Protecting Ohio's Families

Ohio Attorney General Mike DeWine's

Advisory Group on Unmanned Aircraft Systems

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OHIO ATTORNEY GENERAL

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January 26, 2018

Dear Law Enforcement Professional,

With advancements in technology and a decrease in the cost of unmanned aircraft systems (UAS), unmanned aircraft have become more common in communities and as tools of law enforcement. While “drones” can be useful for agencies as eyes in the sky in missing persons cases, at crime scenes, and during SWAT operations, their use also raises public concerns about privacy, accountability, and oversight.

I formed an advisory group to create a model law enforcement policy to guide departments in the use of the aircraft systems. Led by Cuyahoga Community College Police Chief Clayton Harris, the group focused on privacy and data collection, procedures and uses, and training and technology.

Members were subject-matter experts and met frequently over the course of eight months to come up with recommendations on best practices and protocols that agencies can consider when creating their own UAS policies, and advice for the Ohio Peace Officer Training Academy (OPOTA), which is crafting three new advanced training courses on investigating UAS complaints, the practical application of using unmanned aircraft systems, and the implementation of UAS programs.

The following report contains the advisory group’s recommendations, which will be shared on my office’s website.

I want to express my sincere appreciation to everyone on the advisory group. They devoted many volunteer hours to create this report, and I thank them for their service.

Very respectfully yours,

Mike DeWine
Ohio Attorney General

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Members of the Ohio Attorney General's Advisory Group on Unmanned Aircraft Systems

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Special Acknowledgments

Thanks to Battelle for providing assistance and information.

Introduction

Ohio Attorney General Mike DeWine's Unmanned Aircraft Systems advisory group met regularly from November 2016 to June 2017 and consulted with Ohio law enforcement agencies to develop a model law enforcement policy for the use of unmanned aircraft systems (UAS); create recommendations on best practices and protocols that agencies can consider when creating UAS policies; and look at advanced training courses that focus on the practical uses of UAS.

UAS, commonly referred to as "drones," can be used by law enforcement for a number of investigative purposes, such as crime scene and traffic accident investigations, missing persons cases, SWAT operations, and active shooter incidents. However, the use of UAS for law enforcement purposes is relatively new and has prompted privacy and safety concerns among citizens.

The members of the advisory group were selected for their expertise in UAS-related industry, education, or services such as technology, law enforcement, science, and aviation. Each member of the advisory group contributed a unique talent as the group completed its tasks.

While the advisory group was originally formed with the goal of developing a UAS model policy template for law enforcement, the members of the advisory group made 14 recommendations. These recommendations, in addition to the model policy template, cover these topic areas: certifications and authorizations; procedures and uses; privacy; digital evidence and data management; training; and technology.

Please keep in mind that this report is for educational purposes and should not be considered legal advice.

Recommendations

The advisory group recommends:

1. Each law enforcement agency with a UAS program should develop and implement a written policy, using the model policy included in this report as a guide.
2. Law enforcement agencies should require that any staff member operating a UAS have a current remote pilot certificate per 14 Code of Federal Regulations (CFR) Part 107 issued by the Federal Aviation Administration (FAA).
3. Law enforcement agencies should review their needs and the applicability of a Certificate of Waiver or Authorization (COA) before applying to the FAA for one.
4. All UAS vehicles should be tested and inspected prior to each use.
5. Each law enforcement agency should determine its own set of approved uses of UAS.
6. Law enforcement agencies should obtain a search warrant before any use where people would have a reasonable expectation of privacy.
7. UAS operators should take measures to avoid incidentally recording images of people who are not relevant to an approved use of UAS.
8. UAS should never be used to conduct unauthorized surveillance.
9. Law enforcement agencies should work with legal counsel to develop guidelines governing the agency's use of UAS.
10. Law enforcement agencies should develop and implement effective management policies for data collected through UAS use.
11. When law enforcement agencies employ or contract with another party to operate UAS for law enforcement purposes, law enforcement agencies should ensure that they retain ownership and control over all data collected.
12. Law enforcement agencies' pilots and support crew members should engage in applicable skills training no less than once a month in order to retain the knowledge and skills of UAS use.
13. Law enforcement agencies' pilots and support crew should attend an annual training covering updated industry standards, field exercises, review of regulations, and maintenance requirements.
14. Law enforcement agencies should work with their respective political subdivisions to clearly identify the needs and available resources for a UAS program.

Recommendation 1: UAS Model Policy Considerations

The advisory group recommends that each Ohio law enforcement agency with an unmanned aircraft systems (UAS) program develop and implement a written policy for using the aircraft. (Recommendation 1)

The UAS Model Policy Template for Ohio Law Enforcement Agencies is written to be customized to suit agencies of any size or with any level of resources. While drafting the document, the group reviewed and discussed many policies from law enforcement agencies throughout Ohio and in other states. It also drew from the model policy of the International Association of the Chiefs of Police (IACP).

Through its research, the advisory group found several sections in the IACP model policy that law enforcement agencies should consider:

1. The document should offer a clearly stated policy regarding when, where, and how UAS will be used.
2. It should include procedures that the agency will follow to ensure safe, legally compliant and effective UAS use.
3. It should cover digital multimedia evidence storage- and retention-procedures, including references to relevant statues and rules.
4. It should include audit protocols for both flight and digital multimedia evidence audits.
5. It should provide details on training requirements for all personnel assigned to operate UAS.

UAS Model Policy Template for Ohio Law Enforcement Agencies

I. Purpose and Scope

This policy is intended to provide law enforcement agency/department/office personnel who are assigned responsibilities associated with the deployment and use of unmanned aircraft systems (UAS) instruction on when and how this technology and the information it provides may be used for law enforcement and public safety purposes in accordance with law.

II. Policy

It is the policy of this agency/office/department that duly trained and authorized agency personnel may deploy UAS when such use is appropriate in the performance of their official duties, and where deployment and use, and the collection and use of any audio/video recordings or other data originating from or generated by the UAS, comport with the policy provisions provided herein and applicable law.

III. Definitions

1. **Authorized Agency Personnel:** Personnel assigned by authorized supervisory personnel to operate unmanned aerial vehicles (UAV), or any portion of the unmanned aircraft system (UAS), who have also completed an agency-approved training program and meet all conditions of the certificate of waiver or authorization issued by the FAA.

2. **Authorized Supervisory Personnel:** An agency administrator who has full access to, and user rights within, the digital media storage system. He or she can authorize UAV operations, assign and track equipment, control passwords, oversee needed repairs, delete nonevidentiary recordings, and conduct audits and quality control reviews.

3. **Beyond Visual Line of Sight (BVLOS):** When flight crew members — such as the remote pilot in command (PIC), the person manipulating the controls, and, if used, the visual observer (VO) — are not capable of seeing the aircraft with vision unaided by any device other than corrective lenses, such as eyeglasses or contact lenses.

4. **Certificate of Waiver or Authorization (COA):** An FAA grant of approval for specific flight operation.

5. **Control Station:** An interface used by the remote pilot to control the flight path of a small unmanned aircraft (UA). The structure or system (ground-, ship-, or air-based) that controls the UAS and its interface to the aircraft and external systems.

6. **Crew Member:** A person assigned to perform an operational duty during operations. A UAS crew member includes the remote pilot in command, person manipulating the controls, and visual observers, but may include other people as appropriate or required to ensure safe operation of the aircraft.

7. **Crew Resource Management (CRM):** The effective use of all available resources including human, hardware, software, and information resources.

8. **Defined Incident Perimeter:** A location with a set perimeter where UAVs will be operated. The area will be determined based on the scope of the operation and a defined operational ceiling at or below 400 feet above ground level (AGL).

9. **Digital Multimedia Evidence (DME):** Digital recordings of images, sounds, and associated data captured by an aircraft.

10. **Direct Control:** The capability of a remote pilot to manipulate the flight control surfaces of the aircraft using, for example, a radio control box with a joystick or a ground control station with conventional-type aircraft controls (such as a yoke/stick, rudder pedals, power levers, and other ancillary controls). This infers a one-to-one correspondence between control input and flight control surface deflection.

11. **Person Manipulating the Controls:** A person who is controlling a UAS under the direct supervision of a remote pilot in command.

12. **Remote Pilot in Command (PIC):** A person who holds a remote pilot certificate with a small unmanned aircraft systems (sUAS) rating and has the final authority and responsibility for the operation and safety of a sUAS operation conducted under 14 CFR Part 107.

13. **Small Unmanned Aircraft System (sUAS):** An unmanned aircraft of less than 55 pounds and the associated elements required for its safe and efficient operation in the national airspace system (including communication links and the components that control it, as well as launch and recovery systems and equipment).

14. **Tactical Deployment:** Using UAS to support the positioning of officers and equipment in emergency situations, such as incidents involving hostages and barricades, and other temporary perimeter security situations.

15. **Unmanned Aircraft (UA) or Unmanned Aerial Vehicle (UAV):** An aircraft operated without the possibility of direct human intervention from within or on the aircraft.

16. **Unmanned Aircraft System (UAS):** A UA and associated elements (including communication links and the components that control the UA) that are required for the remote PIC to operate safely and efficiently.

17. **Visual Line of Sight (VLOS):** When any flight crew member is capable of seeing the aircraft with vision unaided by any device, other than eyeglasses or contact lenses, in order to know the UA's location, determine the UA's attitude, altitude, and direction of flight, observe the airspace for other air traffic or hazards, and determine that the UA does not endanger the life or property of another.

18. **Visual Observer (VO):** A person who is designated by the PIC to supplement situational awareness and VLOS and assist with seeing and avoiding other air traffic or objects aloft or on the ground. The VO must be able to effectively communicate:

    - The small UA location, altitude, and direction of flight.
    - The position of other aircraft or hazards in the airspace.
    - The determination that the UA does not endanger the life or property of another.

IV. Procedures

A. Administration and use of UAV: All deployments of UAVs shall be authorized by supervisory personnel, be in state and federal legal and regulatory compliance, as well as in compliance with the policy and procedures defined herein. UAVs may be used for, the following purposes, which may be updated:

1. Situational awareness: To assist decision-makers in understanding the nature, scale or scope of an incident and for planning and coordinating an effective response.
2. Search and rescue: To assist in missing person investigations and other search and rescue missions.
3. Tactical deployment: To support the positioning of officers and equipment in emergency situations, such as incidents involving hostages and barricades, and other temporary perimeter security situations.
4. Visual perspective: To provide an aerial perspective to assist officers with directing crowd control, traffic, special circumstances, and temporary perimeter security.
5. Scene documentation: To document a crime scene, accident scene, or other major incident scene.
6. Agency assistance: To assist another government agency not possessing a UAV, with situational awareness, search and rescue, tactical deployment, visual perspective, or scene documentation.
7. Public demonstration: To educate the public regarding the law enforcement use of UAV.
8. Training: To assist remote pilots and aircrews in maintaining proficiency in operation skills of UAS's.

