Michigan DOT
Connected Vehicle Data Use

Collin Castle, P.E.

V2I Deployment Coalition – TWG 3 (Partnerships)
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Presentation Overview

- MDOT CV Data Use
- DUAP System
- Data/System Availability
- Data Sources
- Applications
  - Pavement
  - Weather
  - Traffic
- CV Fleet Instrumentation
MDOT DUAP System

- Enhance agency-wide usage of connected vehicle data
  - Integrate traditional data sets, fixed sensors with mobile and connected vehicle data where possible
  - Support all of the agency’s functional areas

- Increase data sharing and data availability across the agency
  - Identify and specify the data once
  - Collect the data continually
  - Use the data many times
  - Enhance awareness of the data that is available

- Support performance management by providing an agency wide data platform
  - Improve efficiencies
  - Help control agency-wide costs
DUAP Data Sources

- **Traditional System**
  - HPMS
  - Construction
  - Maintenance
  - Winter MDSS
  - Mobility
  - NWS Warnings (text)

- **Fixed**
  - ATMS (CCTV, DMS, MVDS counts)
  - NWS Radar
  - Environmental Sensor Stations (ESS)
  - National Weather Service (NWS) Stations

- **Mobile**
  - Integrated Mobile Observations (IMO) Fleet
  - Vehicle-Based Info & Data Acquisition System (VIDAS)
  - Ann Arbor CV Test Environment (AACVTE) Fleet
  - MDOT AVL Fleet (Winter Maintenance Vehicles)

- **Other Future Data**
<table>
<thead>
<tr>
<th>Planning &amp; Asset Management</th>
<th>Design</th>
<th>Construction</th>
<th>Maintenance</th>
<th>Operations</th>
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<tbody>
<tr>
<td>Pavement Conditions</td>
<td>Pavement Conditions</td>
<td>Pavement Performance Correlation with environment</td>
<td>Pavement Conditions</td>
<td>Pavement Conditions</td>
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<tr>
<td>• IRI</td>
<td>• Measure Rutting (traction control?)</td>
<td>• Long term pavement performance and cracking</td>
<td>• Friction</td>
<td>• Ice Forming</td>
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<td>• PASER sufficiency ratings</td>
<td>• Pavement Roughness vs. Fuel Consumption</td>
<td>• Tracking pavement conditions for verification of reported vehicle damage</td>
<td>• Ride Quality</td>
<td>• Tracking pavement conditions for verification of reported vehicle damage</td>
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<td>• Accelerometry</td>
<td>• Environmental conditions at time of placement</td>
<td>• Cure time in environmental conditions</td>
<td>• Defect Type and Location</td>
<td>• Friction</td>
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<tr>
<td>Traffic Planning</td>
<td>Intelligent Construction Probes for comprehensive As-builds</td>
<td>Weather/Environment Information</td>
<td>Workzone</td>
<td>Traffic Management</td>
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<tr>
<td>• Volume Distribution</td>
<td>• Determine actual subgrade compaction state</td>
<td>• Monitoring weather parameters</td>
<td>• Traffic Conditions, i.e. speed, volume, queue lengths</td>
<td>• Volume</td>
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<tr>
<td>• Volume Growth</td>
<td>• Environmental conditions at time of placement</td>
<td>• Frost depth</td>
<td>• Lane Departures</td>
<td>• Occupancy</td>
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<td>• Congestion Relief</td>
<td>• Best paving Conditions monitoring</td>
<td>• Work Conditions Monitoring, i.e. Rain Delays</td>
<td>• Worker Safety</td>
<td>• Speed</td>
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<td>• Roadway System Planning</td>
<td>• Environmental conditions</td>
<td>• Greenhouse gas emissions</td>
<td>• Monitor when Active</td>
<td>• Travel Time</td>
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<td>HPMS &amp; TMS</td>
<td>Weather stations</td>
<td>Weather</td>
<td>Incident Management</td>
<td>Incident Management</td>
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<tr>
<td>• Asset Location</td>
<td>• Ongoing environmental monitoring</td>
<td>• Winter Weather Maintenance</td>
<td>• Time of Occurrence</td>
<td>• Incident Report</td>
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<tr>
<td>• Current Conditions</td>
<td>• Impact on life of pavement</td>
<td>• Response Times</td>
<td>• Pinpoint locations</td>
<td>• First Responders Times</td>
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<td>• Systems Performance</td>
<td>• Rate of degradation of pavement</td>
<td>• Analyzing &amp; Tracking weather systems</td>
<td>• Damage tracking on infrastructure</td>
<td>• First Responders Guidance</td>
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<td>Reporting:</td>
<td>• Winter weather maintenance</td>
<td>• Winter maintenance activities</td>
<td>• Incident Cause</td>
<td>• Incident Locations</td>
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<td>• Volume</td>
<td>• Traffic monitoring</td>
<td>• General Year-round Maintenance</td>
<td>• Time to repair</td>
<td>• High Incident Locations</td>
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<tr>
<td>• Speed</td>
<td>• Mechanical/Empirical Pavement Design</td>
<td>• Damage Log</td>
<td>• Damage Log</td>
<td>• User Delay Cost</td>
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<td>• Occupancy</td>
<td>• Weather impact</td>
<td>• High Incident Locations</td>
<td>• High Incident Locations</td>
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<td>• Classification</td>
<td>• Fixed Station Placement</td>
<td>• User Delay Cost</td>
<td>• User Delay Cost</td>
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<td>• Travel Time</td>
<td>• Traffic monitoring</td>
<td>Site Monitoring</td>
<td>Signals</td>
<td>Weather Management</td>
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<tr>
<td>• Origin &amp; Destination Planning</td>
<td>• Impact of traffic on pavement over time</td>
<td>• Real time site monitoring</td>
<td>• Cost to Operate</td>
<td>• Treatment Status</td>
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<tr>
<td>Counts Path</td>
<td>• Classification, Load cell</td>
<td>• Utility Location for Construction Equipment (DGSC), i.e. Overhead Power Lines</td>
<td>• Volume</td>
<td>• Driving Conditions Status</td>
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<tr>
<td>• Pedestrian</td>
<td>• Traffic monitoring</td>
<td>• High precision as built mapping</td>
<td>• Incident Analysis</td>
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<td>• Bike</td>
<td>• Contractor Management</td>
<td>• Topological Analysis</td>
<td>• Vehicle Location</td>
<td>• Freight</td>
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<tr>
<td>Truck Tracking</td>
<td>• Conditions of Temporary Pavement (Ride Quality)</td>
<td>• Channel Systems Migration</td>
<td>• Signal Phasing</td>
<td>• Light</td>
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<tr>
<td>• Freight</td>
<td>• Monitor Road/Lane Closures</td>
<td>• Land Depressions</td>
<td>• Signal Delay</td>
<td>• Topography</td>
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<td>• Light</td>
<td>• Work Progress for Incentive Payments</td>
<td>• Water levels</td>
<td>• Parking availability</td>
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<tr>
<td>Rest Areas</td>
<td>• Vehicles Pulling in</td>
<td>Topological Analysis</td>
<td>• Volumes</td>
<td>• Parking availability</td>
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<tr>
<td>• Vehicles Pulling in</td>
<td>• Time spent</td>
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MDOT CV Data Use Applications

