franklin

- Base
- Phase I
- Phase II

Travel Time (seconds)

Time of Day

14 minutes
11 minutes
8 minutes
Travel Time Changes

Golden gate Bridge to ParkPresido/Geary

- Base
- Phase I
- Phase II

Time of Day

Travel Time (seconds)

10 minutes
7 minutes
4 minutes
Bus Travel Times

<table>
<thead>
<tr>
<th></th>
<th>38-Inbound</th>
<th>38-Outbound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel Time within Study Area (min)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base</td>
<td>24.8</td>
<td>30.8</td>
</tr>
<tr>
<td>Phase I</td>
<td>24.6</td>
<td>29.1</td>
</tr>
<tr>
<td>Phase II</td>
<td>24.5</td>
<td>33.4</td>
</tr>
</tbody>
</table>

- 38-Inbound
- 38-Outbound
Queue Lengths at Temporary Signal

Storage Capacity: 823 Feet

Queue Length (ft)

Phase II

Phase II + 20% Demand

Time of Day

Phase II

Phase II + 20%

Demand

Storage Capacity: 823 Feet
Model Evaluation: Did we get it right?
Travel Times

**Observed A→B from Toll Tag Readers**

- **US101S South End GG Bridge to SR1 at California**

- **Source: PeMS**

**Issue I:**
Toll tag (ETC) Reader travel times

**Issue II:**
Volume varies By 20% daily!

**Issue III:**
Holidays odd (but when isn’t)
Weekday Flow Variation

Southbound Golden Gate Bridge Flows 4:00 pm

- Days: 1/4/06 to 3/9/06
- Y-axis: 0 to 4500
- X-axis: Dates from 1/4/06 to 3/9/06
- Line graph showing flow variation over time.
Volume Differences Base → Phase I

**Marina WB**
- DTA: 90
- Reality: 0
- SUE: -70

**Marina EB**
- DTA: 0
- Reality: -300
- SUE: -20

**Lombard WB**
- DTA: 0
- Reality: 100
- SUE: 0

**Lombard EB**
- DTA: 0
- Reality: 150
- SUE: 365

**CA-1 SB**
- DTA: -400
- Reality: -250
- SUE: -600

**CA-1 NB**
- DTA: -1,050
- Reality: -400
- SUE: -900

**Presidio SB**
- DTA: 30
- Reality: 50
- SUE: 90

**Presidio NB**
- DTA: 30
- Reality: 50
- SUE: -30
Phase I Condition: Model versus Counts

Lombard West Of Lyon WB
Lombard West Of Lyon EB
Marina Blvd WB
Marina Blvd EB
Presidio SB
Presidio NB

Counts
DTA
SUE
Volume Differences Base → Phase I

**SB US 101 Off**
- DTA: -60
- Reality: 270
- SUE: 50

**SB US 101 On**
- DTA: 325
- Reality: 310
- SUE: 175

**Lincoln WB**
- DTA: 10
- Reality: 120
- SUE: 0

**Lincoln EB**
- DTA: 10
- Reality: 120
- SUE: 100

**NB US 101 On**
- DTA: 550
- Reality: -50
- SUE: 20

**NB US 101 Off**
- DTA: 275
- Reality: 390
- SUE: 90
Conclusions
Thanks!

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Ghost links

**Slopes**
- No Ghosts: 0.9484
- Ghosts: 0.9274

**R-Squared**
- No Ghosts: 0.8561
- Ghosts: 0.8600