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UAS Air Carrier Operations Survey: Training Requirements

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16. Abstract

There is an increasing demand to utilize unmanned aircraft systems (UAS) for an array of new applications currently outside the scope of written regulations, such as air taxi services, package delivery, and crop dusting. The Code of Federal Regulations on Aeronautics and Space (14 CFR) is restrictive to air carrier applications for UAS. In particular, small UAS (sUAS) regulations (14 CFR § 107 [Federal Regulation for Commercial sUAS]) do not explicitly address air carrier operations. Regulations relevant to air carrier operations (14 CFR § 121 [Federal Regulation for Air Carriers] and § 135 [Federal Regulation for Commuter Air Operations]) were not written to include the use of UAS. Training requirements have been extensively researched in traditionally piloted aircraft operations (see Torrence et al., 2020), but recent and continuing developments in UAS applications and UAS automation have resulted in changing roles and responsibilities for crewmembers. Training literature was gathered in an annotated bibliography, and experts in both industry and academia were surveyed about current and future policies from their companies to gauge the future direction of UAS operations. This survey will help inform current and planned future UAS operations related to training. It will also allow for regulations of last-mile and high-altitude-long-endurance operations so that these novel applications of UAS can be safely integrated into the National Airspace System (NAS). Findings may inform future regulations concerning UAS training for crewmembers related to air carrier operations and potentially help standardize these requirements. Altogether, this will support the safe and efficient integration of UAS into the NAS.

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List of Abbreviations

AFOQT	Air Force Officer Qualifying Test
ASVAB	Armed Services Vocational Aptitude Battery
BVLOS	Beyond Visual Line of Sight
CFR	Code of Federal Regulation
14 CFR	Title 14 (Federal Regulations on Aeronautics and Space)
14 CFR § 107	Title 14 CFR Part 107 (Federal Regulation for Commercial sUAS)
14 CFR § 121	Title 14 CFR Part 121 (Federal Regulation for Air Carriers)
14 CFR § 135	Title 14 CFR Part 135 (Federal Regulation for Commuter Air Operations)
DoD	Department of Defense
FAA	Federal Aviation Administration
JTA(s)	Job Task Analysis
KSAs	Knowledge, Skills, and Abilities
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
RPA	Remotely Piloted Aircraft
SA	Situation Awareness
SME(s)	Subject Matter Expert(s)
sUAS	Small Unmanned Aircraft System
TBAS	Test of Basic Aviation Skills
UAS	Unmanned Aircraft System

Abstract

There is an increasing demand to utilize unmanned aircraft systems (UAS) for an array of new applications currently outside the scope of written regulations, such as air taxi services, package delivery, and crop dusting. The Code of Federal Regulations on Aeronautics and Space (14 CFR) is restrictive to air carrier applications for UAS. In particular, small UAS (sUAS) regulations (14 CFR § 107 [Federal Regulation for Commercial sUAS]) do not explicitly address air carrier operations. Regulations relevant to air carrier operations (14 CFR § 121 [Federal Regulation for Air Carriers] and § 135 [Federal Regulation for Commuter Air Operations]) were not written to include the use of UAS. Training requirements have been extensively researched in traditionally piloted aircraft operations (see Torrence et al., 2020), but recent and continuing developments in UAS applications and UAS automation have resulted in changing roles and responsibilities for crewmembers. Training literature was gathered in an annotated bibliography, and experts in both industry and academia were surveyed about current and future policies from their companies to gauge the future direction of UAS operations. This survey will help inform current and planned future UAS operations related to training. It will also allow for regulations of last-mile and high-altitude-long-endurance operations so that these novel applications of UAS can be safely integrated into the National Airspace System (NAS). Findings may inform future regulations concerning UAS training for crewmembers related to air carrier operations and potentially help standardize these requirements. Altogether, this will support the safe and efficient integration of UAS into the NAS.

Keywords: unmanned aircraft systems, UAS Training, UAS Training requirements, air carrier operations, testing, knowledge

Introduction

As the use of Unmanned Aircraft Systems (UAS) continues to expand, so too does the complexity of flight operations. The Federal Aviation Administration (FAA) refers to these operations, which involve the transportation of cargo and people within the National Airspace System (NAS), as Air Carrier Operations. The current Code of Federal Regulations for air carriers (14 CFR § 121) and commuter air operations (14 CFR § 135) were not created with UAS operations in mind. 14 CFR § 107 provides regulations for small (commercial) UAS (sUAS) operations, but does not address systems that weigh over 55 pounds, nor the more complex types of operations expected for unmanned air carrier activities.

The FAA is working to standardize UAS regulations for air carrier operations. Existing regulations do not adequately address the unique set of challenges presented by novel UAS operations. The type of UAS (airframe and ground control station) and its operational purpose affect the required qualifications and training for the crew. This specific training and certification will be required just as they are for onboard piloted aircraft (e.g., 14 CFR § 91, §121, §135).

To address the expected need for a new set of standards regarding the certification and training of crews associated with UAS air carrier-like operations, a research program was initiated. In the first phase of this research program, literature was reviewed on the following topics:

- Knowledge, skills, and abilities (KSAs; Torrence et al., 2020).
- Crew and staffing options (Hu et al., 2022).
- Duty time, shiftwork, and fatigue (Durham et al., 2020; Nesthus et al., 2021).

