CDOT Automated Traffic Signal Performance Measures (ATSPMs)
2017 CO/WY ITE and ITS Rocky Mountain Joint Meeting

CDOT Statewide Traffic Signal Program
What is Automated Traffic Signal Performance Measures (ATSPMs)?

- FHWA Every Day Counts Technology Initiative.
- Traffic Signal Management and Data Analysis System.
- Uses High-Resolution Data Logs from Signal Controllers and other Probe Devices.
- No Central Signal Control System Required – access data from field controllers.
- Provides Real-Time Signalized Intersection Performance Monitoring and Measurement.
- More than a dozen Performance Measures for **Targeted** and **Proactive** Signal Maintenance.
- Approx. 26 agencies at both state and local levels are currently involved in implementing ATSPMs

- CDOT and City of Lakewood in Colorado
CDOT Statewide Traffic Signal Program

ATSPM Basic Concept

- Reliable Communications
  - Automated Data Collection
    - Signal Controller
    - Field Detectors
    - Other Probe Devices
  - ATSPM Server
    - Data Archive
    - Data Analysis
  - Useful Information on Signal Performance
    - Signal
    - Corridor
    - System

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System Requirements for Implementing ATSPM

- High Resolution Controller (CDOT uses Intellight)
  - Ability to Log 1/10th of a second data
- Reliable communications
  - Fiber
  - Cell Modems
- Database Server*
- ATSPM Software*
- Detection Equipment

*For server requirements, software and installation manuals visit:
https://www.itsforge.net/index.php/community/explore-applications#/30/133
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CDOT Deployment Steps

- **Standardization of Detection**
  - Unique numbering schema for controller IDs
  - Update the position of detection cards in the cabinet

- **ATC Controller Upgrade**
  - Install High Resolution Controllers
  - Review and Upgrade Field Communications

- **Install UDOT ATSPM system**
  - Deployment of ATSPM (v4.0.1) software (with support from UDOT)

- **Add signals to the system**
  - Integrate controller and detection information in the ATSPM system

- **Monitor Performance Measures**
  - Actionable information to deliver quality service to customers.
  - Address problems before they become complaints.
<table>
<thead>
<tr>
<th>Performance Metric</th>
<th>Type of Detection</th>
</tr>
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<tbody>
<tr>
<td>Purdue Coordination Diagram</td>
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<tr>
<td>Purdue Link Pivot Offset Optimization</td>
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<tr>
<td>Approach Volume</td>
<td></td>
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<tr>
<td>Approach Speed</td>
<td></td>
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<tr>
<td>Approach Delay</td>
<td></td>
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<tr>
<td>Preemption Details</td>
<td>Advance Count Detection (350ft-400ft behind stop bar)</td>
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<tr>
<td>Pedestrian Delay</td>
<td>Preemption Devices (Opticom)</td>
</tr>
<tr>
<td>Purdue Split Failure</td>
<td>Pedestrian Push Buttons</td>
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<td>Turning Movement Counts</td>
<td>Lane by Lane Presence Detection</td>
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<td>Yellow and Red Actuations</td>
<td>Lane by Lane Stop Bar Count Detection</td>
</tr>
<tr>
<td>Purdue Phase Termination</td>
<td>Stop Bar or Advance Detection</td>
</tr>
<tr>
<td>Split Monitor</td>
<td>Stop Bar or Advance Detection</td>
</tr>
</tbody>
</table>
ATSPM Watch Dog

Sample Email from Watch Dog

ATSPM Alerts for 6/4/2017
CDOTATSPM@dot.state.co.us

Sent: Sun 6/4/2017 7:00 AM
To: mbrian.tennent@state.co.us; Vijay.Sabawat; warren@kritek.org; warren@kritek.org

--No new missing record errors were found on 6/3/2017:

--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:
107400534 - SH 74 & Stagecoach Rd. - Phase 1 (Max Outs 100%)
107400534 - SH 74 & Stagecoach Rd. - Phase 2 (Max Outs 100%)
107400534 - SH 74 & Stagecoach Rd. - Phase 5 (Max Outs 100%)
107400534 - SH 74 & Stagecoach Rd. - Phase 6 (Max Outs 100%)
107400534 - SH 74 & Stagecoach Rd. - Phase 8 (Max Outs 100%)

--The following signals had unusually low advanced detection counts on 6/3/2017 between 17:00 and 18:00:
107400296 - SH 74 & Squaw Pass - Phase 4 (Count: 28)
107400296 - SH 74 & Squaw Pass - Phase 8 (Count: 38)
107400444 - SH 74 & Lewis Ridge Rd. - Phase 4 (Count: 49)
107400444 - SH 74 & Lewis Ridge Rd. - Phase 8 (Count: 43)

--No new high pedestrian activation errors between 1:00 and 5:00:
Benefits of ATSPM Implementation

- Proactive operations and maintenance activities.
- Continuous monitoring of device and system health.
- Automated Notifications (watchdog emails).
- Before and After studies (why model what we can measure!).
- Efficient Allocating of Scarce Resources.
- Increased Safety (by a shift to proactive operations and maintenance practices).
CDOT ATSPM: Purdue Coordination Diagram (PCD)

Plots vehicle arrivals during each phase and movement of each cycle

Use Case: Troubleshoot Coordination-Related Issues
Use Case: Detection Failures (Constant Ped. Call)

Before: Continuous Ped Calls

After: Ped Button Repaired

SH 74 & Bergen Pkwy intersection
Use Case: Detection Failures
(Constant Vehicle Call)

Before: Constant Veh. Call

After: Detection Repaired

SH 74 & Stage Coach Rd. intersection

CDOT ATSPM: Purdue Phase Termination
Use Case: Analyze Traffic Demand, Retime or Optimize the Signal Plans

CDOT ATSPM: Approach Volumes
## CDOT ATSPM Example: Link Pivot Analysis on SH74 Corridor

### Corridor Summary (Arrivals on Green)

<table>
<thead>
<tr>
<th></th>
<th>Northbound</th>
<th>Southbound</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before</td>
<td>After</td>
</tr>
<tr>
<td><strong>AM Peak</strong></td>
<td>83%</td>
<td>85%</td>
</tr>
<tr>
<td>(6:00 – 9:00)</td>
<td>(11,517)</td>
<td>(12,012)</td>
</tr>
<tr>
<td><strong>Off Peak</strong></td>
<td>80%</td>
<td>84%</td>
</tr>
<tr>
<td>(9:00 – 15:30)</td>
<td>(18,922)</td>
<td>(19,688)</td>
</tr>
<tr>
<td><strong>PM Peak</strong></td>
<td>77%</td>
<td>79%</td>
</tr>
<tr>
<td>(15:30 – 19:00)</td>
<td>(9,881)</td>
<td>(10,159)</td>
</tr>
</tbody>
</table>

### Use Case: Troubleshoot Corridor Coordination issues or Offset Optimization