B. Restrictions on the use of a UAV

1. Authorized agency/department/office personnel shall only deploy UAVs for a public safety purpose.
2. Authorized agency personnel shall not deploy UAVs in a careless or reckless manner or in violation of FAA rules governing use of UAVs by governmental agencies or any other applicable state or federal law.
3. No authorized agency personnel shall operate more than one UAV at a time.

C. Procedures for use of a UAV: All deployments of UAVs shall incorporate the following procedures to assure authorized use, safe operation, secure storage, and documentation:

1. The agency shall consult with legal counsel regarding any search warrant. Authorized agency personnel shall obtain a search warrant when there is reasonable belief that the flight of a UAV or the collection of DME may intrude upon a place and time when a person has a reasonable expectation of privacy, as assured by the U.S. Constitution[1] and the Ohio Constitution.[2]

[1] U.S. Constitution, Fourth Amendment.
[2] Ohio Constitution, Article 1, Section 14.

2. The agency must obtain applicable authorizations, permits, or certificates required by the FAA prior to deploying or operating the UAS, and these authorizations, permits, and certificates shall be maintained and current.

3. UAVs shall be operated solely by authorized personnel duly trained and certified as a remote pilot by the FAA.

4. Authorized agency personnel shall inspect and test UAVs prior to each deployment to verify general airworthiness and mission specific equipment functionality.

5. Authorized agency personnel shall inspect crew fitness, lighting, line-of-sight, altitude, and weather conditions prior to each deployment to verify suitability for flight. Inspections shall conform to the following:

    a. Crew fitness: Authorized agency personnel shall conduct a preflight briefing at which they shall review the mission, goals, methods and procedures; UAV battery charge and Global Positioning System (GPS) strength; personnel communication procedures; emergency/contingency procedures, including but not limited to, UAV malfunction/failure, flight termination, flight diversion, and lost link procedures; contents of the COA, if applicable; radio frequency to be used; and takeoff and landing site, defined incident perimeter, and flight perimeter.

    b. Line-of-sight: Authorized agency personnel shall review the intended flight of UAVs for hazards prior to each deployment. Unless otherwise approved through the FAA, authorized agency personnel shall only deploy UAVs within the line of sight of the operator in an attempt to detect and avoid hazards such as aircraft, trees, and property.

    c. Altitude: All UAV flights shall be conducted at less than 400 feet above ground level unless otherwise noted in the COA or approved by the FAA in an emergency COA, or as permitted by other FAA regulations.

    d. Weather

        i. Temperature: Authorized agency personnel shall only deploy UAVs when the temperature is within the parameters set forth by the operational guidelines of the UAV. Authorized agency personnel shall adjust UAV battery and flight length as necessary according to temperature.

        ii. Wind: Authorized agency personnel shall measure wind velocity prior to each deployment and shall only deploy UAVs when the wind velocity is within the parameters set forth by the operational guidelines of the UAV.

        iii. Rain, snow, fog: Prior to deployment of a UAV, authorized agency personnel shall ascertain whether rain, snow, or fog may decrease visibility or operator safety. Authorized agency personnel may deploy UAVs if weather conditions do not prevent personnel from adhering to line-of-sight and minimum weather requirements.

6. Authorized agency personnel shall store UAVs in a secure manner as well as maintain and operate UAVs with proper care and in the event of an equipment malfunction, report it to authorized supervisory personnel as soon as possible, cease deployment immediately, and document it in a written report.

7. Authorized supervisory personnel shall coordinate maintenance, repairs, and updates of UAVs as well as coordinate on a regular basis with appropriate agency/department/office information technology staff regarding system-related issues.

8. Per federal regulation, authorized supervisory personnel shall inform local air traffic control of an impending flight or obtain a waiver of notice from local air traffic control at the issuance of the COA.

9. All UAV flights shall be documented on a form or database designed for that purpose and shall include, but not be limited to:

    a. The reason or purpose for the flight.

    b. Date, time, duration and location of the flight.

    c. Name of the supervisor approving the flight.

    d. List of staff members assigned to the flight.

    e. The summary of actions taken, and the activities and outcomes from deployment.

    f. A brief description of captured DME and the storage location.

D. DME storage and retention

1. All DME produced through use of UAV shall be handled and stored according to the DME policy developed and maintained in conjunction with the agency/department/office legal counsel.

2. DME captured or recorded by UAVs shall be the sole property of the agency.

3. Storage

    a. Authorized personnel shall handle and store captured DME in accordance with the DME policy for storing digital files and applicable statutes regarding, but not limited to, evidence, discovery, and disclosure pursuant to the Ohio Public Records Act at Ohio Revised Code (ORC) Section 149.43. Any requests for DME disclosure shall be reviewed by the agency/department/office's legal counsel.

4. Downloading procedures

    a. In accordance with the DME policy, authorized agency personnel shall securely download all captured DME at the completion of each mission. Each DME file shall be given a unique label, according to a file classification system created in conjunction with the agency/department/office's legal counsel and shall include but not be limited to, date, time, location, involved personnel, and other mission identifiers.

5. Permitted review of DME

    a. Access to captured DME must be specifically approved by authorized supervisory personnel and documented.

    b. Access records are to be audited regularly to ensure that only approved users are accessing the data for authorized purposes.

c. Review of DME will be authorized under the following terms:

i. The chief executive of this agency/department/office or authorized supervisory personnel shall be permitted to review a copy of captured DME for purposes of investigating alleged misconduct reports or meritorious conduct; whenever such DME would be beneficial in reviewing the performance of the personnel who captured the DME, or were involved with the incident depicted; and to determine whether DME is of value as a training tool.

ii. The chief executive and other members of the agency/department/office will be permitted to review a copy of captured DME for purposes of conducting a criminal investigation; preparing for courtroom testimony or courtroom presentation; providing testimony pursuant to an administrative inquiry; assisting the officer in professional development; or to inform strategy related to the administration of the UAS.

iii. When a third party is authorized by the agency to capture DME pursuant to a current COA or emergency COA, or any other method as an agent of the agency, the agent shall not be permitted to keep, independently access, edit, alter, erase, duplicate, share, or otherwise distribute a copy of captured DME without the written consent of the chief executive of this agency/department/office or authorized supervisory personnel.

iv. The agency/department/office legal counsel shall be notified of DME, as set forth previously, with regard to any criminal investigation, and shall be permitted to review a copy of captured DME as it pertains to that investigation.

v. Retained DME shall be stored in accordance with the minimum standards for such records required by the Ohio Public Records Act, ORC 149.43

vi. Nonevidentiary DME, not relevant to a criminal investigation, emergency management, or mapping shall be retained for a minimum of six months or in accordance with the records retention policy of the agency/department/office.

6. If no extension of DME retention is required, the DME and any copies may be destroyed in accordance with the agency/department/office's record retention and destruction procedures. Authorized supervisory personnel shall review all DME scheduled for destruction. If DME is deemed useful as a training tool by authorized supervisory personnel, DME can be retained for as long as needed and in compliance with the applicable records retention schedule.

7. All retained DME, unless exempted by Ohio Public Records Act, ORC 149.43, shall be available for public inspection. Any and all public disclosure of DME must be consistent with the agency/department/office's records policy and applicable statutes regarding, but not limited to, evidence, discovery, and public records disclosure pursuant to the Ohio Public Records Act, ORC 149.43.

a. The agency's legal counsel shall review any requests for such DME, and where a related criminal investigation or prosecution exists, the agency's legal counsel shall conduct the review.

b. No agency personnel may edit, alter, erase, duplicate, share, or otherwise distribute captured DME in any manner externally, without prior written authorization and approval from authorized supervisory personnel. When approval is granted:

i. Personnel shall document on a form or database designed for that purpose the requesting party and the rationale for determining whether to release a copy of captured DME.

ii. Personnel shall document any changes or edits made to a copy of captured DME and the rationale for doing so on a written form or database designed for that purpose. Changes or edits to a copy of captured DME may be done to preserve the privacy of third-party individuals. The original DME data shall be stored and maintained in an unaltered state to maintain its integrity and metadata. Any alterations, erasures, redactions, or sharing of DME data shall be done using a copy of the original DME file.

iii. A copy of captured DME disclosed to a member of the public may only be edited upon advice of agency/department/office legal counsel for any reason, including preserving the privacy of individuals that are captured in the DME when they have a reasonable expectation of privacy or for their safety.

E. Unmanned aerial vehicle audit protocol

1. Authorized supervisory personnel shall annually audit UAV flight documentation and DME access records and produce a periodic audit report detailing the results of the audit and any changes or corrections made to the flight time counter, captured DME, and DME access records.

2. Authorized supervisory personnel shall annually audit the policy and procedures and make recommendations for any necessary amendments.

F. Training of authorized agency personnel

1. Authorized agency personnel assigned to operate UAVs must complete an agency-approved training program and meet all conditions of the certifications as issued by the FAA. Authorized agency personnel assigned to operate UAVs shall also receive additional training at regular intervals to ensure continued effective use, operation, calibration, and performance of UAVs and to incorporate changes, updates, revisions, and advances in policies and procedures in the deployment and use of UAVs.

2. All certified remote pilots must complete a required initial training as well as a minimum of eight (8) hours of annual training, which shall be documented.

3. All personnel with responsibilities related to the Unmanned Aerial System (UAS) shall be regularly trained in applicable local, state and federal laws, regulations, and the policies and procedures that govern the deployment of UAVs.

Recommendations 2 and 3: UAS Certifications and Authorizations From the FAA

The advisory group recommends that Ohio law enforcement agencies require any law enforcement agency staff member operating a UAS to have a current remote pilot certificate per 14 CFR Part 107 issued by the FAA.[3] **(Recommendation 2)**

The advisory group also recommends that law enforcement agencies review their needs and the applicability of a Certificate of Waiver or Authorization (COA) before applying to the FAA for one because a COA may not be necessary. **(Recommendation 3)**

The advisory group reviewed the processes required by the FAA for both UAS remote pilot certification and for obtaining a COA. Remote pilot certificates are issued to individuals through a certification test administered by the FAA.[4] This certification must be renewed every 24 months.

A COA is an authorization issued by the FAA to an entity that qualifies as a public operator, such as a law enforcement agency, for "public operations" as defined in 49 USC sections 40102(a)(41), 40125.[5] COAs are issued for up to two years for a specific geographical location.

Those who need guidance in either of these application processes should contact the Ohio/Indiana Unmanned Aerial Systems Center and Test Complex (UASC), a division of the Ohio Department of Transportation and the official Ohio liaison to the FAA. The advisory group recognizes that often the processes at the FAA can be complicated, in part because the FAA continues to update its systems and methods of obtaining both the remote pilot certification and COAs. The UASC, which works closely with the FAA, is a good resource for law enforcement agencies interested in applying for a COA and/or navigating the process to certify remote pilots through 14 CFR Part 107. To contact the UASC, call 937-497-6739 or send email to uascenter@dot.ohio.gov.