For the second phase of this research program, and based on some of the findings from the literature reviews, a survey was created and administered to subject matter experts (SMEs) who were either involved in the manufacturing and/or operation of UAS/remotely piloted aircraft (RPA), or in educating personnel for manufacture and/or operation of UAS/RPA. This report summarizes findings from the survey related to both the training provided to pilot/operators and to future training requirements. Other reports summarize aspects of the survey not covered in this report (Durham et al., Under Review; Williams et al., Under-Review-a, Under Review-b).

UAS Air Carrier-like Training Issues

In the United States, commercial aviation operations have been around for more than a century, providing sufficient time to define and revise training regulations and procedures based on research regarding off-nominal events. The publication of 14 CFR § 107 in 2016 was the first step in establishing UAS pilot training requirements; however, this regulation is restricted to only sUAS weighing less than 55 lbs. and operating under certain conditions (e.g., within visual line of sight, less than 400 ft.) with some exceptions provided through waivers (e.g., beyond visual

line of sight [BVLOS]). Much work will be needed to fully identify training requirements for all crewmembers and all types of UAS operations.

Certification and Qualification Requirements

Currently, the only requirement for operating a UAS commercially within the NAS is to hold a remote pilot certification as established in 14 CFR § 107. In addition, qualifying for a remote pilot certificate is accomplished solely by passing a written exam, with no need to demonstrate flight proficiency. While this might be sufficient for simple sUAS operations, it is expected that operations that are more complex will require a much broader level of training and testing for pilots before being certified to conduct these operations. We also expect that these broader requirements will not be the same as those already established for manned air carrier operations because of differences in how operations are conducted, the type of aircraft employed, and the level and kinds of automation used. This research effort should assist regulators in setting requirements for these more complex and specialized operations.

Method

A survey was constructed to gather information regarding the current and expected future state of UAS training practices that were considered relevant to air carrier-like activities. We were interested in gathering information from people engaged in different aspects of commercial UAS activities across a spectrum of responsibilities, from frontline workers to high-level managers and educators. Specifically, we wanted to poll a variety of experts involved in either commercial UAS activities or instructors involved in personnel training for commercial UAS activities.

Stratification and Sample Selection

The strategy employed was to cast a "wide net" of individual experience/knowledge by probing as many viewpoints regarding UAS operations (including UAS air carrier operations) as possible. All respondents had to meet three eligibility requirements before providing survey responses: 1) Must be affiliated with an operation that operates or plans to operate commercial UAS operations *OR* be affiliated with a UAS training or educational institution, 2) Must be affiliated with an organization that has established qualification requirements *OR* an affiliation with an organization that develops training requirements/provides training, 3) If affiliated with an organization that operates or plans to operate commercial UAS activities, the organization must employ two or more UAS Pilots/Operators.

Participant names and email addresses were gathered from publicly available dockets on the Federal Register (which identifies corporations who received blanket waivers from 14 CFR § 107), the FAA's publicly-available *Part 107 Waivers* website[1] (which identifies individuals who

[1] https://www.faa.gov/uas/commercial_operators/part_107_waivers/waivers_issued/

have been granted waivers from 14 CFR § 107, thus known to be involved in commercial UAS activities), Google searches, and names provided by the research sponsors and contractors. To accommodate electronic distribution, only those individuals with email addresses on file were included in the initial sample. Respondents were also encouraged to forward the survey link to other qualified colleagues. Table 1 presents the different types of respondents that were targeted for the survey along with our original goal for the number of respondents of each type.

Table 1

Respondent Recruitment Targets

Respondent Category	Target
Small UAS Pilot/Operator (<55 lbs.)	40
Large UAS Pilot/Operator (≥55 lbs.)	40
UAS Cargo/Sensor Operator	40
Supervisor/Manager	40
UAS Instructor	40
Engineer	10
Other Crewmembers	10
Total	*220*

A statistical power analysis[2] demonstrated that 40 respondents per group would result in a power of 0.8, providing a statistically representative sample of the population. The additional groups of engineers and other crewmembers were included to provide additional assurance of generalizability to the UAS industry.

Survey Items

Survey questions were developed to address critical areas in UAS operations. Besides demographic information, we wanted to cover several topics related to both current and future UAS operations that could be related to air carrier-like activities (e.g. crew and staffing requirements, KSA requirements, duty and shift requirements, and training and certification requirements). The survey was constructed so that not every respondent received the same set of questions. Branching points were incorporated to route the respondents to the set of questions appropriate for their particular areas of expertise. Therefore, the number of responses per question varied. Table 2 provides an exhaustive list of the topics included in the survey. All survey items were administered electronically via a Qualtrics link.

[2] G*Power software, http://www.gpower.hhu.de/

Table 2

Main Survey Sections

Air Cargo	Instructor, Training
Air Carrier/Unmanned	Abilities
Crew & Staffing	Skills
Crew & Staffing, Fatigue	Organization
Crew & Staffing, Fatigue, Scheduling	Respondent Population
Crew & Staffing, Selection	Training
Crew & Staffing, Workload	Training, Certification
Fatigue & Fitness For Duty	Training, Not Required
Fatigue & Fitness For Duty, Reporting	Training, Required
Fatigue, Naps & Breaks	Training, Required, Recurrent
Instructor, Qualifications	UAS Equipment

Appendix A contains a listing of the questions and graphed responses relevant to the training requirements portion of the survey. The survey was reviewed by a group of experienced FAA researchers and sponsors for clarity of instructions and technical details. In addition, beta testing was conducted within the research team and with a few UAS SMEs to evaluate the quality of the survey. Feedback from the beta testing was discussed, incorporated, and approved by all vested parties.