- **Initial Application Domains:**
  - Pavement:
    - Condition – Ride Quality, Surface Smoothness
    - Event – Pavement Defects & Severity – Potholes, Cracking
  - Weather:
    - Condition – Pavement Surface, Weather
    - Event – Pavement Advisory – Slippery, Icy, Snow Covered
  - Traffic:
    - Condition – Average Speed, SPaT
    - Event – Queues, Congestion, Incidents
Pavement Application Domain

- Supports:
  - Maintenance
    - Perf. Based Maintenance
    - Pavement Defect Detection
  - Design
    - Pavement Warranties
    - Pavement Life Cycle Analysis
  - Asset Management
    - Pavement Defect Detection
    - Surface Condition/Ride Quality
Pavement Application Data

- Traditional System
  - HPMS
  - Construction
  - Maintenance
  - Winter MDSS
  - Mobility

- Fixed
  - ATMS (CCTV, DMS, MVDS counts)
  - ESS Stations
  - NWS Stations

- Mobile
  - MDOT IMO Fleet
  - MDOT VIDAS Fleet
  - MDOT AVL Fleet

- Other Future Data
Weather Application

• Supports:
  • Maintenance
    • Maintenance Decision Support
    • Surface Condition Monitoring
  • Operations
    • Traveler Information
    • Real-time Situational Awareness
  • Traffic & Safety
    • Wx-Related Crash Monitoring
Weather Application Data

- Traditional System
  - MDSS (Treatment Recommendations)
  - NWS Warnings (text)

- Fixed
  - ATMS (CCTV, DMS, MVDS counts)
  - NWS Radar
  - ESS Stations
  - NWS Stations

- Mobile
  - MDOT IMO Fleet
  - MDOT VIDAS Fleet
  - AACVTE Fleet
  - MDOT AVL Fleet