Remote Pilot Certification Process for New Pilots

An applicant for a remote pilot certification must be at least 16 years old; able to read, speak, write and understand English; and in a physical and mental condition to be able to safely operate a small unmanned aircraft system.

Applicants must take an initial aeronautical knowledge test at a FAA-approved Knowledge Testing Center. To schedule an appointment, contact the closest testing center. Visit www.faa.gov/training_testing/testing/media/test_centers.pdf.

Helpful resources for studying for the initial aeronautical knowledge test can be found at www.faa.gov/uas/getting_started/fly_for_work_business/becoming_a_pilot.

[3] Federal Aviation Administration, FAA News (June 21, 2016), *Summary of Small Unmanned Aircraft Rule (Part 107)*, https://www.faa.gov/uas/media/Part_107_Summary.pdf.
[4] Federal Aviation Administration, Becoming a Pilot, https://www.faa.gov/uas/getting_started/fly_for_work_business/becoming_a_pilot.
[5] Federal Aviation Administration, Certificates of Waiver or Authorization (COA), https://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/systemops/aaim/organizations/uas/coa.

Tested areas of knowledge include:

- Regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation.
- Airspace classification and operating requirements, and flight restrictions affecting small unmanned aircraft operation.
- Aviation weather sources and effects of weather on small unmanned aircraft performance.
- Small unmanned aircraft loading and performance.
- Emergency procedures.
- Crew resource management.
- Radio communication procedures.
- Determining the performance of small unmanned aircraft.
- Physiological effects of drugs and alcohol.
- Aeronautical decision-making and judgment.
- Airport operations.
- Maintenance and preflight inspection procedures.

Those who pass the test must complete FAA Form 8710-13 for a remote pilot certificate (FAA Airman Certificate and/or Rating Application) using the electronic FAA Integrated Airman Certificate and/or Rating Application system (IACRA).

To register using the FAA IACRA system:

- Visit https://iacra.faa.gov/IACRA/Default.aspx.
- Login and click “Start New Application,” application type “Pilot,” certifications “Remote Pilot,” follow other path information, and start the application.
- Follow the application prompts. When prompted, enter the 17-digit Knowledge Test exam ID. (It may take up to 48 hours from the test date for the test to appear in IACRA. If your test is not yet listed, try again 48 hours after the test date.)
- Sign the application electronically and submit it to the registry for processing.

The application must be vetted by the Transportation Safety Administration, which may take up to 10 business days. A confirmation email will be sent once the background check has been completed. The email will allow the individual to print a copy of the temporary remote pilot certificate. This temporary certificate expires on the expiration date listed (up to 120 days), upon receipt of the permanent certificate, or upon receipt of a notice that the certificate sought is denied or revoked. A permanent remote pilot certificate will be sent via U.S. mail after all other FAA internal processing is complete.

The license must be renewed every two years.

Remote Pilot Certification Process for Existing Pilots

An applicant must hold a pilot certificate issued under 14 CFR Part 61 and have completed a flight review within the previous 24 months. Certificate holders must pass either a recurrent online training course or a recurrent knowledge test every two years.

The online training course "Part 107 Small Unmanned Aircraft Systems (sUAS) ALC-451" is available on the FAA Safety Team website at www.faasafety.gov.

Helpful resources for studying for the knowledge test can be found at www.faa.gov/uas/getting_started/fly_for_work_business/becoming_a_pilot.

The training course areas include:

- Applicable regulations relating to small unmanned aircraft system rating privileges, limitations, and flight operation.
- Effects of weather on small unmanned aircraft performance.
- Small unmanned aircraft loading and performance.
- Emergency procedures.
- Crew resource management.
- Determining the performance of small unmanned aircraft.
- Maintenance and preflight inspection procedures.

To apply for the license, the pilot needs to complete FAA Form 8710-13 for a remote pilot certificate (FAA Airman Certificate and/or Rating Application) using the electronic FAA Integrated Airman Certificate and/or Rating Application System (IACRA).

To register using the FAA IACRA system:

- Visit https://iacra.faa.gov/IACRA/Default.aspx.
- Login and click "Start New Application," application type "Pilot," certifications "Remote Pilot," follow other path information, and start the application.
- Follow the application prompts. When prompted, enter the 17-digit Knowledge Test exam ID. (It may take up to 48 hours from the test date for the test to appear in IACRA. If your test is not yet listed, try again 48 hours after the test date.)
- Sign the application electronically and submit it to the registry for processing.

As part of the application process, an applicant's identity must be validated. The applicant must:

- Contact a Flight Standards District Office of the FAA, an FAA-designated pilot examiner, an airman certification representative, or an FAA-certified flight instructor to make an appointment.
- Present the completed FAA Form 8710-13 along with the online course completion certificate or knowledge test report (as applicable) and proof of a current flight review.
- Sign the completed application, once the applicant's identity has been verified. The identification presented must:

- Include a photograph of the applicant, the applicant's signature, and the applicant's residential address (if different from the mailing address). This information may be presented in more than one form of identification. Acceptable methods of identification include a U.S. driver's license, government identification card, passport, and military identification card.

Once the FAA representative has signed the application, a temporary airman certificate will be issued. Note: Flight instructors are not authorized to issue a temporary certificate but they can process applications for applicants who do not want a temporary certificate.

A permanent remote pilot certificate will be sent via U.S. mail once all other FAA-internal processing is complete.

Self-Certification

Government entities may develop and use their own processes regarding pilot, aircrew, and maintenance personnel certification and training; aircraft certification; and airworthiness, according to the public aircraft operator (PAO) criteria in 49 USC sections 40102(a)(41), 40125(a)(2). When establishing a self-certification program, the government entity conducting the public aircraft operation is responsible for ensuring that the proposed operation can be safely run under the terms of its COA.

Public operators are encouraged to review FAA Advisory Circular 00-1.1A for information on how to establish policies, procedures, protocols, and checklists to ensure safety of flight.[6] Additionally, public entities may review Federal Aviation Regulations parts 61, 91, and 107, to familiarize themselves with areas that a pilot must know and follow. The FAA does not prescribe the method that public entities use when developing processes and programs; it is the responsibility of each public entity to determine them.

COA Application Process

A law enforcement agency's unmanned aircraft (UA) may be flown as a public aircraft in operation under 49 USC sections 40102 (a) (41) and 40125.

The FAA is responsible for processing and approving all requests for UAS operations in the national airspace system. For "public" UAS operators, this authorization is granted via the issuance of a COA. Typically, public safety agency UAS flight operations are considered "public aircraft" operations. The guidelines for operating as a "public aircraft" are described in the FAA Flight Standards Information Management System (FSIMS) 8900.1 Volume 16.

Obtaining a COA

Filing out a registration: Before applying for a COA, a law enforcement agency must register its UAS with the FAA and acquire a declaration letter. Registration of the unmanned aircraft is required under Title 49 sections 44101-44104, which prohibits operation of unregistered aircraft and establishes the requirements for aircraft registration. Public aircraft are not exempt from the registration requirements. The regulations implementing those requirements are in 14 CFR Part 47 for all aircraft or in 14 CFR Part 48 for small UAS (sUAS). Under Section 47.3, aircraft owned by U.S. citizens, lawful permanent residents, and U.S. corporations are eligible for registration and operation. A law enforcement agency can register a sUAS under Part 48 by visiting https://registermyuas.faa.gov and, after registering the agency, selecting the "non-

[6] Federal Aviation Administration, Advisory Circular, Subject: Public Aircraft Operations (Feb. 12, 2014), https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_00-1_1A.pdf.

model" button to register the public aircraft. Alternatively, the aircraft can be registered under Part 47 using the paper link. (Visit www.faa.gov/licenses_certificates/aircraft_certification/aircraft_registry/UA). The COA online program cannot be completed until the aircraft is registered.

Providing a declaration letter: Before the FAA grants an agency access to begin the online application process, the agency (or proponent) will be asked to provide the FAA with a declaration letter from the agency's city, county, or state attorney's office (depending on the agency requesting the approval). Ohio law enforcement agencies should coordinate with their legal counsel, which may be the Ohio Attorney General's Office, or county or city attorney, in drafting the public declaration letter to the FAA. (The Ohio/Indiana Unmanned Aerial Systems Center and Test Complex (UASC) can provide an example). This document assures the FAA that the agency (or proponent) is recognized as a political subdivision of the government of the state under 49 USC Section 40102(a) (41) (c) or (d) and that the agency (or proponent) will operate its unmanned aircraft in accordance with 49 USC Section 40125(b) (not for commercial purposes). An agency's executive cannot self-certify that the agency is a "public" agency. The responsibility for establishing the legal nexus between the state and the agency rests with the agency's appropriate legal counsel.

Approval of the declaration letter grants the agency access to the FAA's online COA application system. Access to COA online and the application program cannot be approved until the declaration letter has been validated by the FAA's legal office. Once the letter has been reviewed by the FAA's legal office and deemed sufficient, an online access form will be forwarded to the point of contact for the public agency to be completed and returned to the FAA. Once the online access form is received by the FAA, it takes about 15 business days for the FAA to establish an account within the online program.

Preparing documents for the application: The COA online application process requires that the applicant address several areas that will provide sufficient information for the FAA to make a determination as to the safety of the operations within the national airspace system. These areas include:

- An executive summary describing an overall program objective and an operational summary that addresses the flight mission description.
- A system description (description of the UAS technology, the ground control station, data link communication and any FAA Technical Standard Order components) including the UAS registration.
- An airworthiness release (AWR) statement from the applicant's accountable executive acknowledging that the applicant accepts all responsibility for ensuring that the UAS is airworthy and that it will be operated and maintained in strict compliance with the public agencies certification criteria.
- A lost-link procedures document that describes the specific procedure that will be implemented in the event of a loss of command and control (C2) link.
- A lost communication procedures document that describes what action(s) the remote pilot in command (PIC) will take if there is loss of communication between the PIC and air traffic control, or lost communication between the PIC and the visual observers (VO).
- An emergency procedures document that explains the protocols and procedures that will be executed at the site in the event of an emergency. (The explanation could include the procedures outlined in the manufacturer's supplied operator's flight manual, other possible alternative courses of action available for each phase of flight, and any outside agencies or resources for medical, fire, or other assistance).

COA application review: When the FAA receives an application for a COA through the online process, the FAA initiates a review and application assessment.

The FAA takes into consideration:

- The type of mission.
- The locations of the launch, recovery, and operations.
- Operational altitudes.
- Flight procedures.
- Communications.
- Emergency procedures, such as lost communication and loss of control link.
- PIC, flight crew, and observer qualifications and training requirements.

Provided there are no submittal errors, missing information, or safety or airspace issues, the typical COA application approval process is completed within 60 business days.