Survey Administration

Upon clicking on the Qualtrics link, respondents received the informed consent notice[3], that provided them with an overview of the study including the purpose, and informed them about their rights as volunteer research respondents (i.e., participation is optional, the FAA will de-identify their data before use). All respondents were asked to provide their consent before continuing with the survey.

The survey consisted of approximately 147 questions; the exact number of questions varied because of the customized items based on job role and experience (asked at the beginning of the survey). Lastly, survey respondents were compensated via a $50 mailed check for their time spent in completing the survey.

Results

The survey was active for 90 days. Recruitment was short of the 220-respondent target. Table 3 provides the final respondent count by job role.

[3] An Informed Consent notice is a legal and ethical requirement for research involving human participants. This study was separately reviewed and approved by the CAMI Institutional Review Board and by the Office of Management and Budget (OMB Control No. 2120-0803).

Table 3

Final Respondent Recruitment

Respondent Category	Target Recruitment	Final Recruitment	Job Role (%)
Small UAS Pilot/Operator (<55 lbs.)	40	51	29.5
Large UAS Pilot/Operator (≥55 lbs.)	40	14	8.1
UAS Cargo/Sensor Operator	40	4	2.3
Supervisor/Manager	40	45	26.0
UAS Instructor	40	41	23.7
Engineer	10	5	2.9
Other Crewmembers	10	13	7.5
Total	***220***	***173***	***100.0***

Eligibility

One hundred and seventy-three respondents met the eligibility requirements of the survey. Of these, 131 (75.7%) reported being affiliated with an organization that operates or plans to operate commercial UAS operations and 42 (24.3 %) of those reported being affiliated with a training or educational organization. Additionally, 107 (61.8%) reported working with an organization with established qualification requirements, and 66 (38.2 %) reported being affiliated with an organization that develops pilot requirements or provides training (Figure 1). To be considered a valid respondent, the organization for which they are employed needed to employ two or more UAS operators. The number of operators employed by each organization and the percentage of organizations with the number of pilots employed per industry sector are provided in Figure 2.

Figure 1

Respondents Who Work with an Organization that Operates/Plans to Operate UAS; Organizations that Have Established Pilot Qualifications (n = 173)

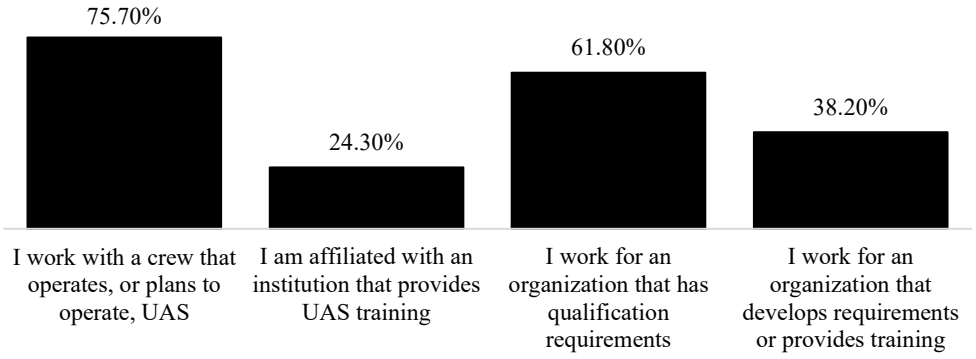
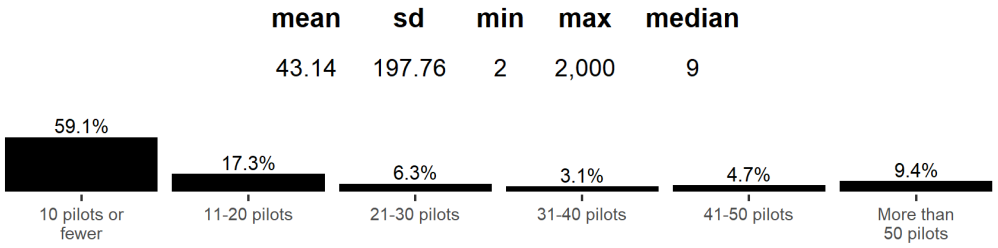


Figure 2

Number of Pilots Employed by Each Organization (n = 127)[4]



