CONNECTED VEHICLE PILOT
Deployment Program

Performance Measurement and Evaluation Support Plan
ICF/Wyoming CV Pilot

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Fred M Kitchener/McFarland Management, PM Lead
Purpose of this Webinar
- To share the Performance Measurement and Evaluation Support plan from the ICF/Wyoming team with the stakeholders of connected vehicle technologies.

Webinar Content
- Connected Vehicle Pilot Deployment Program Overview
- ICF/Wyoming Performance Measurement and Evaluation Support Plan
- Stakeholder Q&A
- How to Stay Connected

Webinar Protocol
- Please mute your phone during the entire webinar
- You are welcome to ask questions via chatbox at the Q&A Section
- The webinar recording and the presentation material will be posted on the CV Pilots website
CONNECTED VEHICLE PILOT DEPLOYMENT PROGRAM

PROGRAM GOALS

- Participate in Concept Development Phase Webinars for the three Pilot Sites (see website for exact dates and times)

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- Visit Program Website for Updates: [http://www.its.dot.gov/pilots](http://www.its.dot.gov/pilots)
- Contact: Kate Hartman, Program Manager, Kate.hartman@dot.gov

PILOT SITES

- ICF/Wyoming DOT
- NYCDOT
- Tampa (THEA)

STAY CONNECTED
High Crash Rates

- Winter crash rate (October to April) has been found to be 3 to 5 times as high as the summer crash rates
- Speed management is critical

4/13/2014 - Between Laramie and Rawlins - Speeds reduced to 45 mph in VSL zone – 0 Fatalities - 70+ vehicles
4/15/2015 - Between Cheyenne and Laramie - Speeds reduced to 45 mph in VSL zone – 0 Fatalities - 65+ vehicles
4/20/2015 - Between Laramie and Rawlins - Speeds 75 mph (no VSL available) – 2 Fatalities - 65+ vehicles
Five Focus Areas

- Manage following speed and distance between vehicles by alerting trucks to slowing traffic ahead to prevent multiple-vehicle crashes.

- Provide custom alerts and advisories for vehicles that are at risk due to their weight, profile or traveling speeds due to high-winds, near work zones, include alerting drivers if their vehicles are too tall for bridges.

- Provide location-based parking information with a focus on directing drivers to safe parking areas in the event of a road closure.

- Allow first responders to be notified of a crash automatically based on vehicle metrics, such as airbag deployment.

- Use data collected from vehicle’s weather sensors such as the status of windshield wipers and if anti-lock brake systems are activated. This information will be used to develop advisories and forecasts for travel to fleet management centers and the general public.
### Goals for WYDOT

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Operational</strong></td>
<td>Not an R&amp;D effort. To be used by WYDOT Operations for immediate needs</td>
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<tr>
<td><strong>Scalable and Sustainable</strong></td>
<td>Ability to incorporate new fleets and applications</td>
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<td><strong>Evolutionary</strong></td>
<td>Ability to start with a few applications/services but grow to an eco-system of services</td>
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<td><strong>Replicable</strong></td>
<td>Be a model deployment for rural freight-heavy corridors</td>
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<td><strong>Leveraged</strong></td>
<td>Maximize use of already created federal investments and state initiatives. Do not recreate the wheel</td>
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## PMs Are Represented in 9 Categories

<table>
<thead>
<tr>
<th>Road Weather Condition Input</th>
<th>TMC Information Dissemination</th>
<th>Vehicle/Roadside Alerts &amp; Advisories</th>
<th>Outcomes</th>
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<tbody>
<tr>
<td>Improve road weather condition reports received into the TMC</td>
<td>Improve ability of the TMC to generate alerts and advisories</td>
<td>Effectively transmit and receive V2V messages</td>
<td>Improve speed adherence and reduce speed variation</td>
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<tr>
<td>Efficiently disseminate broad area traveler information</td>
<td>Effectively disseminate and receive I2V or V2I alert/advisory messages from TMC</td>
<td>Automate emergency notifications of a crash</td>
<td>Reduce vehicle crashes</td>
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<tr>
<td>Improve information to commercial vehicle fleet managers</td>
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**U.S. Department of Transportation**
Performance Measures

