Active Traffic Management Options

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Presentation Outline

- Introduction
- Literature review
- Implementation potential of active traffic management in U.S.
- Case study: Temporary shoulder lane use in Birmingham, AL
  - Study design and results
- Conclusions and recommendations
Introduction

- **Active Traffic Management (ATM)** is the practice of dynamically managing traffic under recurrent and/or non-recurrent congestion.
- ATM typically relies on comprehensive automated systems to continuously monitor and adjust roadway management strategies as traffic conditions change.
- Examples of active management strategies include speed harmonization, dynamic lane management, dynamic vehicle routing, and real time incident management.
Introduction, cont.

- In 2007 the Federal Highway Administration (FHWA) offered recommendations for advancing research and implementation of active management strategies, including:
  - Promote ATM to optimize operations during recurrent and non-recurrent congestion.
  - Emphasize customer orientation and focus on trip reliability.
  - Integrate ATM into infrastructure planning, programming, and funding processes, and
  - Develop tools to support ATM investment decisions.
Literature Review

- Speed Harmonization
- Temporary Shoulder Lane Use
- Queue Warning
- Dynamic Junction Control
- Dynamic Rerouting Information
- Truck Restrictions
Literature Review, cont.

- European studies confirm that ATM strategies result in great operational and safety benefits. For instance:
  - Increase in avg throughput in congested periods of 3 to 7%
  - Increase in overall capacity of 3 to 22%
  - Decrease in primary incidents of 3 to 30%
  - Decrease in secondary incidents of 40 to 50%
  - Decreased headways and more uniform driver behavior
  - Increase in trip reliability,
  - Ability to delay the onset of freeway breakdown, and
  - Improved driving experience and customer satisfaction.
Implementation Potential in the U.S.

- The benefits realized because of the deployment of ATM overseas are a testament to its potential for the United States.
- For this reason, a team of experts who studied European ATM systems as part of a 2006 International Technology Scanning Program agreed that ATM is the next evolution in congestion management in the United States.
Expert Recommendations

- Promote active management to optimize existing infrastructure during recurrent and non-recurrent congestion.
- Emphasize customer orientation and focus on trip reliability.
- Integrate active management into infrastructure planning and programming processes.
- Develop tools to support active management investment decisions.
- Consider public-private partnerships and other innovative financing and delivery strategies.
- Consider pricing as only one component of a total management package.
- Include managed lanes as part of the overall management of congested facilities.
Birmingham, AL Case Study

- In 2003, 9.7 million person-hours were wasted in Birmingham, AL due to congestion.
- Cost of congestion = $165 million dollars, or three times the figure reported a decade ago ($53 Million in 1993).

**Objective:**
Assess the feasibility of temporary shoulder lane use as a strategy for reducing congestion in the Birmingham area
Temporary Shoulder Lane Use

- Gives permission to vehicles to use either the right or left shoulder lanes under specific conditions.
- Dynamical variable signs let drivers know that the shoulder lane is open in this segment.
- The shoulder lane should be a full width hard shoulder and should satisfy design requirements similar to general purpose traffic lanes.
Case Study Approach

- Identification of Candidate Corridors
- Preliminary Assessment of Implementation Potential
- Quantitative Evaluation of Operational Impacts from Implementation
- Identification of Implementation Requirements
- Estimation of Costs and Benefits
- Policy, Operational, and other Considerations
- Funding Considerations
- Recommended Actions
Corridor Selection

- Based on:
  - LOS
  - Physical Characteristics
  - Safety Records

- Selected a 12.5 mile-long segment of the I-65 corridor from Valleydale Road to I-20/59 as a high priority corridor for further analysis
Operational Characteristics of the I-65 Study Corridor-NB Direction

<table>
<thead>
<tr>
<th>Segments</th>
<th>LOS</th>
<th>v/c Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>From Valleydale Road to I-459</td>
<td>F</td>
<td>1.55</td>
</tr>
<tr>
<td>From I-459 to US 31</td>
<td>E</td>
<td>0.99</td>
</tr>
<tr>
<td>From US 31 to Alford Ave</td>
<td>F</td>
<td>1.47</td>
</tr>
<tr>
<td>From Alford Ave to Lakeshore Dr</td>
<td>F</td>
<td>1.47</td>
</tr>
<tr>
<td>From Lakeshore Dr to Oxmoor Rd</td>
<td>F</td>
<td>1.42</td>
</tr>
<tr>
<td>From Oxmoor Rd to Greensprings Ave</td>
<td>F</td>
<td>1.50</td>
</tr>
<tr>
<td>From Greensprings Ave to University Blvd</td>
<td></td>
<td>1.26</td>
</tr>
<tr>
<td>From University Blvd to 3rd-4th Ave S</td>
<td>D</td>
<td>0.84</td>
</tr>
<tr>
<td>From 3rd-4th Ave S to 3rd-6th Ave</td>
<td>C</td>
<td>0.67</td>
</tr>
<tr>
<td>From 3rd-6th Ave to I-20/59</td>
<td>C</td>
<td>0.64</td>
</tr>
</tbody>
</table>
Operational Impacts from Implementation