Demographics

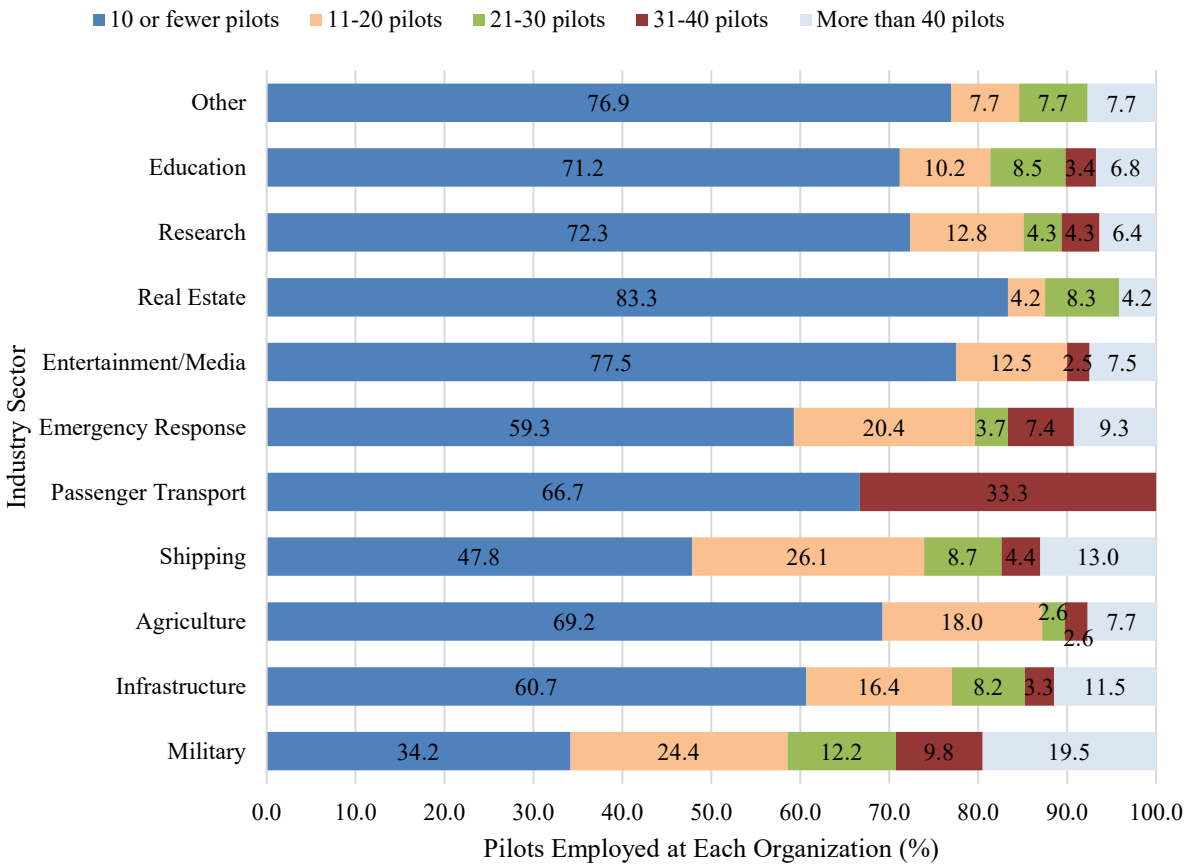
Participants mainly worked in organizations with 10 or fewer pilots, a finding that holds true across each industry. The military and shipping industries appeared to have the largest percentages of organizations employing more than 40 pilots (see Figure 3).

Only three respondents reported being associated with current or future UAS passenger transport; however, there were 23 respondents associated with package delivery (see Table 5). These respondents would be most associated with future air carrier-like UAS operations; however, most current UAS operations are not concerned with these future operations at this time.

[4] Results include only respondents who indicated 'I work with an organization or crew that operates, or plans to operate, unmanned aircraft systems (UAS)/drones)' *see* Appendix A, Section A. Demographics)

Figure 3

Pilots Employed by Each Organization, by Industry Sector (n = 127)



Survey respondents reported an average of 7.01 (*SD* = 5.58) years of experience in their current job role (Figure 4). The majority of survey respondents indicated that they work within a drone service organization, with working at a school or other type of training program being the second most common response (Table 4). Responses for "work within a drone service organization" in Table 4 only included organizations that used drones to make money. This led to a substantial number of respondents (*n* = 38) under the "Works with drones, but none of the above" response in Table 4 (see Table B3 in Appendix B for a listing of these responses). Table 5, on the other hand, included sectors that used drones in a "not-for-profit" capacity as well as "for-profit" sectors. The most common sectors for respondents were infrastructure, education, and emergency response (e.g., law enforcement, search and rescue).

Figure 4

Years of Experience in Current Job Role (*n = 168)*

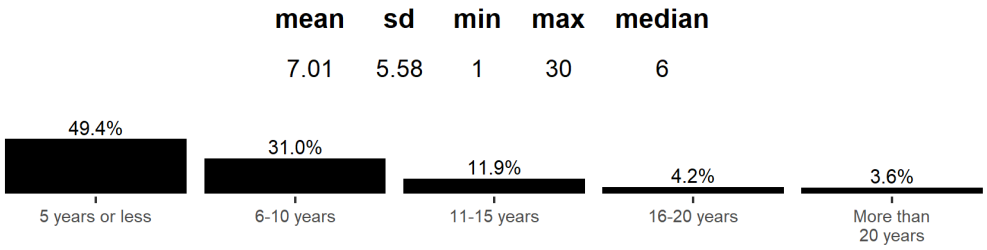


Table 4

Commercial UAS Sector that Best Describes Respondents' Current or Planned Operations (n = 168)

	Respondents	
Sector Type	**Count (n*)**	**Percent (%*)**
Drone Service Operator (Uses drones to make money)	95	56.5
School or Training Program (Teaches students about drones)	76	45.2
Manufacturer of Drones (e.g., drone hardware, control station equipment, software)	28	16.7
Works with drones but none of the above	38	22.6

Note: *May sum to greater than the number of respondents to the item as the response option was "select all that apply", providing an opportunity for respondents to select more than one option. The percentage of respondents (percent [%]) is the number of respondents to the item, out of the total number of respondents.*

Table 5

Commercial UAS Industry that Best Described Respondents' Current or Planned Operations (n = 168)

Industry Type	Respondents	
	Count (n*)	Percent (%*)
Military or Military Contractor	41	24.4
Infrastructure (e.g., energy, roads, construction)	61	36.3
Agriculture	39	23.2
Shipping Package Delivery	23	13.7
Passenger Transportation (Air Taxi)	3	1.8
Emergency Response (e.g., law enforcement, search and rescue)	54	32.1
Entertainment and Media (e.g., news, film-making)	40	23.8
Real Estate	24	14.3
Academic/Scientific Research	47	28.0
Education	59	35.1
Other[5]	13	7.7

Note: *May sum to greater than the number of respondents to the item as the response option was "select all that apply", providing an opportunity for respondents to select more than one option.*

Over ninety percent of respondents currently hold a license or certification to fly a UAS (see Table 6). Respondents who held a certificate that was not listed as an option indicated their certificate in a text entry box (see Table B5 in Appendix B).

