Evolving from Traditional Signal Timing to ATSPM for Proactive Signal Operations and Maintenance

ITE Western District Annual Meeting
June 24, 2019

Christopher Sobie, EIT
Lee Engineering ATSPM Deployments

• Albuquerque, NM, Coors Boulevard
  ▫ Throughput while managing minor street delay
• Albuquerque, NM, Central Avenue
  ▫ Bus Rapid Transit effects on all users
• Castle Rock, CO, Plum Creek Parkway
  ▫ Small corridor and City training
ATSPM in Albuquerque

- Population: 890,000
- 8 Bridge Crossings
- 640 Traffic Signals
  - 264 ATSPM Ready
  - 65 Ready – Copper Comms
  - 291 Not High Res Controllers
- 100+ Miles of Fiber
Corridor Growth

• Last Signal Timing Project 2010

• Growth in Volume

• Major Developments

• CMP Rank = 14th (2014)
Systems Engineering Report

• Coors Corridor Traffic Study (Parametrix 2016)
  ▫ Purpose: minor modifications vs. comprehensive solution

• Benefit of Adaptive Limited By:
  ▫ Overcapacity intersections
  ▫ Predictable peak hour patterns

• ATSPM Utilizes Existing Equipment and Procedures
  ▫ Comprehensive solution using minor modifications
Opportunity to Transform the Practice

Start

Trigger
- Complaints
- 3-5 Year Retiming

Design
- Collect Data
- Design

Implement
- Install
- Fine Tune
- Evaluate

Traditional
Fitness Tracker for Traffic Signals

High Resolution Data Collection

Data Analysis and Performance Report Tools

Step Activity

- Goal met for Today

- 2,238 calories

- 7.6 miles

- 7 hrs 23 mins

- 1230 vs 725
## Value at Any Level

**Version #**
1.19.2.204_2017_05_31_1545.dat

**Intersection #**
10.19.2.204

**IP Address:**
10.19.2.204

**MAC Address:**
00:04:81:02:8b:ba

**Controller Data Log Beginning:**
5/31/17 3:45 PM

<table>
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<th>Parameter</th>
<th>TimeAsDecimal</th>
<th>EventText</th>
<th>ParameterText</th>
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<td>7.02472</td>
<td>PedDetector On</td>
<td>DET Channel # (1-16)</td>
<td>Detector</td>
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Signals and Detection • Every Day Counts • Automated Traffic Signal Performance Measures

Phase 8

Ped Actuations (PA) = 5; Min Delay = 00:16; Max Delay = 02:05; Average Delay (AD) = 01:22

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<thead>
<tr>
<th>Timestamp</th>
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<th>Parameter</th>
<th>Event Description</th>
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<td>648</td>
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<tr>
<td>1137</td>
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<td>21</td>
<td>8 Pedestrian Begin Walk</td>
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Pedestrian Delay by Actuation

Pedestrian Delay by Activation (minutes)
Coors Boulevard Project Goals

• Continuously Measure and Analyze Traffic Conditions
• Proactively Optimize Traffic
  ▫ Reduce delay across the corridor
  ▫ Reduce travel time
• Implement Maintenance and Performance Alerts
Coors Boulevard Upgrades
## Coordination Drop Metric

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<th>Date</th>
<th>Signal ID</th>
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<tr>
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<td>9/24/2017</td>
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<td>9/26/2017</td>
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<td>10/7/2017</td>
<td>7</td>
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<tr>
<td>10/8/2017</td>
<td>3</td>
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Goal: Proactive Maintenance Alerts
Pedestrian Calls All Night

No new missing record errors were found on 9/22/2017:

No new force off errors were found between 1:00 and 5:00:

The following signals had too many max out occurrences between 1:00 and 5:00:

- 0377 - Coors Blvd NW & Bluewater Rd NW - Phase 2 (Max Outs 100%)
- 0377 - Coors Blvd NW & Bluewater Rd NW - Phase 6 (Max Outs 100%)
- 363 - Coors Blvd NW & Old Airport Ave NW - Phase 2 (Max Outs 100%)
- 363 - Coors Blvd NW & Old Airport Ave NW - Phase 6 (Max Outs 100%)
- 363 - Coors Blvd NW & Old Airport Ave NW - Phase 8 (Max Outs 100%)

