Key National Trends

- Toward Zero Deaths
- Rapidly Changing Transportation Technologies
- Lack of AV Analysis and Design Standards – Corridor Planning and Design
- Critical Need - “Right Sized” Project Solutions
- Transportation as a Service
- Agency Budget Challenges

Case Study - Iowa DOT – I-80 PEL Study

Includes Rural Sections of I-80 - Urban locations are not a part of this study

01 Interstate 80 PEL Study
02 Scenario Planning
03 Capacity, Safety, and Reliability Analysis
04 Future Proofing
05 Conclusions / Next Steps

Case Study - Iowa DOT – I-80 PEL Study

- Planning and Environmental Linkages (PEL) Study
  - Statewide Public Involvement
  - Guiding Principles
  - System Evaluation of Overhead Bridges
  - Truck Only and Truck Restricted Lanes
  - Evaluate Parallel Corridors
  - Climate Risk Analysis
  - Automated Vehicle Corridor Planning => HDR

- Outcomes:
  - General Typical Section
  - Segmentation
  - Prioritization
  - Funding Strategy
  - Expandability
Study Goals
- Develop a range of expectations for future automated vehicle (AV) adoption
- Estimate AV benefits to traffic operations, safety, and reliability on rural I-80
- Determine the impact of AV on I-80 system planning and design

Connected Automated Vehicle (AV) Technology

Levels of Autonomy
- GM “Super Cruise” 2017 Cadillac CT6
- Tesla Model S
- Waymo (Google)

Scenario Planning
- Considers wide range of possible futures and how likely trends may affect future transportation operations.

AV Adoption Rates: Passenger Vehicles
Summary of Literature

02 Scenario Planning
Capacity, Safety, and Reliability Analysis

Traffic Analysis
- DOT Statewide travel model runs
  - 2040 4-lane I-80
  - 2040 6-lane I-80
- Research on AV impact to demand
  - Induced trips due to AV
  - Potentially longer trips as well

Traffic Operations Approach
- Develop VISIM models based on existing operating conditions
- Develop a concept of operations for technology
  - Implement in VISIM using COM scripting
- Compute / compare scenario quality of service and capacity

Traffic Analysis Results
- Simulated capacity with AV
  - Default VISIM default behavior
  - AV traffic mixes with non-AVs in all lanes
  - Benefits reach substantial level at 50% AV
  - 85% AV - 4-8-lane freeway can serve roughly 1,800 additional vehicles during the peak hour
  - Dependent on vehicle following / platooning code, likely to change over time
Safety Analysis Approach

Linking Technologies and Crashes on I-80

- 2016 research by Kockleman, Avery, Bansal, et. al.
- Mapped technologies to pre-crash events
- Predicted crash reduction by severity
- Used Iowa Major Crash Cause Data
- Selected Moderate Crash Reduction Assumption
- Resulted in Crash Modification Factors

Safety Analysis Approach

Combine the crash reductions for all AV safety technologies
Apply the crash reduction factors to predicted future crashes

Safety Analysis Results

I-80 Predicted Crash Rates

- Introducing automated vehicles reduces crashes
- Reductions near 70% of total crashes for 85% AV
- Crash rates (normalized for volume) also drop substantially

Safety Analysis Approach

Crash Patterns for I-80

- 30% of crashes classified as run off road or crossed median
- Pick AV safety application to mitigate crash
- Lane-keeping assist reduces 50%-90% of target crashes
- Combine the crash reductions for all AV safety technologies
- Apply the crash reduction factors to predicted future crashes

Reliability | Introduction

Level of consistency in travel conditions over time, measured by describing the distribution of travel times that occur over a substantial period of time.

Source: SHRP2 L03

Level of consistency in travel conditions over time, measured by describing the distribution of travel times that occur over a substantial period of time.