[5] For responses for 'Other' UAS industries not in response list see Appendix B: Table B4 for a list of written responses

Table 6

Certifications Held by Respondents Who Currently Have a License or Certification to Fly a UAS (n = 158)[6].

	Respondents	
License or Certification Type	**Count (n*)**	**Percent (%*)**
14 CFR § 107 certificate (e.g., remote pilot certificate)	143	90.5
14 CFR § 61 certificate (e.g., manned pilot certificate)	50	31.6
Non-certificate: Fly Drones under hobbyist exemption (I fly drones as a hobby)	43	27.2
Instrument Rating	40	25.3
Military-qualified (RPA) pilot	22	13.9
Other[7]	14	8.9
I do not hold a certificate	3	1.9
Non U.S. (foreign) license	1	0.6

Note: *May sum to greater than the number of respondents to the item as the response option was "select all that apply", providing an opportunity for respondents to select more than one option.*

Qualification Requirements

Instructors provided a wide range of responses for the minimum requirements for an instructor at their organization. Responses ranged from "no formal requirements" (i.e., 0) to 250 hours of launch and recovery time. Some respondents stated that several certifications and/or degrees with a check flight by a lead instructor were required (see Table B8 in Appendix B. The most frequently cited minimum requirement for instructors operating UAS was to hold a Remote Pilot Certification, followed by Organizational-Specific Training (Table 7). The results indicated similar organizational requirements for UAS Pilots (Table 8). Only 25.2% (n = 30) of respondents indicated that their company established a minimum number of training flight hours upon hire (see Figure 5). For those who responded 'yes', the average number of required hours was 127.64 (s = 226.96; see Figure 6).

[6] Results for 'Which Certifications do you hold' includes only respondents who indicated they hold a certification to operate an aircraft see Appendix A, Section A. Demographics).

[7] For a full list of written responses for those who indicated 'other' to the certifications they hold see Appendix B, Section A. Demographics (Table B5)

Table 7

Minimum Requirements for Instructors (n = 80) and Pilots (n = 123) to Operate Drones at Respondents' Organization

Requirements	Instructors		Pilots	
	Count (n*)	Percent (%*)	Count (n*)	Percent (%*)
Remote Pilot Certification	69	86.2	111	90.2
Organizational-Specific Training	52	65	72	58.5
Site-Specific Training	28	35	36	29.3
Manufacturer Training	16	20	15	12.2
Other Training	15	18.8	19	15.4
Manned Pilot Certification	14	17.5	11	8.9
N/A or Don't know	2	2.5	3	2.4

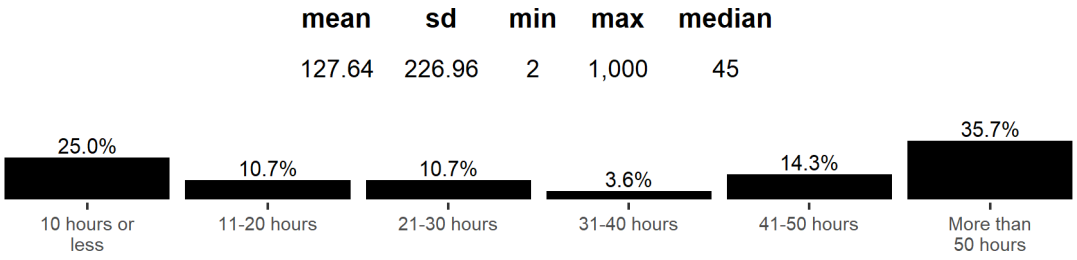
Note: *May sum to greater than the number of respondents to the item as the response option was "select all that apply", providing an opportunity for respondents to select more than one option.*

Figure 5

Required Training Flight Hours upon Hire (n = 115)

Figure 6

If Yes, Flight Hours Required at Hire (n = 28)



Training

Organizational Certifications

Forty-one instructors responded to several questions regarding their organization's training certifications and materials. Thirty-nine of the 41 instructors responded to whether their organization holds certifications to train UAS pilots. Eighteen (46.2%)[8] respondents indicated their organization does hold a training certification. Additionally, 43 (31.9%)[9] respondents indicated the FAA reviews their organizations' training material. Thirty-one (22%)[10] respondents indicated that another government agency (other than the FAA) reviews their organizations' training material for UAS Pilots/Operators. Many of the respondents cited military branches or Department of Defense (DoD), with other less common responses including the National Aeronautics and Space Administration (NASA) and National Oceanic and Atmospheric Administration (NOAA; see Table B11 in Appendix B, Section C). Twenty-eight (22%)[11] respondents indicated that their organizations' training material is reviewed by a non-government organization (see Table B12 in Appendix A, Section D).

