NCHRP 20-68A

"US Domestic Scan Program"

Domestic Scan 17-01

"Successful Approaches for the Use of Unmanned Aerial Systems (UAS) by Surface Transportation Agencies"

Findings, Conclusions and Recommendations

Report to Southeast Bridge Preservation Partnership

April 2019

NCHRP UAS Domestic Scan 17-01

Anticipated Objective

"The scan focus and objectives shall provide a better understanding of the proactive use of UAS technology as well as the ***return on investment and its benefits*** to the surface transportation community. This scan will ***assist the accelerated national deployment of the technology by providing "Getting Started" guidance and case studies of successful applications of UAS.*** The scan will also provide valuable information concerning where additional development and research might be needed to support the increased use of this technology."

NCHRP UAS Domestic Scan 17-01

Successful Approaches for the Use of Unmanned Aerial Systems by Surface Transportation Agencies

- This scan was conducted as a part of NCHRP Project 20-68A, the U.S. Domestic Scan program.
- The program was requested by AASHTO with funding provided NCHRP.
- First meeting in Washington DC – December 13, 2017
  - Develop a work plan
  - Develop amplifying questions for selected state DOT participants
- Interview and Scan Location: San Diego, CA, April 8-14, 2018

NCHRP UAS Domestic Scan 17-01

Team Members

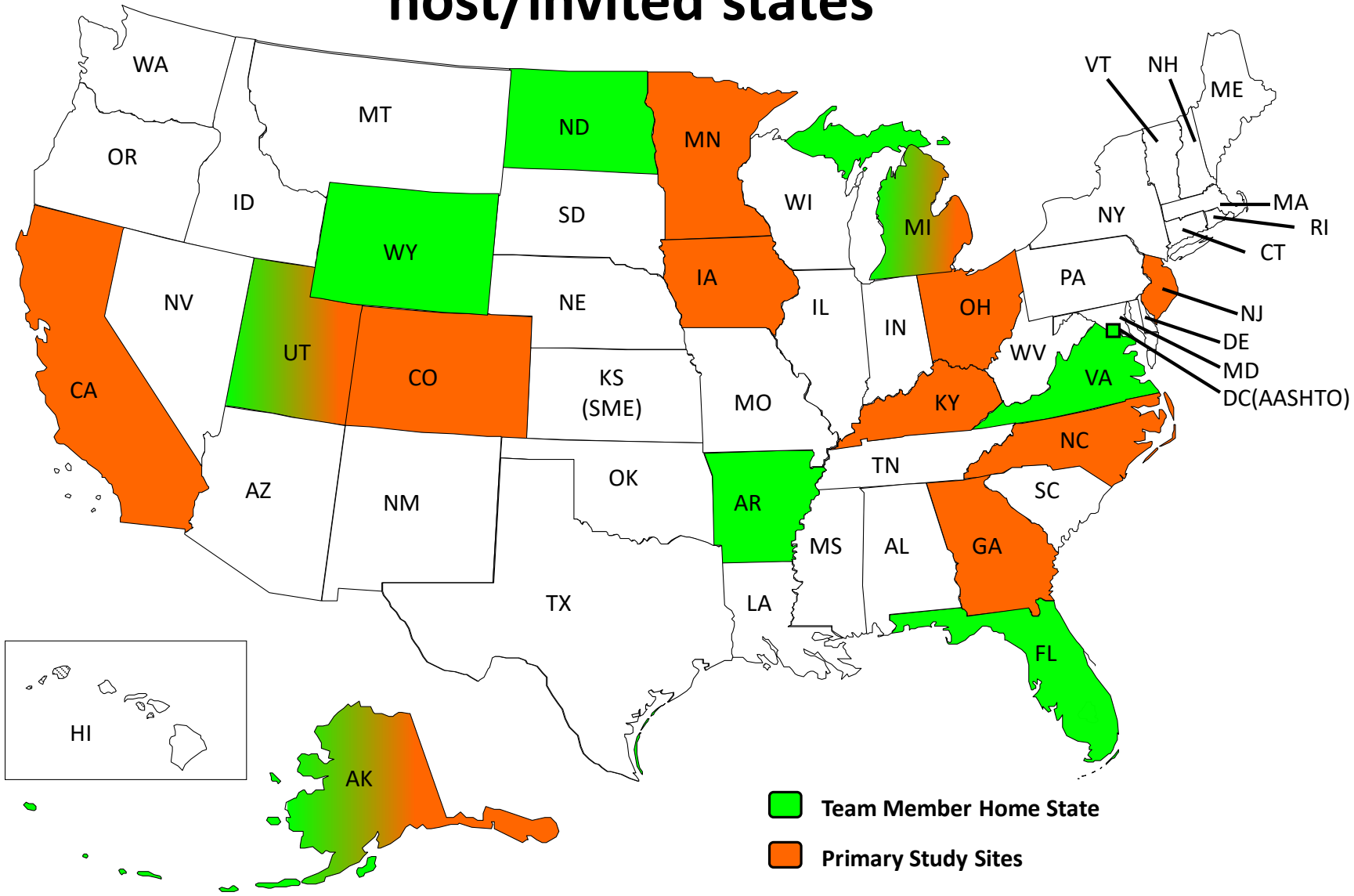
Emanuel Banks	Arkansas Department of Transportation (AASHTO Chair)
James Gray	Federal Highway Administration
Jeffery Milton	Virginia Department of Transportation
Amy Tootle	Florida Department of Transportation
Gregg Fredrick	Wyoming Department of Transportation
Troy Larue	Alaska Department of Transportation
Steve Cook	Michigan Department of Transportation
Stephen Smith	Vermont Department of Transportation
Paul Wheeler	Utah Department of Transportation
Paul Snyder	Dubuque-Snyder Aviation Consulting (Subject Matter Expert)
Zachary Waller	Dubuque-Snyder Aviation Consulting (Subject Matter Expert)
Shayne Gill	American Association of State Highway and Transportation Officials (AASHTO Liaison)