Choosing a COA: There are three types of COAs from which to choose:

- Blanket Area Public Safety COA: A Blanket Area Public Safety COA allows the operation of small UAS (55 pounds or less) during daytime visual meteorological conditions, with the following limitations:
    - At or below 400 feet above ground level.
    - Beyond the following distances from the airport reference point of a public use airport, heliport, glider port, or water landing port listed in the "Airport/Facility Directory":
        - 5 nautical miles from an airport having an operational control tower.
        - 3 nautical miles from an airport having a published instrument flight procedure, but not having an operational control tower.
        - 2 nautical miles from an airport not having a published instrument flight procedure or an operational control tower
        - 2 nautical miles from a heliport.

  Under the Blanket Area Public Safety COA, the public agency will conduct training at training locations that meet the provisions of the COA as addressed above and remain clear of housing areas, roads, people, and watercraft. This allows the agency the ability to conduct the necessary ground and flight training to bring pilots, observers and ground crew members to a high level of UAS flight proficiency, and also enables them to develop and conduct training exercises to ensure efficient, standardized coordination among other supporting or responding emergency elements, such as coordination for search and rescue operations, disaster control efforts, forensic photography, and fire missions.

  Once this training has been completed, the proponent will be authorized under the same COA to conduct UAS public safety missions in compliance with 49 USC Section 40125(b) at any location within the national airspace system under the provisions stated within the COA.

- Jurisdictional COA: For operations that cannot operate within the Blanket Area COA criteria, an expanded COA can be applied to include operations in Class C, D, and E airspace and those conducted at night. When the Jurisdictional COA is issued, the proponent need only file a "Notice to

Airman" prior to flight to identify a defined operating area (Radial/DME off a known Navigational Aid) within the construct of the Jurisdictional COA area and a notification to the appropriate air traffic control facility having jurisdictional responsibility over that airspace (If required).

Like the Blanket Area COA, the Jurisdictional COA has a provision that requires the public agency to conduct training at training locations that meet the provisions of the COA, allowing the agency the ability to conduct the necessary ground and flight training to bring pilots, observers, and ground crew members to a high level of UAS flight proficiency and also enabling the agency to develop and conduct training exercises to ensure efficient, standardized coordination among other supporting and responding emergency elements. Once this training has been completed, the proponent will be authorized under the same COA to conduct UAS public safety missions in compliance with 49 USC Section 40125(b) at any location within the national airspace system under the provisions stated within the COA.

- Special Government Interest COA (formally an Emergency COA): If the proposed operating area is not covered under the approved Blanket Area or Jurisdictional COA, the public safety agency can request and receive approval from the FAA for a Special Government Interest COA. This COA will allow for the one-time operation of the UAS at a specific location based on an eminent risk to life.

Recommendations 4 and 5: UAS Procedures and Uses

The advisory group recommends that all UAS aircraft be tested and inspected prior to each use. **(Recommendation 4)** It is already required of each certified remote pilot in command that he or she conduct a preflight check of the UAS to ensure that it is in a condition for safe operation.[7] Safety check protocols may vary by the particular UAV and the certified remote pilot should have the proper training to complete the preflight test, inspection, and check.

The advisory group recognizes that needs for UAS use will vary widely between law enforcement agencies and each agency is advised to determine its own set of approved uses. **(Recommendation 5)** The advisory group recommends using UAS for:

- Forensic photography or crime scene mapping.
- Emergency or disaster response.
- Public safety and life preservation missions.
- Gaining situational awareness during an active shooter incident.
- Demonstrations of the UAS for purposes of educating the public.

Safety is a top concern for the advisory group, which recognizes that strict adherence to procedures, lessens the possibly of accidents or malfunctions. Group members discussed their experiences with UAS aircraft and the need for certain procedures to be consistently followed for safe, successful flights.

They also discussed the need to regularly use the UAS in public demonstrations to share the functions and capabilities with the public. Such demonstrations encourage public education and interaction with law enforcement UAS programs.

[7] Federal Aviation Administration, FAA News (June 21, 2016), *Summary of Small Unmanned Aircraft Rule (Part 107)*, https://www.faa.gov/uas/media/Part_107_Summary.pdf.

Recommendations 6-9: Privacy and UAS Use

The advisory group recommends that law enforcement agencies obtain a search warrant before any use where people would have a reasonable expectation of privacy. **(Recommendation 6)** Even when a search warrant is obtained for unmanned aircraft system (UAS) use, the advisory group recommends that UAS operators take measures to avoid incidentally recording images of people who are not relevant to the situation. **(Recommendation 7)**

The group also recommends that UAS never be used to conduct unauthorized surveillance. **(Recommendation 8)** Law enforcement agencies should work with their legal counsel to develop guidelines governing their use of UAS. **(Recommendation 9)**

The group extensively discussed the need for law enforcement agencies to be vigilant in their observance of the need to respect all citizens' rights to privacy. Other than UAS use for the sole purpose of public demonstration in educating the public, agencies should be aware that they may need to obtain a search warrant prior to UAS flight.

A comprehensive overview of how the Fourth Amendment to the U.S. Constitution and Article I, Section 14 of the Ohio Constitution might apply to UAS use is beyond the scope of this report.[8] However, a few principles may assist agencies when determining what limits the Fourth Amendment imposes. First, the Fourth Amendment does not typically require agencies to obtain a search warrant when faced with emergencies or other exigent circumstances.[9]

Secondly, a warrant is not required to observe objects in public view.[10] Most relevant to UAS flights, the U.S. Supreme Court has, on two occasions, rejected Fourth Amendment challenges to law enforcement use of aircraft to observe the area surrounding a home. In 1989, in *Florida v. Riley*, the U.S. Supreme Court stated, as "a general proposition, the police may see what may be seen from a "public vantage point where (they have) the right to be."[11] However, a majority of justices failed to agree on the legal test that should apply to such activities.[12] At least one Ohio court held that although a law enforcement helicopter was operated in violation of FAA rules, its operation did not constitute a search requiring a search warrant.[13]

In 2001, the U.S. Supreme Court held that a warrant was required when law enforcement agencies observed the interior of a home using advanced technology that was "not in general public use." [14] Therefore, the use of additional, advanced technology such as thermal imaging devices, even from a public vantage point, may require a search warrant.

At this point, it is still not clear how courts will apply these Fourth Amendment principles to law enforcement's use of UAS. Courts reviewing Fourth Amendment challenges to UAS flights are likely to consider a variety of factors, including the type of property being observed, the altitude at which a UAS was flown, whether a UAS affected activities on the ground, the frequency and duration of UAS flights, and whether a UAS was operated in accordance with all applicable laws, rules, and regulations. It is also likely

[8] U.S. Constitution, Fourth Amendment; Ohio Constitution, Article I, Section 14.
[9] *See Warden v. Hayden*, 387 U.S. 294 (1967); *Michigan v. Fisher*, 558 U.S. 45 (2009); *Cady v. Dombrowski*, 413 U.S. 433 (1973).
[10] *Oliver v. United States*, 466 U.S. 170 (1984).
[11] *Florida v. Riley*, 488 U.S. 445, 447 (1989), citing *California v. Ciraolo*, 476 U.S. 207, 213 (1986).
[12] *See Riley*, 488 U.S. at 445-55.
[13] *See State v. Little*, 183 Ohio App.3d 680 (2d Dist. 2009).
[14] See, *Kyllo v. United States* (2001) 533 U.S. 27.

that, at least in the near future, courts will weigh these factors differently, leading to conflicting decisions about whether a warrant was or was not required.

The shifting legal landscape related to UAS operation and the rapidly evolving capabilities of UAS make it difficult to provide definitive guidance about whether and when agencies should obtain a warrant prior to a UAS flight. Law enforcement agencies are encouraged to consult legal counsel for assistance in both developing and updating guidelines governing their use of UAS. Such guidelines should account for the most up-to-date court decisions when determining when a search warrant might be necessary.

Recommendations 10 and 11: UAS Digital Evidence and Data Management

The advisory group recommends that law enforcement agencies develop and implement effective management policies for data collected through UAS use. **(Recommendation 10)**

The group also recommends that when agencies employ or contract with another party to operate UAS for law enforcement purposes, agencies should ensure that they retain ownership and control over all data collected. **(Recommendation 11)**

Members of the advisory group discussed how data is gathered and processed during and after flights. Members have experience in cataloging and organizing such data and noted that the information can become voluminous. The advisory group discussed the possibility that if the data collected through UAS use is not pursuant to a search warrant and/or for a criminal investigation, it may be subject to public release under the Ohio Public Records Act, Ohio Revised Code (ORC) Section 149.43.

A template data management policy can be found in this report. In addition, other resources are available to assist in developing data management policies. For example, the U.S. Department of Homeland Security has issued best practices and advises that in the collection, dissemination, and retention of UAS-recorded data, "unmanned aircraft program managers should employ reasonable technological or administrative safeguards to ensure that images of people incidentally recorded who are not relevant to an operation are not disseminated or viewed unnecessarily to protect individual rights. This is especially important for recordings that include images of minors not relevant to an operation."[15]

The advisory group recognizes that sometimes a law enforcement agency may hire a contractor for UAS use. In these situations, the law enforcement agency needs to maintain control and ownership of all data collected by the contractor in order to mitigate concerns that it could be improperly released or handled.

The advisory group reviewed and discussed several sources regarding best practices for management of data collected during UAS use, including:

- "Best Practices for Protecting Privacy, Civil Rights & Civil Liberties in Unmanned Aircraft Systems Programs," by the U.S. Department of Homeland Security." To read the report, visit www.dhs.gov/sites/default/files/publications/UAS%20Best%20Practices.pdf.

- "Voluntary Best Practices for UAS Privacy, Transparency, and Accountability, National Telecom and Information Agency," by the Department of Commerce. To read the report, visit www.ntia.doc.gov/files/ntia/publications/uas_privacy_best_practices_6-21-16.pdf.

[15] U.S. Department of Homeland Security, *Best Practices for Protecting Privacy, Civil Rights & Civil Liberties in Unmanned Aircraft Systems Programs*, at 7 (Dec. 18, 2015), https://www.dhs.gov/sites/default/files/publications/UAS%20Best%20Practices.pdf.

Recommendations 12 and 13: UAS Training

The advisory group recommends that law enforcement agency certified pilots and support crew members engage in applicable skills training no less than once a month in order to maintain the knowledge and skills of UAS use. (Recommendation 12)

The group also recommends that pilots and support crew attend an annual training covering updated industry standards, field exercises, review of regulations, and maintenance requirements. (Recommendation 13)

As mentioned in the "UAS Certifications and Authorizations" section, the advisory group discussed the processes and education pilots go through in order to become certified by the FAA as a remote pilot in command per 14 Code of Federal Regulations (CFR) Part 107. The certification must be renewed through the FAA every 24 months. The advisory group recognizes that UAS training is important for a couple of reasons. First, because safety is paramount, only law enforcement agency pilots and crew who are properly trained and certified should be operating UAS and attendant equipment. Also, it is important for UAS pilots and crew to maintain their skills in use and flight of the aircraft and systems in order to make effective use of UAS as a law enforcement tool.