- Other Future Data
Traffic Application

- **Supports:**
  - Maintenance
    - Incident Management
  - Construction
    - Real-time Work Zone Monitoring
  - Operations
    - Congestion/Queue Detection
    - Incident Management
  - Planning
    - Traffic Counts/AADT
Traffic Application Data

- Traditional System
  - Mobility
- Fixed
  - ATMS (CCTV, DMS, MVDS)
- Mobile
  - MDOT IMO Fleet
  - MDOT VIDAS Fleet
  - AACVTE Fleet
  - MDOT AVL Fleet
- Other Future Data
CV Fleet Instrumentation

- Vehicle Awareness Device (VAD)
- Aftermarket Safety Device (ASD)
- Automatic Vehicle Location (AVL) Level 1
- Automatic Vehicle Location (AVL) Level 2
- Vehicle-Based Info & Data Acquisition System (VIDAS)
Vehicle Awareness Device (VAD)

- **Instrumentation**
  - VAD Processor
  - 5.9 GHz DSRC Radio
  - On-Board Diagnostic (OBD-II)
  - GPS Antenna

- **Data Elements**
  - BSM (location, speed, heading, vehicle acceleration, etc.)

- **Applications**
  - Potential V2I applications such as:
    - Roadway maintenance application
    - Density of pedestrian traffic
    - Traffic signal timing
    - Traffic management
    - Support mobility applications
    - Support safety applications (supply BSMs)

- **Benefit**
  - BSM Data generation
  - Supports mobility applications
  - Traffic monitoring
Aftermarket Safety Device (ASD)

- **Instrumentation**
  - ASD Processor
  - 5.9 GHz DSRC Radio
  - On-Board Diagnostic (OBD-II)
  - GPS Antenna

- **Data Elements**
  - BSM (location, speed, heading, vehicle acceleration, etc.)

- **Applications**
  - Potential V2V safety applications such as:
    - Emergency brake-light warning
    - Forward-collision warning
    - Intersection movement assist
    - Blind-spot and lane-change warning
    - Do-not-pass warning
    - Control-loss warning
  - Potential V2I applications such as:
    - Signal priority for transit and emergency vehicles
    - Roadway maintenance application
    - Density of pedestrian traffic
    - Traffic signal timing
    - Traffic management
    - Traffic monitoring

- **Benefit**
  - BSM Data generation
  - Supports mobility applications
  - Traffic monitoring
Automatic Vehicle Location (AVL) Level 1

- **Instrumentation**
  - GPS Unit
  - Cellular
  - GPS Antenna

- **Data Elements**
  - GPS (location, speed, heading)

- **Applications**
  - Pavement Maintenance
  - Pavement Condition
  - Pavement Performance

- **Benefit**
  - Support Asset Management
  - Support Fleet Management
  - Support Maintenance Activities
Automatic Vehicle Location (AVL) Level 2

- **Instrumentation**
  - GPS Unit
  - Cellular
  - GPS Antenna
  - Environmental Sensors
    - DICKEY-John Material Controller
    - RoadWatch

- **Data Elements**
  - GPS (location, speed, heading)
  - Material Application Rate
  - Air & Pavement Temperature
  - Blade Position (Up/Down)

- **Applications**
  - Weather
  - Winter weather maintenance
  - Maintenance material usage
  - Pavement maintenance
  - Pavement condition
  - Pavement performance

- **Benefit**
  - Support Maintenance Activities
  - Support Fleet Management
  - Support Maintenance Activities
Vehicle-Based Info & Data Acquisition System (VIDAS)

- **Instrumentation**
  - VIDAS Processor
  - 5.9 GHz DSRC Radio
  - GPS Unit & Antenna
  - Cellular
  - Wi-Fi
  - Additional Sensors
    - Accelerometer
    - Ultrasonic Distance Sensor
    - Roadwatch

- **Data Elements**
  - GPS (location, speed, heading)
  - Environmental (Air Temp, Surface Temp, Humidity, Dew Point)
  - Pavement Defect (Accelerometer (Displacement, Gyroscope, Compass))
  - Pavement Profile (Ultrasonic Distance (Distance to Roadway Surface))
  - Option for Additional Data Elements

- **Applications**
  - Mobility Applications
  - Fleet Management
  - Pavement condition
  - Pavement maintenance
  - Weather
  - Winter maintenance
  - Asset Management

- **Benefit**
  - Support mobility applications
  - Support maintenance activities
  - Support research activities
  - Support asset management
  - Support research projects
  - Supports pavement design
# MDOT Fleet CV Data

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Questions