BIRDS AREN’T REAL - TXDOT'S UAS PROGRAM AND THE BIRTH OF A DIGITAL TWIN

How TxDOT developed a UAS program, how remote sensing data will help create digital twins, and how contractors can use drones for TxDOT projects.
Presenters

Travis Scruggs
GIS Analyst/UAS Pilot
TxDOT – Transportation, Planning, and Programming Division

Sergio Roman
UAS Coordinator/UAS Pilot
TxDOT – Aviation Division
Birds aren’t real?!
DRONES ARE REPLACEABLE. YOU ARE NOT.

How Drones are increasing safety and redefining what we have considered ‘acceptable risk’
What we mean when we say “drone”

- An UAS (aka Drone) is an aircraft operated without the possibility of direct human intervention from within or on the aircraft.
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Typically used for data collection, infrastructure inspection, mapping and modeling, etc.

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- An UAS (aka Drone) is an aircraft operated without the possibility of direct human intervention from within or on the aircraft.

- Typically used for data collection, infrastructure inspection, mapping and modeling, etc.

- Capable of carrying LiDAR, high-resolution Imagers, and other data collection sensors.
HELP

#EndTheStreakTX
End the streak of daily deaths on Texas roadways.
Why TxDOT, Why Drones?
Why TxDOT, Why Drones?
Why TxDOT, Why Drones?
Why TxDOT, Why Drones?
Why TxDOT, Why Drones?
Why TxDOT, Why Drones?
Use cases and Safety facts
OSHA: bridge inspectors have a higher rate of fatal and nonfatal injuries than other workers in the construction industry.

Bureau of Labor Statistics: 120 fatal injuries per year on bridge and road work

2019 FHWA study: Drones reduce risk of injuries and accidents by up to 90%
Survey

- Bureau of Labor Statistics: 10 fatal injuries per year on bridge and road work

- Journal of Occupational and Environmental Safety: UAS can reduce the risk of accidents and injuries for land surveyors by up to 75%.
**Survey**

- Fly Drone to collect data and generate point clouds from
  - RGB imagers
  - LiDAR

- Thousands of points with an X,Y,Z and R,G,B value

- Feature extraction, measurements, volumetrics, etc
Natural Disasters

- Emergency response
- Real time condition updates
- Hazmat runoff detection
- Debris calculations
High Mast Inspection and Inventory
Construction

Environmental

Facilities
Contractors and Consultants: How to use UAS on TxDOT Projects

- Welcoming and enabling our consultants and contractors to utilize UAS on TxDOT Projects

- Adhere to Federal Aviation Administration’s requirements in 14 CFR 107 (or applicable regulation if UAS is greater than 55lbs)

- Adhere to the data collection and deliverables standards set forth in your specific disciplines and/or contracts
  - TxDOT Surveyor’s toolkit
  - ASPRS
  - FHWA NBIS
  - ASCE

- Adhere to the TxDOT UAS Flight Operations and User’s Manual

- Prohibited Technologies Policy
Prohibited Technologies

- Mandates that state entities and agencies abide by the Prohibited Technologies policy.

- DJI specifically listed as a prohibited manufacturer.

- DJI cannot be used to conduct state business.

- Exemptions on a case-by-case basis for emergency situations (think declared state of emergency)

The official TxDOT list is available at Prohibited Technologies List (txdot.gov)

**Software / Applications**
- Alipay
- CamScanner
- Kaspersky Security & VPN
- SHAREIt
- TikTok
- WeChat
- WeChat Play
- WPS Office

**Developers**
- Alipay (Hangzhou)
- ByteDance LTD
- INTSIG Information Co., Ltd
- Kaspersky Lab Switzerland GmbH
- Kingsoft Office Software Corporation
- SHAREIt Technologies Co. Ltd
- Tencent Holdings
- TikTok Ltd.
- WeChat

**Hardware / Equipment Manufacturers**
- Dahua Technology Company
- Huawei Technologies Company
- Hangzhou Hikvision Digital Technology Company
- Hytera Communications Corporation
- SZ DJI Technology Company
- ZTE Corporation
What does the Flight Operations and User’s Manual Cover?