- **Approach**
  - Simulation modeling using CORSIM.
  - The model has the ability to simulate fairly complex geometric conditions and realistic driver behavior after it is appropriately calibrated and validated.
  - Studied impact of temporary shoulder lane use during recurrent and non-recurrent congestion conditions
## Scenarios Considered in Case Study

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
<th>NB Lanes Available</th>
<th>NB Shoulder Lanes in Use (Duration)</th>
<th>SB Lanes Available</th>
<th>SB Shoulder Lanes in Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No shoulder use- Regular traffic</td>
<td>3</td>
<td>0 (1:00AM-13:00PM)</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>NB shoulder use- Regular traffic</td>
<td>3</td>
<td>1 (1:00AM-13:00PM)</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>NB temporary shoulder use- Regular traffic</td>
<td>3</td>
<td>1 (7:00-9:00AM peak)</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>No shoulder use- NB incident</td>
<td>3 or 2*</td>
<td>0 (1:00AM-13:00PM)</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>NB temporary shoulder use- NB incident</td>
<td>3 or 2*</td>
<td>1; downstream of incident (7:00-8:00AM peak)</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>NB temporary shoulder use- NB incident</td>
<td>3 or 2*</td>
<td>1; downstream of incident (7:00-9:00AM)</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

* 2 lanes available from 7:00-8:00AM on link (564,565) due to incident
Study Design

- Detailed geometric and traffic data were obtained and used to create a realistic representation of actual conditions along the I-65 corridor in Birmingham.
- Simulations were run for 12hrs (from 1AM-13:00 PM).
- Five (5) replications were performed for each test scenario in order to introduce randomness and the results were averaged.
- Attention was given to the northbound direction (NB) that carries suburban and local traffic into the city of Birmingham during the morning peak (from 7:00 am to 9:00 am).
# Simulation Results – Network Wide

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Traffic Conditions</th>
<th>NB Left Shoulder Use</th>
<th>Total Travel Time (veh-hrs)</th>
<th>Total Delay Time (veh-hrs)</th>
<th>Avg. Travel Speed (mph)</th>
<th>Delay Time (min/veh-mi)</th>
<th>Total Time (min/veh-mi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Regular</td>
<td>no</td>
<td>30,229</td>
<td>12,026</td>
<td>36.11</td>
<td>0.67</td>
<td>1.67</td>
</tr>
<tr>
<td>2</td>
<td>Regular</td>
<td>yes</td>
<td>20,187</td>
<td>5,137</td>
<td>54.34</td>
<td>0.10</td>
<td>1.10</td>
</tr>
<tr>
<td>3</td>
<td>Regular</td>
<td>yes, AM peak</td>
<td>30,204</td>
<td>11,980</td>
<td>36.00</td>
<td>0.66</td>
<td>1.67</td>
</tr>
<tr>
<td>4</td>
<td>NB incident</td>
<td>no</td>
<td>36,382</td>
<td>18,699</td>
<td>29.20</td>
<td>1.06</td>
<td>2.05</td>
</tr>
<tr>
<td>5</td>
<td>NB incident</td>
<td>yes, 7-8 AM</td>
<td>31,605</td>
<td>13,453</td>
<td>34.34</td>
<td>0.75</td>
<td>1.75</td>
</tr>
<tr>
<td>6</td>
<td>NB incident</td>
<td>yes, 7-9 AM</td>
<td>29,833</td>
<td>11,598</td>
<td>36.54</td>
<td>0.64</td>
<td>1.65</td>
</tr>
</tbody>
</table>
# Sample of Link by Link Results

