1 | An Introduction to ATSPMs
2 | ATSPM Implementation
3 | ATSPM Applications
• Uses high-resolution data logging
• Allows continuous monitoring of signalized intersections
• Supports performance-based maintenance and operations strategies
• FHWA has included Automated Traffic Signal Performance Measures in EDC-4 (2017-2018)

• EDC is a state-based model to identify and rapidly deploy proven but underutilized innovations

• [https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/](https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/)

1. SHORTEN PROJECT DELIVERY PROCESS
2. ENHANCE ROADWAY SAFETY
3. REDUCE CONGESTION
4. IMPROVE ENVIRONMENTAL SUSTAINABILITY
MORE DATA = MORE ACTION

- Courtesy of Eddie Curtis. FHWA
Flow of Information Example

Data Logger

Server

Software

Signal State

Detection

INPUTS

DATA LOGS

REPORTS
More Detection Leads to More ATSPMs

- No Detection
- Stop Bar Detection
- Stop Bar and Advance Detection
- All Detection

Additional ATSPMs Available

Automated Traffic Signal Performance Measures
ATSPMs Pyramid of Opportunities

- **Communication**: Is communication working?
- **Detection**: Is detection working?
- **Coordination**: Is there adequate green time for each phase?
- **Advanced Applications**: Are most vehicles arriving on green?

PLUS REPORTS!
# Maintenance Alarms

<table>
<thead>
<tr>
<th>Alarm</th>
<th>Looking For...</th>
<th>During...</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Data</td>
<td>Low Records</td>
<td>All Day</td>
</tr>
<tr>
<td>Too Many Max Outs</td>
<td>High Percentage</td>
<td>Late Night</td>
</tr>
<tr>
<td>Too Many Force Offs</td>
<td>High Percentage</td>
<td>Late Night</td>
</tr>
<tr>
<td>Too Many Pedestrian Calls</td>
<td>High Number</td>
<td>Late Night</td>
</tr>
<tr>
<td>Low PCD Detector Count</td>
<td>Low Number</td>
<td>Peak Hour</td>
</tr>
<tr>
<td>High PCD Detector Count</td>
<td>High Number</td>
<td>Peak Hour</td>
</tr>
</tbody>
</table>

**Automated Traffic Signal Performance Measures**

- Communication Failure
- Vehicle Detection Failure
- Pedestrian Detection Failure
- Signal Timing Parameters Programmed Incorrectly

*Kittelston & Associates*
Signal Timing Tools

- **Purdue Phase Termination**: No Additional Functionality Required
- **Purdue Split Failure**: Stop Bar Detection Required
- **Purdue Coordination Diagram**: Advance Detection Required
ATSPMs Can Redefine the Traditional Signal Retiming Process

**STM2 STEPS**
- Trigger Event
- Identify Desired Outcomes
- Develop New Signal Timing
- Implement
- Monitor
- Document

**TRADITIONAL**
- Public Service Request or Periodic Retiming
- Field Observations
- Counts
- Model
- Program Signal Timing in Controller(s)
- Field Observations
- Static Before/After Study

**ATSPMs**
- Automated Alert
- Review ATSPM Reports
- Determine Adjustments Using ATSPM Reports
- Program Signal Timing in Controller(s)
- Review ATSPM Reports
- Dynamic ATSPM Reports

Automated Traffic Signal Performance Measures
1 | An Introduction to ATSPMs
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EDC-4/ATSPM State Implementation Goals

Implementation Stage

- Not Implementing
- Development
- Demonstration
- Assessment
- Institutionalized
- Local Agency Deployment

Map showing the implementation stage of EDC-4/ATSPM across the United States.
Active NCHRP Research

- NCHRP 03-122: Performance-Based Management of Traffic Signals
  - Developing guidance to implement a performance measurement approach to traffic signal management

  — Doing more with less!
Increased Efficient and Effective Signal System M&O
Pilot Projects Should Consider Locations with...

- Available equipment
  - ATC controllers with high-resolution-data-logging capabilities
  - Communication to a central location
  - Reliable detection
- Uncongested conditions during parts of the day
- Planned signal timing adjustments for before/after study
Signal Controller Vendors

- The following signal controller vendors have high-resolution data that uses the Indiana Enumerations.
  - Econolite
  - Intelight
  - McCain
  - Peek
  - Siemens
  - Trafficware
- Most are offering some level of ATSPMs through their central software programs.
Other Vendors

- Some vendors are offering an approach outside the signal controller for performance measures.
  - EDI
  - Live Traffic Data
  - Miovision
  - Sensys Networks
- Most vendors are using metrics developed by Purdue and UDOT. Some are offering a more dynamic user interface.
PBOT Pilot Project
PBOT Flow of Information

Intelight & Econolite → Data Logger → Server → Server Housed at PBOT

Inputs

Loops & Radar → Internal PBOT Network → Software

Automated Traffic Signal Performance Measures
Implementation Advice

• Work closely with vendors to review raw data files and ensure correct decoding.
• Test output from all versions of firmware being used in the field.
• Inventory and document detector channel mapping.
• Work closely with IT to ensure cybersecurity vulnerabilities are assessed and protocols are maintained.
1 | An Introduction to ATSPMs
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Application #1: VDOT Pilot Project

US 29/Airport

US 29/Hydraulic
Application #1: Midday Offsets

- Midday offset optimization
- Arrivals on green increased from 68% to 79% (comparing week before to week after change)
Application #1: Midday Offsets

- Northbound arrivals on green were maintained (downstream)
- Week Before (M-F) = 75%
- Week After (M-F) = 79%
Application #1: Midday Offsets

- Southbound arrivals on green were improved (upstream)
- Week Before (M-F) = 59%
- Week After (M-F) = 78%
Application #1: Midday Offsets

Before 6/14
Application #1: Midday Offsets
Average Corridor Speed Comparison

Time of Day Comparison

Cumulative Distribution

Speed (mph)

Before
After

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Application #2: Purdue Coordination Diagram
Are most vehicles arriving on green?

- Advance Detection Activated
- Use Programmed Speed and Distance to Estimate Arrival at Stop Bar
- Compare to Signal State to Determine Whether Vehicle Arrived on Green
Application #2: Purdue Coordination Diagram
Are most vehicles arriving on green?

Source: Jim Sturdevant, INDOT; Every Day Counts 4 Presentation
Application #2: Purdue Coordination Diagram
Are most vehicles arriving on green?

Source: Jim Sturdevant, INDOT; Every Day Counts 4 Presentation
Takeaways

• ATSPMs provide a sustainable method to continuously monitor signalized intersections.

• Proactive monitoring of a signal system will lead to quicker problem solving and fewer public service requests.

• ATSPMs can be implemented without full detection (or even communication).

• Performance-based programs allow agencies to tell better stories about their signal systems.
Thank you

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