Source: SHRP2 L03
Reliability | SHRP2 L03/L07 Prediction Models

- Predict TTI for five percentiles as a function of:
  - Demand to Capacity (D/C) ratio – AVs improve capacity
  - Incident Lane Hours Lost – based on predicted number of crashes/ incidents (reduced with increasing AV)
  - Frequency of rain and snow – research database derived from National Climatic Data Center (NCDC)

Reliability | Metrics

- Misery Index
- Reliability Rating
- Lateness Index

Reliability | Results

- Developed by HDR for Iowa DOT
- Educational Video for Public Use
  - AV Technology
  - AV Adoption Rates
  - Benefits
  - Mixed Environment Traffic Simulation

Rise of the Automated Vehicles Video

- Developed by HDR for Iowa DOT
- Educational Video for Public Use
  - AV Technology
  - AV Adoption Rates
  - Benefits
  - Mixed Environment Traffic Simulation

04 Future Proofing
05 Conclusions / Next Steps

Conclusions

Study Conclusions

**TRADITIONAL PLANNING STUDY**
- Future Forecast – Business as Usual
- Traffic LOS Analysis
  - HCM - 20 year forecast – peak 15 minutes
- Roadway Facility Design
  - Standard Design Approach

**PLANNING FOR AV (other disruptive trends)**
- Scenario Planning
  - Forecast technology impacts / other disruptive trends
  - Analyze multiple scenarios
- Comprehensive Operational Analysis
  - Traffic Capacity due to AV / tech disruptors
  - Crash Prediction / AV / tech disruptors
  - Travel time Reliability Modeling
- Flexible Roadway Facility Design
  - Future-Proofing for AV / tech disruptors
  - Communications / Active Traffic Operations / ITS
  - Right-Size Project

Next Steps

- Consider Future Proofing in I-80 Design
  - Pavement Design
  - Typical Section
  - Expandability
- Development of I-80 Smart Corridor
  - Concept of Operations
  - Specific Technology Needs
  - Maintenance and Operations
- Complete I-380 (Cedar Rapids – Iowa City) Automated Corridor Study

Links

- Full I-80 Automated Corridors Report with Appendices –
  [https://www.iowadot.gov/interstatestudy/IADOT_FEL_80_AV_TechMemo_withAppendices_FINAL_20170629.pdf](https://www.iowadot.gov/interstatestudy/IADOT_FEL_80_AV_TechMemo_withAppendices_FINAL_20170629.pdf)
- Automated Vehicles Video –
## QUESTIONS

**Traffic Operations Approach**

- How do you measure traffic benefits?
  - Level of service not sensitive to AVs

### LOS Vs. Demand-to-Capacity Ratio

![Graph showing LOS vs. Demand-to-Capacity Ratio](image)

### Traffic Analysis Results – Iowa City to Quad Cities

<table>
<thead>
<tr>
<th>EB / WB</th>
<th>Volume (pcu)</th>
<th>AV %</th>
<th>Average Speed (mph)</th>
<th>Average Density (pc / mi / ln)</th>
<th>Demand/Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Existing</td>
<td>2,030 / 1,800</td>
<td>0%</td>
<td>65.4 / 65.7</td>
<td>28.1 / 24.9</td>
<td>0.42 / 0.37</td>
</tr>
<tr>
<td>2025 Scenario 1</td>
<td>3,005 / 2,660</td>
<td>25%</td>
<td>66.8 / 66.6</td>
<td>40.6 / 36.5</td>
<td>0.41 / 0.36</td>
</tr>
<tr>
<td>2025 Scenario 2</td>
<td>3,645 / 3,230</td>
<td>50%</td>
<td>66.6 / 66.6</td>
<td>49.5 / 44.4</td>
<td>0.46 / 0.40</td>
</tr>
<tr>
<td>2040 No-Build</td>
<td>3,150 / 2,785</td>
<td>0%</td>
<td>62.3 / 63.4</td>
<td>45.8 / 40.1</td>
<td>0.65 / 0.58</td>
</tr>
<tr>
<td>2040 Scenario 3</td>
<td>3,155 / 3,185</td>
<td>20%</td>
<td>65.8 / 65.7</td>
<td>57.1 / 51.2</td>
<td>0.57 / 0.50</td>
</tr>
<tr>
<td>2040 Scenario 4</td>
<td>3,675 / 4,140</td>
<td>85%</td>
<td>66.7 / 66.6</td>
<td>63.3 / 56.6</td>
<td>0.51 / 0.45</td>
</tr>
</tbody>
</table>