James (Doug) Daniels, a senior Law Enforcement Training Officer at the Attorney General Ohio Peace Officer Training Academy (OPOTA) and a member of the advisory group, developed the following training outline.

Law enforcement agencies are encouraged to consult this training outline as a guide when selecting training courses and/or materials for their UAS pilots and crew.

Outline of Recommended UAS Pilot Training

1. Objective

A. The key to continued safe operation of an unmanned aircraft system (UAS) program is maintaining a professional level of aviation competency and proficiency, which can be accomplished by:

1. Establishing minimum qualifications for aircrew.
2. Training.

2. Goal

A. The goal of the aircrew training program is to produce and maintain mission-ready remote pilot(s) in command.

3. Instructor pilots

A. All small unmanned aircraft system (sUAS) senior and command pilots are designated as instructors for both ground and flight operations.

B. Any FAA certified flight/ground school instructors may also be used to teach both ground and flight operations.

C. An FAA certified flight/ground school instructor should teach the portion of 14 Code of Federal Regulations (CFR) 107 that addresses:

1. Airspace designations and definitions.
2. Temporary flight restrictions (TFR).
3. Aviation weather/METARS.
4. Airport/aircraft communications
5. Crew resource management (CRM).
6. Load: weight and balance.

D. Senior or command pilots or FAA certified flight/ground school instructors may instruct the 14 CFR 107 test preparations for the sUAS portion.

4. Senior remote pilots in command

A. A senior remote pilot in command has either the most years in service as an officer at the agency, the most flight hours and experience over the agency's other remote pilots, or both.

B. To be a senior remote pilot in command:

1. A candidate must have taken an FAA 107 remote pilot prep course and passed the remote pilot exam.
2. A candidate must take and pass a basic operation course for a UAS, offered within the agency.
3. He or she must complete these requirements before becoming part of the agency's UAS program.

C. The senior remote pilot shall oversee the day-to-day operations and training for the agency's UAS program.

5. Remote pilots in command

A. To be a remote pilot in command:

1. The candidate should have at least two years' experience as a full-time officer. (An agency may consider experience earned as a reserve, auxiliary, or special-duty officer.)
2. The candidate must have taken a FAA 107 remote pilot prep course and passed the FAA 107 remote pilot exam.
3. The candidate must take and pass a basic UAS operation course offered within the agency.
4. He or she must complete these requirements before becoming part of the agency's UAS program.

6. Support crew

A. An agency may have only one remote pilot in command for its UAS program, or the agency may have more than one remote pilot in command and have no support crew.

B. The support crew is made up of:

1. Visual observer (VO)
2. Sensor system/camera operator
3. Payload specialist

C. To be a support crew member:

1. The candidates must have at least two years' experience as a full-time officer. (An agency may consider experience earned as a reserve, auxiliary, or special-duty officer.)
2. The candidates must have taken and passed training in their prospective assignments.
3. Support crew members should have a minimum of 24 hours of initial training from the agency or an outside source.

7. Training plans

A. The chief or senior pilot will formulate a training plan for each unit.

B. Training objectives will vary depending on whether the team member is new to unmanned aviation or an experienced member.

C. For new members, the training should focus on familiarization with equipment and operations procedures.

D. For experienced members, the training should challenge them to increase their competency in the knowledge and skills necessary to perform safe sUAS operations.

8. Initial training

A. Once the FAA remote pilot in command training has been completed and the member is certified, the member will then begin the initial training phase with the sUAS. There are two options, depending on what is available to the agency:

1. Initial factory-authorized training, which covers the skills necessary to operate specific unmanned aircraft systems.

2. Training provided by a remote pilot in command who has experience operating the same unmanned aircraft system used by the agency.

B. Once the support crew training has been completed and the member is certified, the member will then move to the initial training phase with the UAS. There are two options depending on what is available to the agency:

1. Initial factory-authorized training, which provides new support crew with the skills sufficient to assist in the operation of specific unmanned aircraft systems.

2. In-house training on assisting in the operation of specific unmanned aircraft systems.

    a. Observer

        i. Observers are required on all training and actual missions. They are also required on night missions.

        ii. Observers shall meet all conditions of the most recent COA issued by the FAA (if one has been issued to the agency). They will have current working knowledge of: the airspace intended for operations; air traffic control phraseology and communication requirements; specific UAS aerodynamic factors; the weather and how to obtain and interpret information about it; how to see and avoid aircraft, and the ability to identify positions for purposes of relaying position reports to the remote pilot in command.

        iii. Observers must participate in preflight briefings.

    b. Camera and remote sensing operator

        i. Camera and remote sensing operators are required on all missions, including training ones.

        ii. Camera and remote sensing operators shall receive training on camera and sensing equipment operations, including recording and storing of digital data for evidentiary purposes prior to assisting with mission flights.

        iii. Camera and remote sensing operators must participate in preflight briefings.

C. Any new crew member, whether it is the remote pilot in command or support crew, who fails to successfully complete initial training may be subject to removal from the unit.

9. Recurrent training

(Note: This section may be adjusted to suit an agency that has one or more remote pilots in command.)

A. Recurrent training for pilots and support crew members will be conducted no less than once a month. The UAS chief pilot, or person in charge of the unit, is responsible for organizing the training sessions. That person may assign the task of training to any crew member, who will have to come up with a training topic.

B. Training will emphasize safety; respect for law and citizens' privacy; crew resource management; "lessons learned" in previous deployments; lost link issues; emergency procedures; equipment failure; scenario-based missions; mapping and waypoint missions; and efficiency. Training should also include going back to the basic operation and flight skills for operating a UAS.

C. All remote pilots in command must complete at least three "currency events" each 90 days using the make and model of the UAS to be deployed. Currency events include takeoffs and landings and simulator events, if available. Pilots who experience a lapse in currency must perform their currency events under a UAS instructor pilot. To maintain proficiency, all pilots shall conduct at least one training flight, to include one takeoff and landing, each month.

   Lapsed currency flights may not be in support of a public safety mission. Flights necessary to demonstrate pilot currency will be recorded in the pilot's UAS pilot logbook.

   1. General experience: No person may act as a pilot in command unless that person has made at least three takeoffs and three landings within the preceding 90 days, with some exceptions.[16]

   2. The required takeoffs and landings may be accomplished in a flight simulator or flight training device.

D. Recurrent training is not limited to flying skills but includes knowledge of all pertinent unmanned aircraft systems and aviation matters.

E. All members within the UAS unit shall read the COA issued by the FAA (if one is issued to the agency) and maintain proficiency in operator and support crew abilities.

F. The remote pilot in command will be given time during his or her duty to practice with a sUAS. This time should be a minimum of four hours to maintain proficiency.

G. The remote pilot in command must follow FAA requirements for certification by retaking and passing the FAA 107 exam every two years.

H. A remote pilot in command or support crew member's failure to demonstrate proficiency may result in removal from the unmanned aircraft systems unit.

10. In-service/annual training

A. All members of the UAS unit must attend in-service/annual training in conjunction with recurrent training.

B. The in-service/annual training shall include updated industry standards; field exercises; review of current case law governing the use of UAS; review of policy and procedures; review of Fourth Amendment search and seizure issues; recommendations from the prosecutor or legal adviser on

[16] 14 C.F.R. 61.57.

UAS uses in criminal cases; maintenance requirements and standard operating procedures; and anything else of importance relating to the unit.

C. Recommend topics include:

1. Applicable regulations relating to sUAS ratings, privileges, limitations, and operations.
2. Airspace classification and operating requirements and flight restrictions affecting sUAS operations.
3. Emergency procedures.
4. Crew resource management.
5. Aeronautical decision-making and judgment.
6. Airport operations.
7. Maintenance and preflight inspection procedures.

11. Annual evaluation

A. Once a year each remote pilot in command shall demonstrate proficiency with the agency's UAS through an evaluation designed and set by the agency. Since there is not a national or state standard in place, the agency shall set the standard requirements for the evaluation.

B. The evaluation should objectively evaluate the competency-level and skill of the remote pilot in command. This evaluation must be documented on a form designed and implemented by the agency.

C. The evaluator must be a remote pilot in command who demonstrates superior knowledge and skill operating a UAS platform.

D. The evaluator can be:

1. Another remote pilot in command within the agency.
2. A remote pilot in command from another agency.
3. A contracted remote pilot in command from a national organization or training company.

E. The agency shall keep documentation of the evaluation within the guidelines of the agency's document retention policy. (It is suggested that the agency keep this documentation as long as the remote pilot in command is a member of the unit.)

12. Use of agency's UAS for training

A. The agency's UAS may be used to meet training objectives.

13. UAS tasks, conditions, and standards

Law enforcement remote pilots in command are faced with challenges requiring them to fly in complex operating environments and sometimes on short notice. It is imperative that agencies train their aircrews to sustain their aviation proficiency. To achieve maximum training results, planning must be detailed and focused on mission requirements. The following tasks are clearly defined, measurable activities that a remote pilot in command must be able to perform:

Task 1: Plan a UAS flight

Needed for the task: Access to weather information, Notices to Airmen (NOTAMs), temporary flight restrictions (TFRs), flight planning aids, any necessary charts, forms, publications, and other appropriate information.

Standards:

1. Determine whether the aircrew and aircraft are capable of completing the assigned mission.
2. Determine whether the flight can be performed based on current and forecast weather conditions, applicable code of federal regulations, local regulations, and agency standing operating procedures.
3. Determine the correct departure, en route, and destination procedures.
4. Select routes and altitudes that avoid hazardous conditions and do not exceed aircraft or equipment limitations.
5. Determine the battery and fuel requirements for the flight.
6. Perform a mission safety risk assessment per agency standing operating procedure.

Description:

1. Crew actions:
   a. The remote pilot in command will conduct an assessment of the operating environment to include the following:
      - Local weather conditions.
      - Local airspace and any flight restrictions.
      - Location of persons and property on the surface.
      - Other ground hazards.
   b. The remote pilot in command will ensure that the crew is current and qualified to perform the mission and that the aircraft is equipped to accomplish it. The remote pilot in command may direct the crew (visual observer and/or sensor operator if applicable) to complete some portions of the flight planning.
   c. The crew will complete all assigned elements and report the results to the remote pilot in command.
2. Procedures: Using appropriate FAA weather facilities, the remote pilot in command will obtain information about the weather. After ensuring that the flight can be completed under the conditions, the remote pilot in command will check NOTAMs, and other appropriate sources, for any restrictions that may apply to the flight. The remote pilot in command will obtain navigational charts that cover the entire flight area and allow for changes in routing that may be required because of terrain, obstacles, people, or property. He or she will select the best course(s) and altitude(s) for the mission, estimate the total distance and flight time, and calculate the required battery life and fuel needed for the flight. He or she will verify that the aircraft weight and center of gravity will remain within allowable limits for the entire flight.