Peer Exchange Workshop

Scan participants reviewed applications of UAS by Surface Transportation Agencies from 12 states:

- Alaska
- California
- Colorado
- Georgia
- Iowa
- Kentucky
- Michigan
- Minnesota
- New Jersey
- Ohio
- North Carolina
- Utah

Scan 17-01 Team Members Home States and selected host/invited states



General Guidance to Scan Team

Information gathered included but is not limited to:

- Why, how, and where are they are using this technology for inspection, inventory, survey, etc.
- How the data is being stored and used
- What control method is being used (remote control or autonomous)
- What attached devices are being used
  (i.e. HD cameras, video cameras, Infrared, LiDAR, etc.)
- How is agency organized to manage the use of UAS
- Who is the Owner/Operator of the UAS:
  (agencies, Contractors, Consultants, and/or Universities)
- Costs and realized Benefits
- Barriers, obstacles and opportunities experienced in deployment

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Summary of Initial Findings

- Findings presented here were gleaned from four days of presentations, group discussions and participant notes.
- The scan team settled on the seven themes below for "Getting Started with UAS"
  1) Executive Support
  2) Organizational Structure
  3) Policy and Regulation
  4) Safety and Risk Management
  5) Training and Crew Qualifications
  6) Public Relations
  7) Application and Operation

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Finding 1 - Executive Support Conclusions:

- **Successful programs have executive support**
- Successful programs recognize the importance of planning both the initial for purchase - and operations and maintenance
- Successful programs agreed that UAS save resources, increase efficiency, and improves safety
- **Successful programs emphasize the benefits of UAS, but understand negative connotations related to the technology**

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Finding 2 - Organizational Structure Conclusions:

- **Successful programs have a centralized authority and top-down support**
- **Successful programs leveraged existing aviation experience in their state**
- Successful programs utilized a variety of funding models but had a dedicated source
- **Successful programs recognized that a relationship with - and understanding of - the FAA is critical**
- Successful programs dedicated personnel to understanding and keeping up with federal, state and local regulations
- Successful programs transferred knowledge across departments and encouraged transparency through relationships
- Successful programs increased efficiency through fleet management and resource sharing

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Finding 3 - Policy and Regulation Conclusions:

- **Successful programs align their policies and procedures to be consistent with federal and state regulations**
- Successful programs have expertise in UAS regulations and the ability to keep up with changes
- Successful programs understand how to obtain airspace authorization and work with local airports
- Successful states promoted existing regulation within the state to prevent unneeded regulations on a state or local level
- **Successful programs developed or adopted policy and procedures manual for UAS operations**

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Finding 4 - Safety and Risk Management Conclusions:

- **Successful programs have a system to manage safety, which includes Emergency Response Plans (ERP) and safety policy**
- Successful programs have proper personnel and equipment for each mission
- Successful programs have flight risk assessment tools and risk acceptance procedures
- Successful programs have adopted and promote an aviation safety culture
- Successful programs assure adequate insurance

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Finding 5 - Training and Crew Qualifications Conclusions:

- **Meeting Part 107 minimum requirements is not a guarantee of the UAS expertise needed in surface transportation UAS applications**
- Successful programs establish and maintain initial and recurrent training needs for proficiency
- Successful programs tailored training needs to the varied applications of UAS
- Successful programs identified expectations of UAS operations with management
- **Successful programs use training to educate users on Alternate Methods of Compliance (AMOC) for UAS operations such as night operations, flight over people, or complex airspace**

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Finding 6 - Public Relations Conclusions:

- **Successful programs have a plan that identifies and addresses target audiences**
  - **Internal (legislators, executive & technical staff, state employees)**
  - **External (federal, local, university, vendors, public, and airports)**
- **Successful programs identify existing regulations, rules, and policies and positive use of social media, videos, and outreach to educate UAS users (Commercial use and Hobbyists)**
- Successful programs include media into worksite set up addressing privacy, safety, notice for operation, on-site interaction during UAS flight
- Successful programs include communication office in their Emergency Response Plan (ERP)

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Finding 7 - Application and Operation Conclusions:

- **Each state transportation agency is unique**
  - **It is important to recognize data needs vary and should be systems requirements driven**
- Successful programs start small and grow with success
- Successful programs did not require a large investment to get started
- Successful programs justified UAS use with increase safety, reducing liability, saving money, greater productivity, better end product, protect environment, and reduced impact on public
- **Successful programs followed standard operating procedures**
- **Successful programs leveraged UAS across disciples and shared UAS assets throughout state**
- **Successful programs had workflow processes for data collection storage, usage, application development, and repurposed use of data collected**

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Final Conclusions

- Invited and host state transportation agencies have collectively developed significant use cases for UAS which supplement their surface transportation efforts

- Future UAS programs among state transportation agencies should…
  - consider further validation of these applications with rigorous benefit-cost analysis as well as
  - investigate whether UAS data can be integrated into agencies existing programs/methods and if it's suitable for meeting industry standards

Schedule Moving Forward

- The final report is available on the TRB website:
  http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP20-68A_17-01.pdf
- Various dissemination activities will be undertaken by the scan team over the next several months

Questions?

AASHTO / NCHRP
U.S. Domestic Scan Program

Additional Activities Concerning UAS

Proposed Research - Michigan Tech Research Institute

Additional Activities Concerning UAS

- **Proposed Research - Michigan Tech Research Institute**
  - **Michigan Tech Research Institute has developed a Research Needs Statement titled “Evaluating and implementing unmanned aerial systems (UAS) into bridge management methods through element-level data collection”.**

Additional Activities Concerning UAS

- **Proposed Research - Michigan Tech Research Institute**
  - **This research will be focused on field testing the application of UAS based bridge inspections as it relates to supporting bridge management data collection and practices at the element level. Field inspections and integration of resulting data into bridge management workflows, including working with multiple transportation agencies, will be used to achieve the following objectives:**

Additional Activities Concerning UAS

- **Proposed Research - Michigan Tech Research Institute**
  - **Objective 1. Determine which bridge element types are most suited to UAS assessment.**
  - **Objective 2. Determine what types of required element-level bridge management data cannot be collected via UAS and compare to traditional methods.**
  - **Objective 3. Compare UAS collected element-level data to data collected by an inspector with respect to data type, quality, cost, time required, traffic impact, or other.**

Additional Activities Concerning UAS

- **Proposed Research - Michigan Tech Research Institute**
  - **This RNS has been reviewed and endorsed by the TRB AHD35 Bridge Management Committee**
  - **This RNS will be submitted to AASHTO COBS and AASHTO MaC for consideration**

Additional Activities Concerning UAS

FHWA EDC-5 Innovations

Additional Activities Concerning UAS

➢FHWA EDC-5 Innovations

- What is *"Every Day Counts"*(EDC)?
  - State-based model to identify and rapidly deploy proven but underutilized innovations to:
    - shorten the project delivery process
    - enhance roadway safety
    - reduce congestion
    - improve environmental sustainability
    - EDC Rounds: two year cycles
    - Initiating 5thRound (2019-2020) -10 innovations
    - To date: 4 Rounds, over 40 innovations

Additional Activities Concerning UAS

➢FHWA EDC-5 Innovations

- Unmanned Aerial Systems
  - **What are they? "Drones”**
    - Multi-use aircraft controlled from a **licensed** operator on the ground
    - Coupled with sensors such as high definition cameras and LiDAR
  - **What are they used for?**
    - Enhanced data acquisition for:
      - **Structural Inspection**
      - **Construction Inspection**
      - **Emergency Response**

Additional Activities Concerning UAS

➢FHWA EDC-5 Innovations

- Benefits
  - *“An average cost savings of 40% over traditional inspection methods” - -Minnesota DOT*
  - *“Workforce was 45% more productive and the project was completed ahead of schedule” - -Utah DOT*
  - *“Reduced lane closures and increased safety for both workers and the traveling public” - -New Jersey*

Additional Activities Concerning UAS

➢FHWA EDC-5 Innovations

- Mission Statement - To facilitate the National Deployment of Unmanned Aerial Systems (UAS) to increase safety and efficiency, while saving time and money for the taxpayers.

Additional Activities Concerning UAS

- **FHWA EDC-5 Innovations**

  - **Structural Inspection**
    - **Bridge Inspection**
    - **High Mast Lighting**
    - **Confined Space Inspection**
    - **Retaining Walls**
    - **Tunnels**

Additional Activities Concerning UAS

- **FHWA EDC-5 Innovations**

UAS can support traditional bridge inspection practices to provide rapid, high-quality data.

Additional Activities Concerning UAS

- **FHWA EDC-5 Innovations**

  - Construction Inspection
    - Surveying
    - Routing Inspection
    - Construction Quantities
    - Pre-Construction/Project Scoping
    - Work Zone Traffic Monitoring

Additional Activities Concerning UAS

- **FHWA EDC-5 Innovations**

  - **Emergency Response**
    - **Flooding Events**
    - **Wind Events**
    - **Earth Movement (landslides, mudslides, volcanoes)**
    - **Fire Events**
    - **Earthquakes**