Section i — TxDOT UAS Program
Section ii — UAS at TxDOT
Section iii — Regulatory Environment
Section iv — FAA Remote Pilot Certificate
Section v — Indemnification
Section vi — Emergency Operations
Section vii — Important Information Links

TxDOT UAS Program
Section 1.1. — Organization and Administration
Section 1.2. — Safety Management System (SMS)
Section 1.3. — Program Operation

Air Operations
Section 3.1. — Flight Crew Organization
Section 3.2. — Flight Crew Duty Day
Section 3.3. — Flight Crew Health
Section 3.4. — On-Location Risk Assessment
Section 3.5. — Flight Procedures
Section 3.6. — Privacy Issues

Appendix
Appendix A — Example Flight Plan
Appendix B — Pre-approval Form
Appendix C — Example Traffic Control Plan
Appendix D — In-Flight Emergency Checklist
Appendix E — Downed Aircraft Emergency Plan Checklist
Appendix F — Accident Report Form

Ground Operations
Section 2.1. — Flight Crew Requirements
Section 2.1.1. — Remote Pilot in Command
Section 2.1.2. — Visual Observer
Section 2.1.3. — Secondary Pilot in Command
Section 2.1.4. — Additional Visual Observer
Section 2.1.5. — Recurrent Training
Section 2.2. — Project Risk Assessment
Section 2.3. — Flight Planning
Section 2.3.1. — Flight Planning General Rules
Section 2.3.2. — Flight Plan
Section 2.3.3. — Traffic Control Plan
Section 2.4. — Health and Safety Plan
Section 2.5. — In-Flight Emergency Plan
Section 2.5.1. — Total Loss of Aircraft Power
Section 2.5.2. — Partial Loss of Aircraft Power
Section 2.5.3. — Airspace Encroachment
Section 2.5.4. — Loss of Aircraft Control
Section 2.5.5. — Erratic Aircraft Behavior
Section 2.5.6. — Aircraft Fly-Away
Section 2.5.7. — Bird Strikes
Section 2.5.8. — Fixed Object Strikes
Section 2.5.9. — Interference with Flight Crew
Section 2.5.10. — Nearby Emergency Operations
Section 2.6. — Downed Aircraft Recovery Plan
Section 2.6.1. — DARP General Rules
Section 2.6.2. — The DARP Procedures
Section 2.7. — Accident Reporting
Section 2.7.1. — TxDOT Reporting Requirements
Section 2.7.2. — FAA Notification Requirements
Section 2.7.3. — NTSB Notification Requirements
Section 2.8. — Maintenance
Section 2.9. — Aircraft Registration Number
Section 2.10. — Logs and Records
Section 2.10.1. — Pilot Log
Section 2.10.2. — Aircraft Maintenance Log
Section 2.10.3. — Record Retention

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Section 2.7.2. — FAA Notification Requirements
Section 2.7.3. — NTSB Notification Requirements
Flight Plan

UAS Flight Plan

Project Information

Project Name: [project_name]
Pro-Approval Required?: Yes

Location: [location]
County: [county]
Project Number: [project_number]

Purpose of Flight:
The data gathered will be used to assess the drainage area around a detention pond located on the north side of Highway 29.

Maximum Flight Altitude to be used:
Flight Altitude: [flight_altitude]
In an FAAR waiver required?: Yes

Airspace Class:
Will a NOTAM be used?: Yes
Proposed flight date: [proposed_flight_date]
Backup flight date: [backup_flight_date]

Project Location:
The nearest improved airport is Burnet Municipal at 9.4 miles. The nearest unimproved airport is Camp Longhorn at 1.8 miles. Camp Longhorn is a remote control aircraft airport.