The following signals had unusually low advanced detection counts on 9/22/2017 between 17:00 and 18:00:

- 363 - Coors Blvd NW & Old Airport Ave NW - Phase 2 (Count: 0)
- 363 - Coors Blvd NW & Old Airport Ave NW - Phase 6 (Count: 0)
- 377 - Coors Blvd NW & Bluewater Rd NW - Phase 2 (Count: 0)
- 377 - Coors Blvd NW & Bluewater Rd NW - Phase 6 (Count: 0)

The following signals have high pedestrian activation occurrences between 1:00 and 5:00:

- 327 - Coors Blvd NW & Irving Blvd NW - Phase 4 (221 Pedestrian Activations)
Goal: Proactive Maintenance Alerts

All Night: Stuck Ped Button

7:15 AM: Email Received

8:15 AM: Issue Resolved
Goal: ABQ311 Citizen Concerns

<table>
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<tr>
<th>Contact Information</th>
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<tbody>
<tr>
<td>Email Address:</td>
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<tr>
<td>First Name: Anonymous</td>
</tr>
<tr>
<td>Last Name: Caller</td>
</tr>
<tr>
<td>Phone Number:</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Case Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address Line1: COORS BLVD NW</td>
</tr>
<tr>
<td>Address Line2: MONTANO RD NW</td>
</tr>
<tr>
<td>City: Albuquerque</td>
</tr>
<tr>
<td>State: New Mexico</td>
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<tr>
<td>Zip Code: 87120</td>
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<table>
<thead>
<tr>
<th>Case Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference Number: 180213-002353</td>
</tr>
<tr>
<td>Summary: Timing not right</td>
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<tr>
<td>Street Light Maintenance: No</td>
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<tr>
<td>Date and Time: 2/13 7:40-7:45am, 5:45pm</td>
</tr>
<tr>
<td>Closest intersection: Coors NW and Montano NW</td>
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Coors Blvd Citizen Concerns

- Lee Engineering Receives CABQ 311 Complaints
- Use ATSPMs to Investigate Complaint
  - Confirm or refute complaint
  - Measure before and after changes
- Example
  A citizen stated that “due to the growing development on the east side of Coors Blvd at Montano Plaza Dr the westbound left-turn movement did not receive enough green time to serve demand.”
Coors Blvd Citizen Concerns

**BEFORE**

**Protected Phase 3: Westbound Left**
Total Split Failures = 87

**Permissive Phase 8: Westbound Left**
Total Split Failures = 74

**AFTER**

**Protected Phase 3: Westbound Left**
Total Split Failures = 46

**Permissive Phase 8: Westbound Left**
Total Split Failures = 49
Goal: Maximize Throughput
ATSPM Metrics - Coordination

Coors Blvd and Montano Plaza SB
Friday November 10\textsuperscript{th} - Before

\[ \text{AoS} = 79\% \]
ATSPM Metrics – Coordination

Coors Blvd and Montano Plaza SB
Friday December 8th – After

AoS = 89%

Volume Per Hour
Detector Activation
Change to Green
Change to Yellow
Change to Red
AoS - Arrival On Green
GT - Green Time
PR - Platoon Ratio
Goal: Optimize User Delay
Goal: Optimize User Delay

Signal Timing Investigation – Unused Green Time

Split Failures Before

Split Failures After

63.8% GapOuts
22.4% Skips

27.9% GapOuts
65.5% Skips
Coors Blvd Vehicle Delay

- Average Delay per Vehicle Across Corridor Analysis
  - Before (October 2017) and after (February 2018)
    - Morning – 7:30 AM to 8:30 AM
    - Midday – 11:00 AM to 1:00 PM
    - Evening – 4:30 PM to 6:30 PM
  - Change in average volume per day during peak hours
  - Change in average delay per vehicle during peak Hours
Coors Blvd Vehicle Delay