Organizational Programs

Instructors and operators associated with a training organization indicated the certifications and degrees provided by their organization's training program. These included a Remote Pilot Certification (14 CFR § 107 compliant), followed by topic-specific certification (no certification at the completion of program) (Table 8). Top-cited UAS operational training provided for specific operations included education, emergency response, and infrastructure inspection (Table 9). Most respondents indicated that they provide manual flight control training and in-flight automation with pilot controlling takeoff and landing (see Table 10 for other automation techniques). Respondents' organizations most commonly provided training to UAS pilot/operators for multi-rotor (82.5 %) and fixed-wing (61.3%) UAS airframes (Table 11). Multi-rotor airframes were most commonly equipped with four (95.5%) and six (36.4%) rotor-blades (Table 12). All respondents indicated that they were provided classroom based training, and nearly all of the organizations (93.3%) indicated that they performed supervised hand flying training (Table 13).

[8] Respondents only included if indicated instructor as a job role (n = 39); Bar graph is presented in Appendix A, Section D.
[9] Respondents included all job types (n = 135); Bar graph is presented in Appendix A, Section D.
[10] Respondents included all job types (n = 141); Bar graph is presented in Appendix A, Section D.
[11] Respondents included all job types (n = 140); Bar graph is presented in Appendix A, Section D.

Table 8

Certification offered at Training Completion (n = 80)

	Respondents	
Certifications	**Count (n*)**	**Percent (%*)**
Remote Pilot Certification (Part 107 Compliant)	40	50.0
We Do Not Offer Any Recognized Certification	25	31.2
Topic-Specific Certification	24	30.0
Four-year Degree from a College or University	12	15.0
Two-year Degree from a College or University	11	13.8
AUVSI TOP Certification	2	2.5

Note: *May sum to greater than the number of respondents to the item as the response option was "select all that apply", providing an opportunity for respondents to select more than one option.*

Table 9

Specific Operation Training Provided by Organization (n = 78)

	Respondents	
Operation Type	**Count (n*)**	**Percent (%*)**
Education	45	57.7
Emergency Response	41	52.6
Infrastructure Inspection	39	50.0
Academic/Scientific Research	38	48.7
Agriculture	32	41.0
Surveillance	32	41.0
Real Estate	31	39.7
Entertainment and Media	30	38.2
Military	28	35.9
Oil and Gas	27	34.6
Shipping or Cargo Delivery	9	11.5
Other[12]	6	7.7
Passenger Transport	0	0.0

Note: *May sum to greater than the number of respondents to the item as the response option was "select all that apply", providing an opportunity for respondents to select more than one option.*

[12] See Appendix B, Section C, Table B14 for a list of respondent-provided specific operational training.

Table 10

Automation Techniques Taught during Training Programs (n = 80)

	Respondents	
Automation Techniques	**Count (n*)**	**Percent (%*)**
Pilot manually controls the drone, which may include manipulating the actual flight controls, minimal automation	69	86.2
Pilot programs the flight plan, performs takeoffs and landings	68	85.0
Pilot monitors flights and only intervenes when an abnormal event or emergency occurs	52	65.0
Complete autonomy, no human intervention from takeoff to landing	23	28.7

Note: *May sum to greater than the number of respondents to the item as the response option was "select all that apply", providing an opportunity for respondents to select more than one option.*

Table 11

UAS Platforms Institutes Training Provided (n = 80)

	Respondents	
Airframe Type	**Count (n*)**	**Percent (%*)**
Multi-Rotor Wing	66	82.5
Fixed-Wing	49	61.3
Transition (VTOL, Vertical to Horizontal)	23	28.7
Single Rotor Wing	11	13.8
Other[13]	2	2.5

Note: *May sum to greater than the number of respondents to the item as the response option was "select all that apply", providing an opportunity for respondents to select more than one option.*

[13] See Appendix B, Section C, Table B15 for a list of respondent-provided specific airframe training.

Table 12

Number of Rotors for each Multi-Rotor Wing UAS Training Provided (n = 66)[14]

	Respondents	
Number of Rotor Blades	**Count (n*)**	**Percent (%*)**
4 rotors	63	95.5
6 rotors	24	36.4
8 rotors	20	30.3
1 rotor	4	6.1
2 rotors	3	4.5
3 rotors	2	3.0
10 rotors	1	1.5
5 rotors	0	0.0
7 rotors	0	0.0
9 rotors	0	0.0

Note: *May sum to greater than the number of respondents to the item as the response option was "select all that apply", providing an opportunity for respondents to select more than one option.*

Table 13

Training Provided by Each Organization (n = 33)

	Respondents	
Types of Training	**Count (n*)**	**Percent (%*)**
Classroom Training	33	100.0
Supervised Hands-on Flight Training	31	93.9
Computer-Based Training	20	60.6
Simulation Training[15]	17	51.5

Note: *May sum to greater than the number of respondents to the item as the response option was "select all that apply", providing an opportunity for respondents to select more than one option.*

[14] Respondents only included those who indicated 'multi-rotor' training provided by organization from Table 11.
[15] See Appendix B, Section C, Table B16 for a list of respondent-provided simulation type of training provided (n = 17).