Improve road weather condition reports received into the TMC

1. Number of road weather condition reports per road segment/day pre and post CV Pilot (quantity)
2. Miles with at least one reported road condition per hour pre and post CV Pilot (coverage)
3. Average refresh time of road condition reports in each segment pre and post CV Pilot (latency)

Improve ability of the TMC to generate alerts and advisories

4. Pikalert™ generated alerts and advisories that were accepted by TMC operators

Efficiently disseminate broad area traveler information

5. TMC staff time to disseminate broad area traveler information. Activities include log/process road condition reports and activate/update VSL, DMS, and HAR systems
6. Qualitative improvements in 0-6 hour road weather forecasting accuracy due to enhanced road condition data
Performance Measures

7. Alerts/advisories sent from the TMC and received by the RSU
8. Alerts/advisories sent and received between the RSU and OBU
9. Connected vehicles that took action following receipt of an alert
   a. Parked
   b. Reduced Speed
   c. Came to a stop safely
   d. Detoured

10. Number of operational changes made by fleet managers due to information from TMC during CV Pilot
   a. Routing
   b. Timing
   c. Parking availability
   d. Canceled trips

11. Commercial vehicle managers are satisfied with information provided by the TMC during the CV Pilot
   a. Road conditions
   b. Road weather forecasts
   c. Parking information
Performance Measures

12. V2V alerts properly received in surrounding vehicles from sending vehicle

13. Connected vehicles that took action following receipt of a V2V alert
   a. Parked
   b. Reduced Speed
   c. Came to a stop safely
   d. Detoured

14. Number of emergency notifications that are first received in the TMC from connected vehicles (compared to alternate traditional methods, such as 911 caller)
Performance Measures

15. Total vehicles traveling at no more than 5 mph over the posted speed (compare before and after CV Pilot)
16. Total vehicles traveling within +/- 10 mph of 85th percentile speed (compare before and after CV Pilot)
17. Speed of applicable connected vehicles are closer to posted speed when compared to non-connected vehicles

18. Reduction of total and truck crash rates of along the corridor *
19. Reduction of the number of vehicles involved in a crash *
20. Reduction of total and truck crash rates within a work zone area *
21. Reduction of critical (fatal or incapacitating) total and truck crash rates in the corridor *
22. Number of connected vehicles involved in a crash
   a. Initial crashes
   b. Secondary crashes

* Compare a 5-year average before Pilot to CV Pilot data and track connected versus non-connected vehicles
ICF Wyoming CV Pilot Confounding Factors
Confounding Factors

- **CV Technology Penetration Rate**
  - 400 – 500 connected vehicles – known location and time
  - Estimate penetration rate – support understanding evaluation results
  - Simulation modeling will provide additional insights

- **CV Technology Adoption**
  - New technology = CHANGE (process, equipment, etc.)
  - Myriad agencies, users, stakeholders
  - Significant system training, follow-up
  - Qualitative assessments will help to understand technology adoption

- **Freight and Passenger Vehicle Demand**
  - Freight demand dependent on economic conditions, fuel prices, construction, etc.
  - Alternate routes are generally not practical
  - Numbers of trucks and cars will be tracked throughout demonstration
Confounding Factors

- **Weather Condition Variability**
  - Need to conduct evaluation analysis during like conditions
  - Before/after and with/without analysis methods
  - Weather events will be logged and categorized (baseline and demonstration)
  - Data comparisons will be for like weather events

- **Availability of Sensing in the Corridor**
  - Weather, speed sensing – focused in VSL corridors (35% of corridor)
  - Roughly 6-7 mile spacing (heavily instrumented Interstate corridor)
  - Supplement: Proposing mobile sensor trailers (budget permitting)

- **Limited Duration of Evaluation Activities**
  - Primarily focus on weather events – mostly winter seasons
  - Aggressive project schedule allowing for two evaluation periods
    - 2017-2018 winter season
    - 2018-2019 winter season
ICF/Wyoming CV Pilot Impact Evaluation Design
Five Evaluation Designs

- **Before – After**
  - Comparison of pre and post deployment
  - Key: documented baseline (planned in Phase II)

- **With – Without**
  - Compare with and without technology deployment during same conditions
    - Equipped vehicles compared to non-equipped vehicles at same time, location

- **System Performance**
  - Evaluate how well system worked
    - Alerts/advisories created, sent, received (I2V, V2I, V2V)

