Executive Summary, Research Readiness Level Assessment, and Technology Transfer

Research and Education for Optimizing the Development and Implementation of an Unmanned Aircraft Program at the Nebraska Department of Transportation

Research Objectives

The goal of this project was to conduct research and education to optimize and document the development and implementation of a new unmanned aircraft program for the Nebraska Department of Transportation (NDOT). To accomplish this goal, the Nebraska Unmanned Aircraft Innovation, Research and Education (NU-AIRE) laboratory at the University of Nebraska-Lincoln provided research and education for NDOT so that the Unmanned Aircraft Systems (UAS) Program Manager and affiliated personnel are able to efficiently establish a successful and safe in-house UAS program. This initial phase of the effort included research and education for: 1) Administrative policy development, 2) Training, and 3) Operations and Use Case analysis, with subsequent phases to be determined, based on status, and need.

Research Benefits

This project resulted in the development and implementation of an unmanned aircraft program within the NDOT, that is built on a comprehensive administrative policy, culture of safety and demonstrated expertise in successfully accomplishing missions. This included research of high priority use cases where NDOT anticipates the use of UAS to improve efficiencies, provide better data and/or make for safer operations to NDOT and the public. The documentation produced proved to be helpful not only to NDOT, but to other state departments of transportation that are in the process of building their in-house UAS program.

Principal Investigator

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Background

It has recently become legal to fly Unmanned Aircraft Systems (UAS) in US airspace for commercial purposes. This stems from the FAA reauthorization act that enacted by Congress and signed into law in 2012, which included a specific, but little-known provision directing the FAA to develop regulations to bring UAS into US airspace by Sept 30, 2015 (actual timeframe was circa August 2016). The confluence of new UAS regulations that allow commercial unmanned aerial operations, and a thriving U.S. economy, leads to the reality that UAS opportunities in surface transportation will expand significantly in the next decade and beyond.

The opening of National Air Space to UAS has the potential to be a “game changer” for the surface transportation industry, much like GPS, GIS, and associated information technologies. UAS will offer an unparalleled opportunity to place sensors, robotics, and advanced information systems at desired locations for increasing productivity, improving efficiency, and enhancing safety of surface transport systems. The commercial market for UAS is expected to triple in the next 5 years, with a projected increase to $42.5 billion by 2024 from a global perspective. Control of the National Air Space will be achieved through implementation of emerging NextGen technology aligned with Unmanned Aircraft Systems Traffic Management (UTM), which will be based on a GPS foundation. These developments present a compelling motivation for the NDOT to develop and implement an in-house unmanned aircraft program.

It is generally accepted that the commercial use of unmanned aircraft, and their associated control and sensor systems, are a relatively recent phenomenon, with the recent promulgation of Federal Aviation Administration (FAA) Part 107 regulations, establishing a new Remote Pilot Certificate (circa August 2016). Never-the-less, there have been some agencies and organizations that have initiated the development and implementation of internal UAS programs to meet their needs. Some of these agencies and organizations include the US Department of Interior, University of Nebraska, North Carolina Department of Transportation, Alabama Department of Transportation, as well as a host of others, that are seeking to define a UAS ecosystem, within the given agency/organization.

In addition, the Federal Highway Administration (FHWA) has identified Unmanned Aircraft Systems as one of the innovations on their Every Day Counts (EDC-5) initiatives. The EDC-5 initiatives span 2019 and 2020 and are identified as innovations that can accelerate the delivery of highway projects and foster a culture of innovation within the transportation community. NDOT’s pursuit of developing an Unmanned Aircraft Program directly aligns with this.

Conclusion

This report describes the development and implementation of an Unmanned Aircraft System Program at the Nebraska Department of Transportation (NDOT). The project involved the selection and purchase of appropriate UAS and imaging systems for NDOT, education and training for NDOT personnel with classroom and hands-on operation of UAS with the goal of obtaining proficiency and pilot licenses. In addition, the development of policy for the use of UAS within NDOT was accomplished as well as standard operating procedures (SOP) documentation and the development of example case studies of interest to NDOT using the purchased systems and technology.