Pilot Training

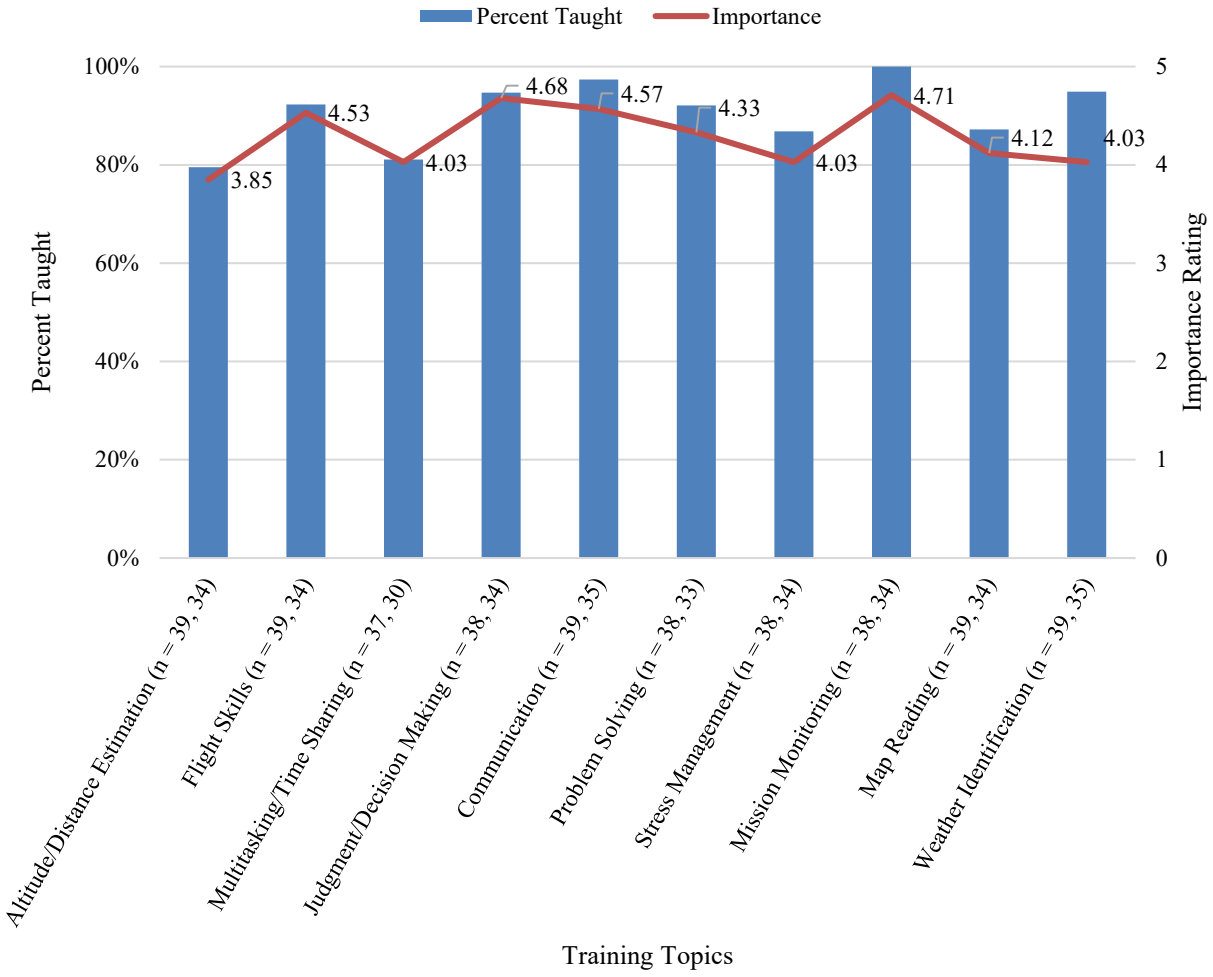
Respondents answered questions related to pilot training requirements, such as whether their training materials were submitted to, or reviewed by the FAA (see Appendix A for the complete set of training questions and responses). Only 31.9% of respondents indicated yes. They were also asked whether the training materials were submitted to or reviewed by any other government agency. Twenty-two percent of the respondents indicated yes. The majority of those respondents identified a military branch or the DoD as the reviewing agency (see Appendix B Table B11 for the complete set of responses).

All respondents were asked whether their organization provided training and testing on specific topics. These topics included: 1) requirement to remain clear of and give way to manned aircraft; 2) distance limitations from other aircraft; 3) prohibition on unauthorized flight beyond visual line of sight; 4) requirement to flight plan to avoid public use airports and approach/departure corridors; 5) requirement to communicate with ATC regarding flight authorizations; 6) training of visual observers and briefing before each flight; 7) procedures to cease flight when hazardous conditions arise; and 8) procedures covering carriage of hazardous materials. Approximately 90% of the respondents indicated their organization provided training and testing for those topics, with the exception of procedures covering the carriage of hazardous materials, which was covered by only 69% of the organizations.

UAS Instructors were asked to review a list of training topics and identify which ones they provided training on, as well as rate their importance. Results are provided in Figure 7 and Figure 8.