2023 Texas GIS Forum
General Rules
Pre-Approval Request Form

- Within Class B,C,D airspace or Class E at the surface
- Exception from general rules
- If FAA waiver or authorization is required (not LAANC)
- Within a railroad corridor
- If private landowner permission is required
- Within 2 nautical miles of an airport or heliport with a paved runway
- 100 feet of the ROW of an interstate highway or Any highway with 3 or more travel lanes
- Complex UAS operations area
- Traffic control beyond warning signs
The TxDOT UAS Program

A good UAS program saves you time, money, and increases safety—If it does not, it’s not working.

- Use UAS as a tool to collect quantitative and qualitative data.
- Train and equip the department to deploy UAS at scale.
- Ensure all UAS operations abide by state/federal rules, regulations, and policy.
- Create a standardized program across the state.
- Enable txdot personnel to oversee UAS operations by external parties.
- Redefine ‘acceptable risk,’ mitigate or eliminate accidents and injuries.

- Comprehensive training program from FAA certification preparation through advanced flying tactics and techniques.
- Hardware and Software Procurement.
- Specialty training:
  - Mapping and modeling
  - Confined space / close quarters
  - Cinematic flight movements
  - Inspections
  - etc
- TxDOT UAS Flight Operations and User’s Manual
- TxDOT UAS community of Practice
- Pilot Culture
State of the TxDOT UAS Program as of October 2023

- 68 UAS Pilots
- 32 additional queued for training
- 21 additional training slots remaining for FY24
- 22 of 25 districts have (or are scheduled to have) a trained pilot within their boundaries
- 19 Divisions have Pilots
- 60 training slots available per FY
- ~180 Pilots by end of FY25 + 60 each FY
The Big Picture

Every district has UAS on hand for daily operations

Specialty UAS for relevant missions

District pilots:
- Determine when to use UAS
- Determine which UAS to use
- Ensure adherence to TxDOT UAS policies
- Oversight of outsourced UAS services

How?

Why?

Increase safety

Increase efficiency

Reduce costs

How?

Why?
The latest revision (1 April 2023) to the Flight Operations and User’s Manual (FOM) is available in the Documents page. Check out the video summary of changes video at this link: https://txdot.sharepoint.com/v/s/txdotB01UP5sGpsaZxWpupqDBgFrBEE8_apsOplWd1kZnp7s=pBzEkl
Unmanned Aircraft System (UAS) Services

The TxDOT Unmanned Aircraft System (UAS) Program is designed to be flexible while ensuring that all UAS activities conducted on behalf of TxDOT are done in the safest manner possible in compliance with all statutory requirements. To this end, all UAS (also known as drone or drones) flights are required to have:

- A flight plan providing information about the proposed flight.
- A Project Risk Assessment (PRA) completed prior to the flight.
- Appropriate liability insurance.
- Depending on the project, pre-approval from the TxDOT UAS Coordinator may be required prior to any flight operations.
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Aviation Division
Flight Services

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Digital twins are motivated by outcomes, tailored to use cases, powered by integration, built on data, guided by domain knowledge, and implemented in IT/OT systems.
Collection and Processing for UAS Data

- Data collection
- Bentley iTwin Capture Modeler
- ArcPro
Collecting UAS Data
Data

Source: Stephanie Marquez
FM 1977 widening
JEDI Project

Journey to Enterprise Data Integration

GOALS
1. Assess the state of geospatial data systems at the agency
2. Provide Recommendations on how to advance shared goals
3. Create strategy to fulfil identified needs
Summary

- Understand the needs
- Define the structure
- Collect and process the data
- Display in context

- Birdwatching goes both ways...
Special Thanks

- Stephanie Marquez
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- Matt Washburn
- Design Division
- Chris Bardash
- Jenn Lash
Safety: Mission
ZERO

Safety Never Stops!