Training and evaluation requirements:

1. Training will be conducted academically.

2. Evaluation will be conducted academically.

References: Appropriate UAS operator's manual, 14 CFR Part 107, COA, Detroit and/or Cincinnati sectional charts, and agency standard operating procedures and regulations

Task 2: Conduct a UAS crew mission brief

Needed for the task: Agency-approved crew briefing checklist

Standards:

The remote pilot in command will:

1. Brief all assigned crew members on the following mission-related items:
    - Operating conditions.
    - Emergency conditions.
    - Contingency procedures.
    - Roles and responsibilities of each person involved in the operation.
    - Potential hazards.
2. Have each crew member acknowledge that they fully understand their duties and responsibilities.

Description:

1. Crew actions:
    a. The remote pilot in command has overall responsibility for the crew mission briefing.
    b. The remote pilot in command will ensure all aircraft system information is correct and that the crew is current and qualified to perform the mission.
    c. The crew members being briefed will repeat the information back to the remote pilot in command, ask any questions, and acknowledge that they understand their assigned actions, duties, and responsibilities.
2. Procedures: An agency-approved crew mission briefing checklist is to be used during the briefing. It will identify the mission and flight requirements that will demand effective communication and proper sequencing and timing of actions by the crew members.

Environmental considerations: During mission planning, crew members should stay aware of weather conditions to include temperature, wind, precipitation, storms, sunlight, and moonlight in the area of operations.

Night considerations: A thorough crew briefing should be conducted prior to night operations; crew coordination is crucial. When maneuvering the aircraft, the remote pilot in command must consider obstacles and other aircraft. All crew members must avoid fixation by using proper scanning techniques.

Training and evaluation requirements:

1. Training will be conducted academically.
2. Evaluation will be conducted academically.

References: Appropriate UAS operator's manual, 14 CFR Part 107, COA, Detroit and/or Cincinnati sectional charts, agency standard operating procedures and regulations

Task 3: Perform a preflight inspection

Needed for the task: UAS, UAS operator's manual or manufacturer's inspection procedures

Standards:

1. Perform a preflight inspection according to the UAS operator's manual or manufacturer's inspections procedures.
2. Enter and verify the appropriate information in the UAS logbook in accordance with the agency's standard operating procedures.

Description:

1. The remote pilot-in-command will ensure that a proper preflight inspection is accomplished using the operator's manual or manufacturer's inspection procedures and will also ensure that the appropriate information is entered in the UAS logbook in accordance with the agency's standard operating procedures.
2. Procedures: The remote pilot in command will complete a preflight inspection in accordance with the aircraft operator's manual or manufacturer's inspection procedures and ensure the final airworthiness of the aircraft.

Note: Oil leaks and other defects are difficult to see at night when using a flashlight with a colored lens.

Environmental considerations:

1. Cold weather operations: In addition to the normal exterior inspection, special attention should be given to all vents, openings, control surfaces, hinge points, and fuselage surfaces for accumulation of ice or snow. Ice, snow, and frost accumulation must be removed before takeoff. Propeller blades and hubs should be inspected for ice and snow. The propellers should be turned by hand in the direction of normal rotation to verify they are free to rotate prior to starting the engines. Remove snow, frost, and ice accumulations, in accordance with the aircraft operator's manual.
2. Night considerations: If time permits, the preflight inspection should be completed during daylight hours. If it is dark, a flashlight with an unfettered lens should be used to supplement available lighting.

Note: Crew performing preflight inspection should be aware of any recent maintenance performed and look at those areas in greater detail.

Training and evaluation requirements:

1. Training will be conducted on the UAS (preflight inspection) and academically (forms and records review).
2. Evaluation will be conducted on the UAS (preflight inspection) and academically (forms and records review).

References: Appropriate UAS operator's manual, 14 CFR Part 107, agency standard operating procedures, and regulations

Task 4: Perform engine start and system check

Needed for the task: UAS, UAS operator's manual

Standards:

1. Perform procedures and checks in accordance with the UAS operator's manual.

2. Ensure that the checks are completed and systems are operating within prescribed tolerances.

3. Correctly perform crew coordination actions.

Description:

1. Crew actions: The remote pilot in command will complete the required checks and procedures in accordance with the UAS operator's manual.

2. Procedures: The remote pilot in command will ensure the engine, related systems, and equipment is operating within specified limits.

Training and evaluation requirements:

1. Training will be conducted on the UAS (required checks on the aircraft).

2. Evaluation will be conducted in the UAS (all parts internal and external).

References: Appropriate UAS operator's manual, 14 CFR Part 107, agency standard operating procedures, and regulations.

Task 5: Perform payload operational checks

Needed for the task: UAS, UAS operator's manual

Standards:

1. Perform operational checks on all installed payloads.

2. Determine the operational status of all payloads.

Description:

1. Crew actions: The remote pilot-in-command or sensor operator, if applicable, will perform operational checks as necessary to determine whether the installed payloads are operating properly. He or she will determine the effects of any payload discrepancies against the needs of the mission. If using a sensor operator, the sensor operator will announce the status of the payloads when the checks are completed and record any discrepancies in the UAS logbook in accordance with the agency's standard operating procedure.

2. Procedures.

   a. The remote pilot in command or sensor operator will perform operational checks as necessary to determine whether the payloads are operating properly. If using a sensor operator, he or she will announce when the checks are complete.

   b. The crew will determine the effects of a payload malfunction and if the system(s) can be used to perform the assigned mission.

   c. The crew will record any discrepancies in the UAS logbook in accordance with the agency's standard operating procedure.

Environmental considerations: The remote pilot in command must evaluate the environmental conditions and conduct a thorough crew briefing prior to operations. Crew coordination is crucial.

Training and evaluation requirements:

1. Training will be conducted on the UAS (required checks on the aircraft).

2. Evaluation will be conducted on the UAS.

References: Appropriate UAS operator's manual, 14 CFR Part 107, agency standard operating procedures and regulations

Task 6: Perform radio communication procedures

Needed for the task: UAS, UAS operator's manual, established radio communication

Standards:

1. Check, set, and operate the radios as required.
2. Establish and maintain radio contact with the desired individual and/or the appropriate air traffic control facility.
3. Operate all internal/external communication systems and mission equipment.
4. Perform two-way radio failure procedures per local procedures and the flight information handbook (FIH).
5. Adjust radios to the proper frequencies based on mission requirements.
6. When communicating with ATC facilities, use the correct radio communication procedures and phraseology according to Federal Aviation Regulations (FAR) and Aeronautical Information Manual (AIM)
7. Acknowledge each radio communication by using the correct aircraft call sign.
8. Correctly perform crew coordination actions.

Description:

1. Crew actions:
   a. The remote pilot- in command will assign radio frequencies per mission requirements during the crew briefing and will indicate which crew member will establish and maintain primary communications with the appropriate agency. However, if crew members monitor two frequencies simultaneously, they will keep each other informed of any actions or communications conducted on their respective frequencies.
   b. Crew members should monitor avionics, perform frequency changes, and establish initial contact. Crew members will copy pertinent information and repeat information as requested by the remote pilot in command.
2. Procedures:
   a. The crew will use radio communications procedures, phraseology, and terms as appropriate for the area of operations. Use correct call sign, signal operating instruction, or tail number as appropriate to the situation when acknowledging communication transmissions.
   b. The assigned crew member will check and set radios, as required and maintain a continuous listening watch on the assigned frequencies. When required, the assigned crew member will establish communications with the appropriate air traffic control facility. The assigned crew member will monitor the frequency before transmitting and use the correct radio call sign when acknowledging each communication. The assigned crew member will transmit pilot reports, position reports, and flight plan changes (as required).
   c. If advised to change frequencies, the assigned crew member will acknowledge the transmission before making the change.

d. In case of two-way radio failure, the assigned crew member will attempt to re-establish communications by using alternate frequencies and radios. If unsuccessful, he or she will execute lost communication procedures in accordance with the appropriate local reference, or flight information handbook.

Training and evaluation requirements:

1. Training will be conducted academically or on the UAS.

2. Evaluation will be conducted in the UAS.

References: Appropriate common references, *Aeronautical Information Manual* (AIM), *Flight Information Handbook* (FIH), appropriate UAS operator's manual, 14 CFR Part 107, agency standard operating procedures and regulations

Task 7: Perform a manual takeoff

Needed for the task: UAS, UAS operator's manual, clearance by air traffic control (if required)

Standards:

1. Configure aircraft for takeoff.
2. Without error performs takeoff checks and procedures in the UAS operator's manual.
3. Without error complete the take-off procedures in accordance with the operator's manual.
4. Without error complete the post take-off checks and procedures in accordance with the operator's manual.
5. Correctly perform crew coordination actions.

Description:

1. Crew actions:
   a. The remote pilot in command will select the appropriate takeoff location based on weather, terrain, obstacles and current traffic conditions. The VO, if used, will assist the remote pilot in command in clearing the aircraft and looking out for other aircraft in the area.
2. Procedures:
   a. Prior to takeoff, the remote pilot in command will complete all takeoff checks and procedures in accordance with the operator's manual. He or she will confirm there is at least 3 miles visibility from the ground control station.
   b. The remote pilot-in-command will perform a takeoff from a location that is free of obstacles and clear of people and other aircraft. As the aircraft transitions into flight, the remote pilot in command will monitor the takeoff to ensure that all systems are functioning properly.
   c. If aircraft exceeds any of the parameters listed in the operator's manual, the remote pilot in command will abort the takeoff.
   d. Perform post-takeoff procedures in accordance with the operator's manual.

Environmental considerations: Cold weather operations: If there is a possibility of ice, snow, or frost accumulation on the flying surfaces, do not attempt a takeoff.

Training and evaluation requirements:

1. Training will be conducted on the UAS.
2. Evaluation will be conducted in the UAS.

References: UAS operator's manual, 14 CFR Part 107, agency standard operating procedures and regulations

Task 8: Perform an autonomous takeoff

Needed for the task: UAS, UAS operator's manual, clearance by air traffic control (if required)

Standards:

1. Configure aircraft for takeoff.

2. Perform takeoff checks and procedures in accordance with the UAS operator's manual.

3. Complete the autonomous mode takeoff procedures in accordance with the UAS operator's manual.

4. Complete the post-takeoff checks and procedures in accordance with the UAS operator's manual.

5. Perform crew coordination actions.

Description:

1. Crew actions:

   a. The remote pilot in command will select the appropriate takeoff location based on weather, terrain, obstacles, and current traffic conditions. The VO, if used, will assist in clearing the aircraft and looking out for other aircraft in the operating area.