<table>
<thead>
<tr>
<th>Scenario</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Conditions</td>
<td>Regular</td>
<td>Regular</td>
<td>Regular</td>
<td>Incident</td>
<td>Incident</td>
<td>Incident</td>
</tr>
<tr>
<td>Shoulder Use</td>
<td>no</td>
<td>yes</td>
<td>yes-AM peak</td>
<td>no</td>
<td>yes-7 -8 AM</td>
<td>yes-7 -9AM</td>
</tr>
<tr>
<td>NB Links</td>
<td>Speed (mph) for Scenarios 1 through 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(563,564)</td>
<td>28.61</td>
<td>57.08</td>
<td>31.91</td>
<td>19.99</td>
<td>24.82</td>
<td>27.50</td>
</tr>
<tr>
<td>(564,565)</td>
<td>28.77</td>
<td>57.01</td>
<td>33.36</td>
<td>21.77</td>
<td>25.16</td>
<td>27.87</td>
</tr>
<tr>
<td>(565,566)</td>
<td>27.88</td>
<td>56.01</td>
<td>32.79</td>
<td>20.46</td>
<td>22.82</td>
<td>26.17</td>
</tr>
<tr>
<td>(566,567)</td>
<td>23.21</td>
<td>56.68</td>
<td>29.13</td>
<td>17.50</td>
<td>20.64</td>
<td>24.80</td>
</tr>
<tr>
<td>(567,569)</td>
<td>21.38</td>
<td>57.51</td>
<td>29.01</td>
<td>16.25</td>
<td>18.16</td>
<td>21.51</td>
</tr>
<tr>
<td>(569,570)</td>
<td>19.54</td>
<td>57.57</td>
<td>28.48</td>
<td>15.82</td>
<td>17.69</td>
<td>21.41</td>
</tr>
<tr>
<td>(570,571)</td>
<td>17.91</td>
<td>56.43</td>
<td>28.09</td>
<td>15.51</td>
<td>17.48</td>
<td>19.94</td>
</tr>
<tr>
<td>(571,572)</td>
<td>19.77</td>
<td>46.78</td>
<td>29.13</td>
<td>17.99</td>
<td>19.42</td>
<td>21.25</td>
</tr>
<tr>
<td>(572,574)</td>
<td>24.71</td>
<td>54.57</td>
<td>32.48</td>
<td>21.93</td>
<td>21.00</td>
<td>23.42</td>
</tr>
<tr>
<td>Average Speed</td>
<td>23.53</td>
<td>55.52</td>
<td>30.49</td>
<td>18.58</td>
<td>20.80</td>
<td>23.76</td>
</tr>
</tbody>
</table>
Results Discussion

- As expected, the continuous availability of an extra lane on the NB direction (Scenario 2) results in a profound improvement of all network performance measures compared to the base case (Scenario 1).
- The temporary use of the NB shoulder lane for 2 hrs during the morning peak (Scenario 3) has a small, but still positive impact as it results in a small reduction in the total network delay over Scenario 1.
- Under incident conditions, network delay savings over 5,200 veh-hrs can be realized from the use of the shoulder lane for 1hr, a savings of 39%.
- As expected, further benefits are achieved under incident conditions by keeping the shoulder lane open for 2hr (Scenario 6).
Identification of Implementation Requirements

- This step involved:
  - Detailed documentation of current traffic management practices and procedures, geometric characteristics of the study corridor, and available technologies such as:
    - Variable message signs (VMS)
    - CCTV cameras
    - Loop detectors
  - Identification of needs for implementation and integration requirements with existing ITS infrastructure
Other Feasibility Study Points

- Estimation of Benefits and Costs
- Policy, Operational, and other Considerations
- Funding Considerations
- Recommended Actions
Conclusions

- ATM seeks to introduce new proactive congestion management strategies to the U.S. while enhancing the effectiveness of existing strategies.
- The European experience with ATM clearly demonstrates its positive impacts on traffic operations and safety and thereby, its tremendous potential for alleviating traffic congestion in the US.
- The implementation of ATM is a significant investment so the potential benefits would have to be clearly defined and sufficient to justify the costs.
Conclusions cont.

- The simulation analysis results demonstrate the feasibility and benefits of a temporary left shoulder lane use system on a segment of I-65 in Birmingham, AL
- The results from the simulation analysis, coupled with findings from a cost-benefit analysis that is currently underway will be used to demonstrate the potential of the strategy to improve traffic operations and safety and justify the need for deployment of the proposed strategy at the study location.
Recommendations and Future Studies

- It is recommended that additional analysis is performed to refine the current scenarios and compare the effectiveness of temporary shoulder lane use to other potential ATM strategies.
- Additional model calibration and validation is expected to further improve modeling accuracy and the confidence in the model findings.
- The success of implementation greatly depends on public support and positive public perception. Thus, the role of public education in the early planning stage is critical and should not be overlooked.
Thank You!