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Interested in finding out more?
Final report is available:
HERE

NDOT Recommendations Based Off Research Project – 2021 – RRL4

Based on lessons learned during this project, the following are the recommendations that NDOT has developed for the next steps of the program: Expanded use of UAS at NDOT to include additional pilots geographically located throughout Nebraska to better respond to basic UAS operations. Expanded UAS equipment to take advantage of additional efficiency gains:

1. Thermal Sensor- Add thermal sensor to M210 package to continue evaluating the use of thermal imagery for detecting bridge delamination, as well as environmental uses in counting/locating bats and birds.
2. LIDAR- Obtain a UAS LIDAR system to expand and integrate aerial LIDAR data into our survey practices; allowing for remote sensing and safer operations where this technology makes sense.
3. Pursue and acquire a UAS Program management technology to log and track all UAS assets (equipment, pilots, missions, maintenance, etc.) that can be configured to align with NDOT UAS SOPs.
4. Pursue a waiver to § 107.31 Visual Line of Sight Aircraft Operation to allow for daisy chaining visual observers to make larger, linear missions more feasible to perform. 5. Develop additional case studies to support the NDOT program, such as highway bridge monitoring and wetland habitat mapping for example, drawing from existing expertise at UNL for these applications.

- *As provided by Jon Starr, Lead TAC Member*

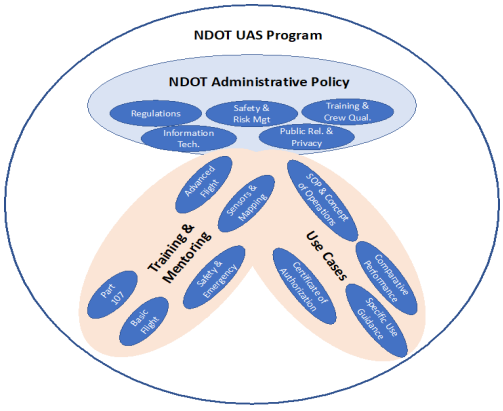

Figure 1 UAS Operational Framework

Figure 2 Unmanned Aircraft Drone

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NDOT Recommendations Based Off Research Project – 2025 – RRL5

NDOT UAS Program Overview

Over the past four years, the Nebraska Department of Transportation (NDOT) has been actively developing and implementing a comprehensive Unmanned Aircraft Systems (UAS) program. This initiative has focused on establishing an adaptive and agile framework to optimize operational processes and enhance project efficiency.

Program Framework and Collaboration

NDOT successfully established a UAS operational framework, as outlined in Figure 1, leveraging research and expertise from the Kansas State University, a recognized leader in UAS education and innovation. The resulting internal policy was designed to bring an in-house UAS program to operational status in a safe, efficient, and scalable manner.

Training and Certification

Training has been delivered across 6 of the 8 NDOT districts, as well as to personnel within the Materials and Research, Project Development, and Bridge Divisions at the Central Complex. To date, 19 certified UAS operators have been trained to ensure consistent and compliant operations.

UAS Applications

NDOT's UAS program currently supports a wide range of applications, including:

1. Construction Project Monitoring
2. Construction Project Preliminary Survey
3. Earthwork Volume Calculations
4. Stockpile and Borrow Pit Measurement
5. Erosion Control and Seeding Compliance
6. Asset Management of Facilities
7. Wetland Mitigation Site Monitoring (Annual Reporting)
8. Thermal Inspections and Bridge Assessments
9. NDOT Media for Publications and Social Media

All certified UAS pilots are required to log and monitor their flight hours to ensure safety and compliance.

Program Highlights

NDOT has documented key projects through UAS footage to showcase the capabilities and benefits of the program. One such highlight can be viewed at the following link: NDOT UAS Construction Project Highlight

The benefits of introducing UAS technologies into NDOT's practices include:

- Safety: Data acquisition in areas where traditional workers would need to put themselves at risk (i.e. an active roadway, steep slopes, or generally hard-to-reach areas).
- Efficiency (time and cost savings): Data acquisition with UAS can be accomplished in shorter time compared to traditional surveying methods, resulting in time and cost savings.
- Accuracy: Depending on the application, UAS data can be more accurate than traditional surveying methods due to the amount of data that can be captured efficiently and by taking the element of human error out of the equation.

- *Implementation provided by Jording Shawn*

Research Readiness Level (RRL) Assessment

RRL 5

Level 5: Standard Practice

Research adopted; no evaluation is required. Moved up from RRL Level 4, assessed in 2021

This brief summarizes Project SPR-P1 (20) M117
"Research and Education for Optimizing the Development and Implementation of an Unmanned Aircraft Program at the Nebraska Department of Transportation"
Nebraska Department of Transportation Research Program