2. Procedures:

   a. Prior to takeoff, the remote pilot in command will complete all autonomous takeoff checks and procedures in accordance with the operator's manual. He or she will confirm there is at least 3 miles visibility from the ground control station.

   b. The remote pilot in command will perform an autonomous takeoff from a location that is free of obstacles, people, and other aircraft. As the aircraft transitions into flight, he or she will monitor the takeoff to ensure that all systems are functioning properly.

   c. If aircraft exceeds any of the parameters listed in the operator's manual, the remote pilot in command will perform a manual abort.

   d. The remote pilot in command will perform post-takeoff procedures in accordance with the operator's manual.

Environmental considerations: Cold weather operations: If there is a possibility of ice, snow, or frost accumulation on flying surfaces, the remote pilot in command will not attempt a takeoff.

Training and evaluation requirements:

1. Training will be conducted on the UAS.

2. Evaluation will be conducted on the UAS.

References: UAS operator's manual, 14 CFR Part 107, agency standard operating procedures and regulations

Task 9: Perform a manual landing

Needed for the task: UAS, UAS operator's manual, clearance by air traffic control (if required)

Standards:

1. Complete the landing checks according to the operator's manual.

2. Complete the post-landing checks and procedures in accordance with the operator's manual.

3. Perform crew coordination actions.

Description:

1. Crew actions:

   a. Prior to landing, the remote pilot in command will complete all landing checks and procedures in accordance with the operator's manual.

   b. The remote pilot in command will select a landing location that is free of obstacles and clear of people and other aircraft. As the aircraft is inbound for landing, the remote pilot in command will monitor all systems to ensure that they are functioning properly.

   c. If aircraft exceeds any of the parameters listed in the operator's manual, the remote pilot in command will abort the takeoff.

   d. The remote pilot in command will perform post-takeoff procedures in accordance with the operator's manual.

Training and evaluation requirements:

1. Training will be conducted on the UAS.

2. Evaluation will be conducted in the UAS.

References: UAS operator's manual, 14 CFR Part 107, agency standard operating procedures and regulations

Task 10: Perform autonomous landing

Needed for the task: UAS, UAS operator's manual and clearance by air traffic control (if required)

Standards:

1. Complete the pre-landing checks according to the operator's manual.

2. Complete the post-landing checks and procedures in accordance with the operator's manual.

3. Correctly perform crew coordination actions.

Description:

1. Crew actions:

   a. Prior to landing, the remote pilot in command will complete all landing checks and procedures in accordance with the operator's manual.

   b. The remote pilot in command will select a landing location that is free of obstacles and clear of people and other aircraft. As the aircraft is inbound for landing, the remote pilot in command will monitor all systems to ensure that they are functioning properly.

   c. If the aircraft exceeds any of the parameters listed in the operator's manual, the remote pilot in command will perform a manual return-to-home.

   d. The remote pilot in command will perform post-takeoff procedures in accordance with the operator's manual.

Training and evaluation requirements:

1. Training will be conducted on the UAS.

2. Evaluation will be conducted in the UAS.

References: UAS operator's manuals, 14 CFR Part 107, agency standard operating procedures and regulations

Task 11: Perform flight using automatic flight modes

Needed for the task: UAS, UAS operator's manual

Standards:

1. Exercise all automatic flight modes.
2. Verify correct mission is loaded.
3. Engage and verify that the aircraft enters the selected flight mode.
4. Verify that the airspeed, heading, and altitude are correctly set for the mission.
5. Perform crew coordination actions.

Description:

1. Crew actions. The remote pilot in command will verify that the aircraft enters the selected flight mode by monitoring the flight mode section on the air vehicle control panel/mobile device.
2. Procedures: The remote pilot-in-command will select and load a mission to the aircraft as required. He or she will verify that the waypoints, airspeed and altitude are appropriate for the mission and do not exceed system limitations. He or she will verify that the aircraft achieves designated waypoints and executes flight plan parameters within programmed limitations.

Training and evaluation requirements:

1. Training will be conducted on the UAS.
2. Evaluation will be conducted in the UAS.

References: UAS operator's manual, 14 CFR Part 107, agency standard operating procedures and regulations

Task 12: React to a system emergency

Needed for the task: UAS; UAS operator's manual; indications of an emergency condition, specific malfunction, warning, caution, or advisory

Standards:

1. Recognize, announce, and analyze indications of an emergency and perform or describe all underlined steps without reference to the operator's manual.
2. Complete appropriate emergency procedures.
3. Perform crew coordination actions.

Description:

1. Crew actions: When a crew member, remote pilot, or VO detects an emergency situation, he or she will immediately alert the others and the:
   a. Remote pilot in command will initiate the appropriate response as required for the emergency.
   b. The VO will perform as directed or briefed and if time permits, will verify all emergency checks with the operator's manual.
2. Procedures: The crew member who makes the announcement, identifies the malfunction, and the remote pilot in command performs the appropriate emergency procedure.

Environmental considerations: Evaluate the environmental conditions and conduct a thorough crew briefing prior to operations. Crew coordination is crucial.

Training and evaluation requirements:

1. Training may be conducted academically or on the UAS.
2. Evaluation will be conducted academically or on the UAS.

References: UAS operator's manual, 14 CFR Part 107, agency standard operating procedures, regulations

Task 13: Operate the sensor/payload

Needed for the task: UAS, UAS operator's manual with sensor/payload operational checks complete

Standards:

1. Perform sensor payload(s) procedures and checks in accordance with the operator's manual.

2. Determine any malfunctions and apply corrective action/troubleshooting procedures.

3. Determine the operational status of the sensor payload(s).

4. Employ all sensor modes — for example, electro optical (EO), infrared (IR), and EO/IR as applicable.

6. Perform crew coordination actions.

Description:

1. Crew actions:

   a. The remote pilot-in-command will perform operational checks as necessary to determine whether the sensor/payload is operating properly. The remote pilot-in-command will determine the effects of any sensor/payload discrepancies against the needs of the mission. Any sensor/payload discrepancies should be recorded in the UAS logbook.

2. Procedures:

   a. The remote pilot-in-command will perform operational checks as necessary to determine whether the sensor/payload is operating properly. The remote pilot-in-command will determine the effect of a sensor/payload malfunction and whether the system can be used to perform the assigned mission.

   b. Configure and operate the sensor/payload according to the operator's manual. Select the various sensors and sensor features that offer different imaging capability, such as field of view and magnification. Adjust the sensor as necessary to obtain the best picture.

Environmental considerations: Evaluate the environmental conditions and conduct a thorough crew briefing prior to operations. Crew coordination is crucial.

Training and evaluation requirements:

1. Training will be conducted on the UAS.

2. Evaluation will be conducted on the UAS.

References: UAS operator's manual, 14 CFR Part 107, agency standard operating procedures and regulations

Task 14: Perform after-landing procedures

Needed for the task: UAS, UAS operator's manual

Standards:

1. Perform after-landing checks according to the aircraft operator's manual.

2. Determine the status of the UAS.

3. Perform crew coordination actions.

Description:

1. Crew actions. The remote pilot-in-command will shut down the UAS in accordance with the operator's manual. After it has been shut down, the remote pilot-in-command will complete the required checks or procedures according to the UAS operator's manual.

2. Procedures. The remote pilot in command will:

   a. Shut the aircraft down in accordance with the UAS operator's manual.

   b. Ensure the appropriate information and any faults found are entered in the UAS logbook.

Training and evaluation requirements:

1. Training may be conducted academically (for forms and records review) and on the UAS.

2. Evaluation will be conducted in the UAS, including forms and records completion.

References: UAS operator's manual, 14 CFR Part 107, agency standard operating procedures and regulations

Task 15: Process video, data, and imagery

Needed for the task: UAS, UAS operator's manual with sensor/payload operational checks complete, data and imagery from a completed mission

Standards:

1. Process the video, data, or imagery in accordance with the software manufacture's manual.

2. Correctly determine any malfunctions and apply corrective action or troubleshooting procedures.

3. Perform crew coordination actions.

Description:

1. Procedures:

   a. The remote pilot-in-command and/or sensor operator will retrieve the video, data, and imagery from the UAS and process the information in accordance with the software guidelines.

   b. The remote pilot in command/sensor operator will provide the processed information to the appropriate point of contact within the agency.

Training and evaluation requirements:

1. Training will be conducted on the UAS.

2. Evaluation will be conducted on the UAS.

References: UAS operator's manual, 14 CFR Part 107, software manufacturer's manual, agency standard operating procedures and regulation

Recommendation 14: UAS Technology and Equipment

Before starting an unmanned aircraft system (UAS) program, law enforcement agencies should work with their political subdivisions to identify what needs the program would meet and consider the resources available to support it. **(Recommendation 14)** The discussion should cover the importance of maintaining and updating UAS technology as well as the obligation to regularly re-evaluate the goals of the program.

Group member Dan Stamm, counter-UAS program manager at Battelle, developed an outline of some current UAS technology for law enforcement agencies to consider. (This outline is not exhaustive and, given the rapid change of technology, the information is perishable.)

Outline of Current UAS Technology and Equipment

Purpose

This document is intended to provide a foundational understanding of a wide range of UAS and associated technology that may be used in the service of Ohio law enforcement and public safety officers. It should be noted that, although common UAS variants and other technology may be mentioned in this document, in no way does this document endorse one UAS or manufacturer over any other. A thorough search should be conducted for the optimum UAS and associated technology that meets the organization's mission needs and budget before making any acquisition decisions.

Components of a UAS

The basic components of a UAS are the unmanned aerial vehicle (UAV), the ground control station, and the payload or payloads implemented on the UAV. This section provides a description of these components and how they work together as a system.

UAV

Payload

Ground control station

A DJI Phantom 3 UAS comes with all three primary components already integrated together.

Unmanned aerial vehicle (UAV)

UAV is another term for the aircraft portion of the UAS. It is the flight platform that carries the payload or payloads. The UAV flight is controlled by the ground control station (GCS). There are multiple types and sizes of UAV.

Ground control station (GCS)

The GCS is operated by the pilot to control the flight of the UAV. The ground control station is the primary interface between the pilot and the UAS. Most commercial off-the-shelf (COTS) unmanned aircraft systems will come with a basic ground control station to control the UAV. However, it may be useful to upgrade the commercial off-the-shelf ground control station with additional equipment such as a tablet or smartphone for real-time video or to replace it altogether with a more capable ground control station that can be customized to achieve the UAS mission needs. Despite often coming with a ground control station, almost all commercial off-the-shelf UAV can be connected to and controlled by a custom third-party ground control station. These third-party ground control stations may provide longer connection ranges to the UAV and usually have more control options for payloads that require additional control inputs.

Payload

The payload or payloads that are implemented in the UAS are the key to achieving the UAS mission objective. Without an effective payload, there are few reasons to operate a UAS. The payload is carried by the UAV and controlled through the ground control station.