- **Behavior Assessment**
  - Measure driver’s actions that result from CV technology application

- **Qualitative Assessment**
  - Surveys and Interviews with key stakeholders
  - Supplemental to quantitative analyses
    - Learn details regarding perceptions, likes/dislikes, and the why, when, and how’s
<table>
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<tr>
<th>Evaluation Category</th>
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<th>With – Without</th>
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<th>Behavior Assessment</th>
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<td>Improved alerts - advisories</td>
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<td>Disseminated broad area Traveler info</td>
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<td>Sent, received V2I alerts-advisories</td>
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<td>Information to CVO fleet managers</td>
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Contextual Performance Measurement Data

- Connected Vehicle Location at all times (time, location, direction)
- Estimated connected vehicle penetration rate
- Weather event and road condition characteristics at all times
- Alert/advisory message details (number, type, content, time stamp, and location)
- Connected vehicle incidents
- Equipment reliability and up-time
Many PMs will use Before-After evaluation design method

Establishing a baseline (prior to CV technology deployment) is essential to successful evaluation

- Phase II activity

Examples of baseline data

- Traffic characteristics – truck and cars
- Road weather condition reports
- TMC operator time to conduct key actions
- Baseline surveys of key stakeholders
- Vehicle speed, speed variation
- 5-year history of crash data
ICF/Wyoming CV Pilot Data Collection Plan
Data Collection

- Data types
  - System
  - Non-System
  - Survey
  - Modeling and simulation
  - Interview

- Frequency of data collect is dependent on type and system

- Stored in WYDOT Data Warehouse

- Baseline data collection

- Data available to evaluate Performance Measures
## Data Types

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<th>Elements</th>
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<tr>
<td>System</td>
<td>BSMs, alerts/advisories, RSU logs, DSRC logs, OBU logs, PikAlert logs, TMC logs, WTI updates, crash notifications, partner fleet manager data, security breaches, mobile road weather observations, other connected vehicle alerts</td>
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<tr>
<td>Non-System</td>
<td>Traffic data, crash records, road closures, RWIS data, DMS logs, Construction and maintenance event logs</td>
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<tr>
<td>Survey</td>
<td>Participant survey results pre and post deployment</td>
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<tr>
<td>Model and Simulation</td>
<td>VISSIM simulation model results, UW driver simulator analysis results</td>
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<tr>
<td>Interviews</td>
<td>Stakeholder interview results pre and post deployment</td>
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ICF/Wyoming CV Pilot Performance Reporting and Data Sharing
Data Sharing

- System performance data will be shared with USDOT and Independent Evaluator on a regular basis
  - System data – as appropriate
  - Crash and other outcome data – seasonally, focused on weather events

- Templates and dashboards will be created for efficient data sharing
  - USDOT and Independent Evaluator

- Appropriate data will be uploaded to RDE at appropriate times during the Pilot
ICF/Wyoming CV Pilot
Next Steps
Next Steps

- Complete Phase 1 activities – Deployment Plan
- Baseline data collection and documentation
- Revise Performance Measurement and Evaluation Support Plan
- Execute during demonstration
  - 2017 – 2018 winter – WYDOT and TriHydro vehicles
  - 2018 – 2019 winter – add other commercial vehicle partners
STAKEHOLDER Q&A

- Please keep your phone muted

- Please use chatbox to ask questions

- Questions will be answered in the order in which they were received
Contact for CV Pilots Program:
Kate Hartman, Program Manager
Kate.Hartman@dot.gov

Join us for the Getting Ready for Deployment Series

- Discover more about the CV Pilot Sites
- Learn the Essential Steps to CV Deployment
- Engage in Technical Discussion

Website: http://www.its.dot.gov/pilots
Twitter: @ITSJPODirector
Facebook: https://www.facebook.com/USDOTResearch

CV Pilot Sites’ Performance Measurement Webinars

- 6/6/2016, 2:00 pm – 3:00 pm ET
  ICF/WYDOT Performance Measurement Webinar

- 6/6/2016, 3:30 pm – 4:30 pm ET
  NYCDOT Performance Measurement Webinar

- 6/7/2016, 12:00 pm – 1:00 pm ET
  Tampa (THEA) Performance Measurement Webinar

Please visit the CV pilots website for the recording and the briefing material of the previous webinars.