Before
- 7,973 vehicles
- Delay = 22 sec/veh

Change in Volume = +26%
Change in Delay = -31%

After
- 10,076 vehicles
- Delay = 15 sec/veh
Coors Blvd Coordination & Cost Analysis

- Travel Time Across Corridor from Bluetooth Readers
  - Separate system provide unbiased measurement

- Coors Blvd and Quail Rd to Coors Blvd and Irving Blvd
  - 5.5 mile segment
  - 13 traffic signals
  - 18,900 vehicles per day during coordinated hours

- Cost Analysis
Travel Time Improvements

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<th>Northbound</th>
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<tbody>
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<tr>
<td>MD Peak</td>
<td>0:00:04</td>
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<td>PM Peak</td>
<td>0:00:11</td>
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<thead>
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<th>Southbound</th>
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<tbody>
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<td>MD Peak</td>
<td>-0:00:54</td>
</tr>
<tr>
<td>PM Peak</td>
<td>-0:00:50</td>
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Net Change: -0:02:22
Average Change: -0:00:24
Cost Savings

Net TT Change = -2:22
Average Change = -0:24

$751,170  Total cost savings per year during coordination hours

$57,782  Total annual cost savings per signal

$1,330,000  Total annual cost savings for 23 signals on Coors Blvd
Additional Benefits

- Around the Clock Data Collection
- Immediate Turnaround Time

Non-Traditional Benefits
- Weekend Timing
- Holiday Timing
- Citizen Complaints
Coors Blvd Holiday Signal Timing

- Cottonwood Mall Shopping
  - Christmas Eve, Saturdays before Christmas
  - Identified worst movements:
    - Coors & Coors Bypass - WB left turn
    - Coors Bypass & Eagle Ranch – N-E left turn
    - Coors Bypass & Ellison – WB left turn
  - Significant reduction in split failures
Coors Blvd Holiday Signal Timing
Coors Blvd and Coors Bypass
Saturday December 9\textsuperscript{th} - Before

Total Split Failures = 147
Coors Blvd and Coors Bypass
Saturday December 23rd - After

Total Split Failures = 99
Coors Bypass and Ellison Dr
Saturday December 9th - Before

Total Split Failures = 79
Coors Bypass and Ellison Dr
Saturday December 23rd - After

Total Split Failures = 18
ART ATSPM

- Build upon the ART System Upgrades
- Installation of Advanced Radar Detection
- Complimentary to Transit Signal Priority (TSP)
  - Provide additional data to implementation designers
  - Active ATSPMs management
  - Develop TSP ATSPM statistics
ART ATSPM Metrics - TSP

TSP Early or Extend Green Effects on Coordination

- TSP Early Green
- Coordination Transition Add Time
- TSP Extend Green
- Coordination Transition Subtract Time
Castle Rock, CO
Install, Train, and Support

- Installed UDOT ATSPMs on City provided server
- Configured 4 intersections for data collection
- Completed active training on installed intersections
Castle Rock, CO

Purdue Coordination Diagram
Plum Creek Pkwy @ Perry St - SIG#012
Monday, May 6, 2019 6:00 AM - Monday, May 6, 2019 9:00 PM
Advanced detector located 325 ft. upstream of stop bar

Phase 2: Eastbound
AoG = 54%

Plan 1
73% AoG
63% GT
1.16 PR

Plan 2
48% AoG
46% GT
1.04 PR

Plan 3
45% AoG
44% GT
1.02 PR

Plan 2
70% AoG
62% GT
1.13 PR

Platooning

Cycle Time (Seconds)

Volume Per Hour

Time (Hour of Day)
Castle Rock, CO

Changing Action Plan
ATSPM Benefits

- Increased Safety
  - Proactive operations and maintenance practices
- Targeted Maintenance
  - Provide actionable information, significant agency cost savings
- Improved Operations
  - Active monitoring of signalized intersection performance

ATSPMs provide affordable and sustainable system improvements by leveraging existing resources more effectively
Thank you!

Chris Sobie, EIT

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