UAV types and common groupings

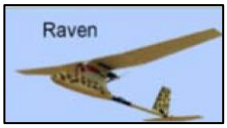
A wide range of UAV types and sizes have been developed commercially to achieve UAS mission objectives. Unmanned aircraft systems are commonly grouped by basic size (as bounded by maximum weight including payload), flight speed, and normal operating altitude. UAV are also divided into different types based on their mode of achieving lift/flight, with the most common being fixed-wing platforms and rotary-wing platforms. A third type of UAV, which attempts to leverage the advantages of both fixed-wing and rotary-wing UAV, is also described later for the reader's technological awareness.

Despite the fact that there are multiple means for powering the UAV, all unmanned aircraft systems that will likely be used by law enforcement agencies are powered by rechargeable batteries. Therefore, this document assumes the use of batteries as the primary power source.

U.S. Department of Defense "Unmanned Aircraft System Airspace Integration Plan"

Beginning in the late 1990s or early 2000s, the U.S. Department of Defense (DOD) began studying the challenges associated with integrating unmanned aircraft systems into foreign and domestic airspaces. As part of that investigation, the DOD found it valuable to group unmanned aircraft systems based on some of the basic performance characteristics of UAV. The groupings are defined by the maximum UAV weight in pounds, including all aspects of the UAV necessary for flight as well as the payload(s), the normal operating altitude in feet above ground level (AGL) or feet flight level (FL; referenced to sea level), and maximum speed in knots (kts). The DOD defined the boundaries of the groupings using these variables in Appendix D of the "Unmanned Aircraft System Airspace Integration Plan."[17] It is advisable to research newer versions of that document to determine whether modifications have been made.

[17] Department of Defense, *Unmanned Aircraft System Airspace Integration Plan*, Version 2.0 (Mar. 2011), available at https://www.hsdl.org/?view&did=723337.

UAS Groups	Maximum Weight (lbs.) (MGTOW)	Normal Operating Altitude (ft.)	Speed (knots)	Representative UAS	
1	0 – 20	<1,200 AGL	100	Raven (RQ-11), WASP	
2	21 – 55	<3,500 AGL	<250	ScanEagle	
3	<1,320	< FL 180		Shadow (RQ-7B), Tier II / STUAS	
4	>1,320		Any Airspeed	Fire Scout (MQ-8B, RQ-8B), Predator (MQ-1A/B), Sky Warrior ERMP (MQ-1C)	
5		> FL 180		Reaper (MQ-9A), Global Hawk (RQ-4), BAMS (RQ-4N)	

The representative unmanned aircraft systems for each group in the "UAS Airspace Integration Plan" are all U.S. military assets; however, the groupings are applicable to commercial off-the-shelf UAS, as well.

The boundaries between the groups should not be considered completely bounding. For example, there may be UAVs that weigh less than 20 pounds and are capable of flying at speeds greater than 100 knots. Generally, the most bounding criterion that defines the groups is the maximum UAV weight. The combination of these variables helps to quickly inform UAS operators on the basic capabilities of, and potential risks to public safety, posed by UAVs.

Rotary-wing UAVs

Rotary-wing UAVs achieve lift by rotating propellers or airfoils. The rotating portion of the UAV is the rotor. Historically, rotary-wing UAVs were primarily helicopterlike aircraft with a single primary rotor. These helicopters' rotor blades are airfoils with varying angles of attack for control and lift. This resulted in complex UAVs that were complicated to control and often prone to failure despite the capabilities of a highly trained pilot. More recently, rotary-wing UAVs that use multiple horizontal propellers, referred to as "multi-rotors" have become very popular due to their ease of use and low complexity in comparison to single rotor UAVs. Common multi-rotor variants have four rotors (termed "quadcopters"), six rotors ("hexacopters"), or eight rotors ("octocopters").

Common models of rotary-wing UAVs

Of multi-rotor UAV types, quadcopters are the most prevalent and commercially available. They can range from small Group 1 UAVs through large Group 2 and into Group 3 UAVs. Hexacopters and octocopters are most often used to achieve added stability and/or additional lift capacity. The largest manufacturer of all multi-rotor UAVs is the Chinese company DJI. Additional manufacturers include YUNEEC, Parrot, and 3D Robotics (3DR), although 3DR appears to be exiting the civilian multi-rotor market.

DJI Phantom 3, shown with all components of the UAS, is a recognizable multi-rotor.

The DJI Inspire is known as a capable camera platform.

The DJI Mavic folds into a small size for stow and transport.

The DJI S1000 is a semi-custom octocopter known for having an impressive payload capacity for a multi-rotor and for its stability when used for photography.

The YUNEEC Typhoon H is an example of a hexacopter with six rotors.

The YUNEEC Typhoon Q500 is intended to be competitive with the DJI Phantom.

The Parrot Bebop, shown here with its controller, is known as an entry-level multi-rotor.

The 3DR Solo is also intended to compete against the DJI Phantom; the camera can be purchased separately.

Pros and cons of rotary-wing UAVs

Multi-rotor UAVs have become popular due to their vertical takeoff and landing capability, the ease of operation, and their precision control, which results in a UAV with high general utility. Multi-rotors can handle windy conditions fairly well. However, there are certain aspects of multi-rotors that limit their capabilities in comparison to other types. In general, multi-rotors have limited lift capacity and limited flight endurance. They can also be somewhat complex to maintain, especially after an accident, since it may be difficult to replace damaged components (besides the rotors) in the smaller fully-integrated COTS multi-rotors. Additionally, there is almost no way to recover from a motor failure on all multi-rotors except for the larger and more expensive hexacopters and octocopters. Multi-rotors are also quite loud due to the spinning rotors and motors.

Common mission applications of rotary-wing UAVs

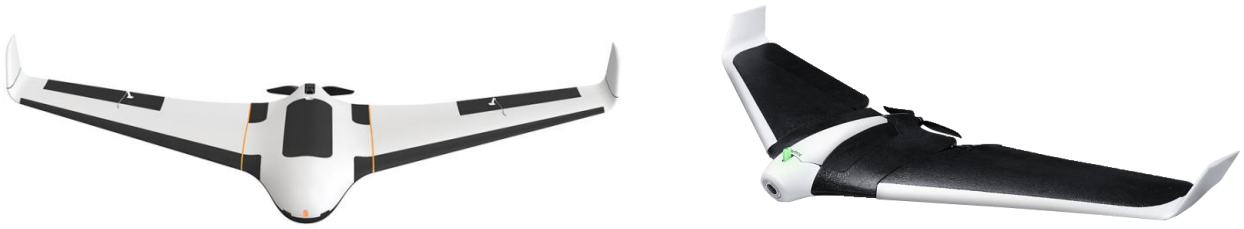
Despite the limitations, multi-rotors are useful for a range of applications. Due to their stability, maneuverability, and ease of operation, they are useful for capturing photos and videos, and getting visual intelligence about dangerous or hard-to-reach locations. They are useful for search and rescue, search and seizure, location inspection, and crime and accident scene documentation. Using a process called photogrammetry, crime and accident scenes can be recreated in a 3-D virtual environment so they can be better maintained for later inspection. Additionally, mechanical actuators may be implemented as payloads on multi-rotors to be able to deliver rescue supplies and equipment (such as rope or water) to stranded citizens.

Fixed-wing UAVs

Fixed-wing UAVs achieve lift by propelling an airfoil forward, like an airplane. They use vertically-oriented propellers to achieve the forward motion. Fixed-wing UAVs are often equipped with pusher-style propellers, rather than propellers at the front of the UAV pulling it through the air, but both styles exist and are quite functional. Flying-wing styles of fixed-wing UAVs (where there is no significant distinction between the fuselage and the wings) are also quite prevalent, however, traditional style fixed-wing UAVs with separated fuselage and wings are common, as well.

Common Models of Fixed-Wing UAVs

Multiple manufacturers make flying-wing UAVs, such as Skywalker, UAV Systems International, and 3DR — all of which are referred to as X8 configurations. The Parrot Disco is a similar flying-wing UAV to the X8 configuration. The X-UAV Talon is a common, robust fixed-wing UAV with clearly identifiable separated fuselage and wings.



The X8, left, by UAV Systems International, and the Parrot Disco are common flying-wing UAVs.

The X-UAV Talon is a fixed-wing UAV that can function as a general platform for multiple payloads.

Pros and cons of fixed-wing UAVs

The primary advantages of fixed-wing UAVs result from the energy-efficient lift generated by the wings. In comparison to multi-rotors, fixed-wing UAVs generally have longer flight durations, can carry heavier payloads, and can often be landed safely in the event of a failure of the primary motor or propeller. They can also be piloted over longer distances due to their long flight durations and constant forward motion. (The pilot must be able to see the UAV at all times during flight so the long flight range that fixed-wing UAVs can fly should usually not be a mission selection criterion.) Fixed-wings are also much quieter than multi-rotors. However, the primary disadvantages are also related to the fixed-wing UAVs mode of generating lift. They usually require somewhat large clear areas for takeoff and landing, it is difficult to hold the camera on a specific scene since the UAV must maintain forward motion, and the size of the wings make this type of UAV less transportable. Additionally, fixed-wing UAVs are generally more difficult to pilot safely and effectively, and they are more susceptible to losing control in windy conditions.

Common mission applications of fixed-wing UAVs

Fixed-wing UAVs are useful for any application that requires extended duration flight. This includes search and rescue, search and seizure, and property inspection. It is possible to achieve photogrammetry with fixed-wings, however, it can be more difficult than with multi-rotors. Additionally, fixed-wing UAVs are useful in situations for which their low acoustic signature is advantageous. For example, fixed-wings are useful in missions that require stealth.

Hybrid fixed-wing UAVs with vertical takeoff and landing (VTOL) capabilities

Hybrid fixed-wing UAVs with vertical takeoff and landing capabilities can take off and land vertically and then transition to horizontal flight. They are slowly becoming more prevalent in the commercial market due to their abilities to leverage many of the positive attributes of both fixed-wing and multi-rotor UAVs. Since they can take off and land vertically, they can be used in situations with tight physical constraints like multi-rotors. Once airborne, they transition to horizontal flight gaining lift via larger fixed airfoils (wings). Therefore, they are able to operate efficiently for long flight durations like fixed-wing UAVs. However, it should be noted that hybrid VTOLs are less capable than multi-rotors for vertical flight and stability and less capable than fixed-wings in horizontal flight due to the added weight of the transition hardware. Hybrid VTOLs are also more complex than multi-rotors and fixed-wings. They require more complex control software to safely transition from vertical flight to horizontal flight and back to vertical. These additional complexities usually result in more expensive systems. It may be possible to buy a multi-rotor and a fixed-wing for less than a single hybrid VTOL that achieves all the same mission capabilities as the two separate UAVs.

Ohio Attorney General Mike DeWine's

Advisory Group on Unmanned Aircraft Systems

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