Figure 7

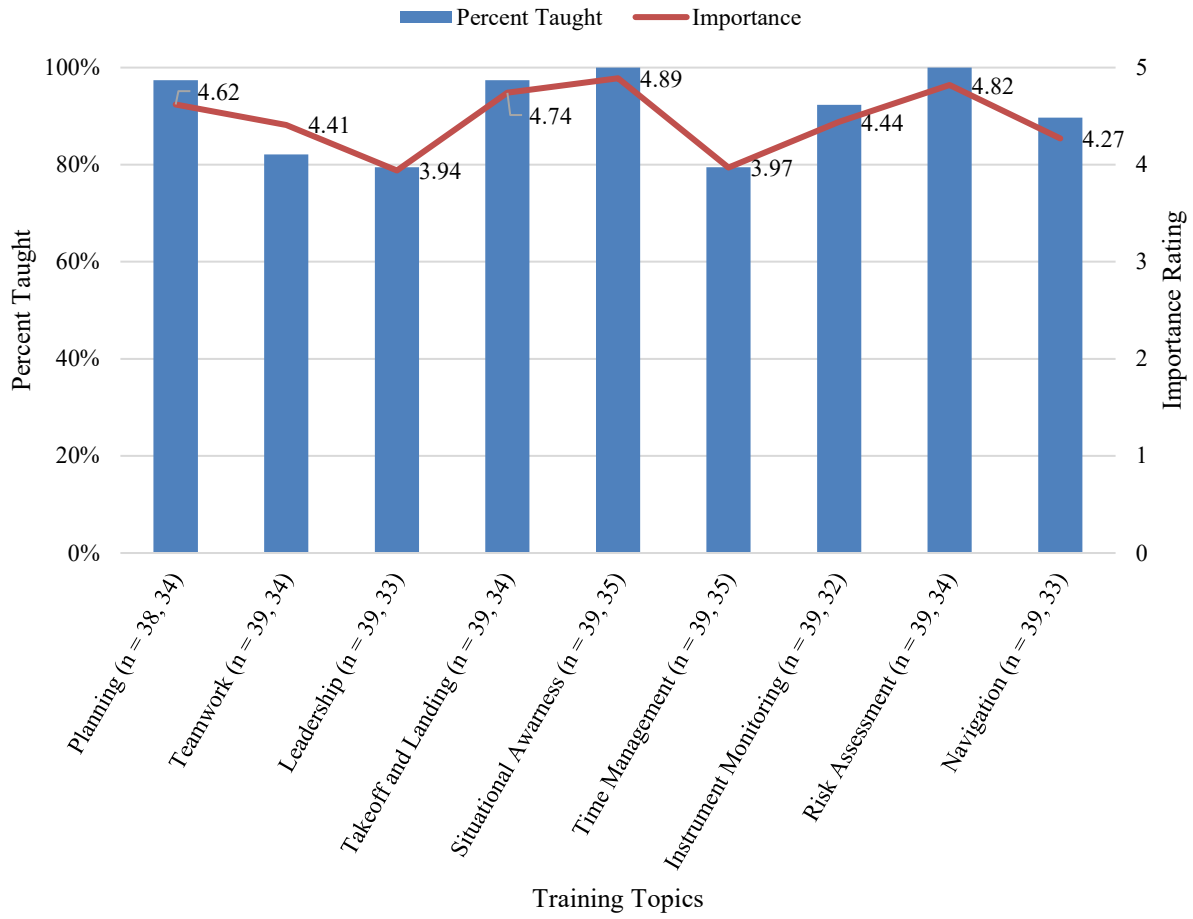
Topics Taught by Instructors and Instructors' Ratings of Topic Importance (n = Percent Taught/ n = Importance)



Note: *Instructors provided an Importance Rating for each Training Topic on a scale of 1 (Not Important) to 5 (Extremely Important). Responses may sum to greater than the number of respondents to the item as the response option was a rate all that apply, providing an opportunity for respondents to select more than one option. Number of respondents (n) are reported in pairs for Percent Taught and Importance, respectively.*

Figure 8

Topics Taught by Instructors and Instructors' Ratings of Topic Importance (continued; n = Percent Taught/n = Importance)



Note: *Instructors provided an Importance Rating for each Training Topic on a scale of 1 (Not Important) to 5 (Extremely Important). Responses may sum to greater than the number of respondents to the item as the response option was a rate all that apply, providing an opportunity for respondents to select more than one option. Number of respondents (n) are reported in pairs for Percent Taught and Importance, respectively.*

As can be seen in these figures, all of the training topics included were taught, according to at least 80% of the respondents. Ratings of importance for each of the topics were closely correlated with the percentage taught. Three of the topics, Mission Monitoring, Situational Awareness, and Risk Assessment, were taught by 100% of the respondents. Topics with a lower percentage of being taught included Altitude/Distance Estimation, Multi-tasking/Time Sharing, Teamwork, Leadership, and Time Management. The fact that Altitude/Distance Estimation was not taught at a higher percentage could be due to systems and/or operations that are flown

beyond visual line of sight of the crew. Lower percentage scores for the other topics listed here may be due to many operations requiring only a single or very few crewmembers, thus lessening the need for crew cooperation skills.

Respondents were asked if a number of topics were taught specifically for UAS operations. Figure 9 lists those topics, ranked from the highest percentage of coverage to the lowest. Looking at the results, we see that topics with the lowest percentage of training coverage deal primarily with the development of skills required in the manual control of the aircraft. Topics with the highest percentage of training coverage deal with procedures required for conducting a full operation from beginning to end.

In addition to asking respondents about topics covered during initial training, we also asked them about recurrent training requirements as well. When asked whether recurrent training occurred in-house or by a second party, 78.8% of the respondents indicated the recurrent training was in-house. When asked how often recurrent training was required, responses varied from as often as weekly, to once every three years. Figure 10 shows the various recurrent training periods, along with the number and percentage of respondents indicating each period of recurrent training.

Figure 9

Topics Taught to UAS Operator/Pilots Ranked by Percent Taught (n = Provided by Topic)

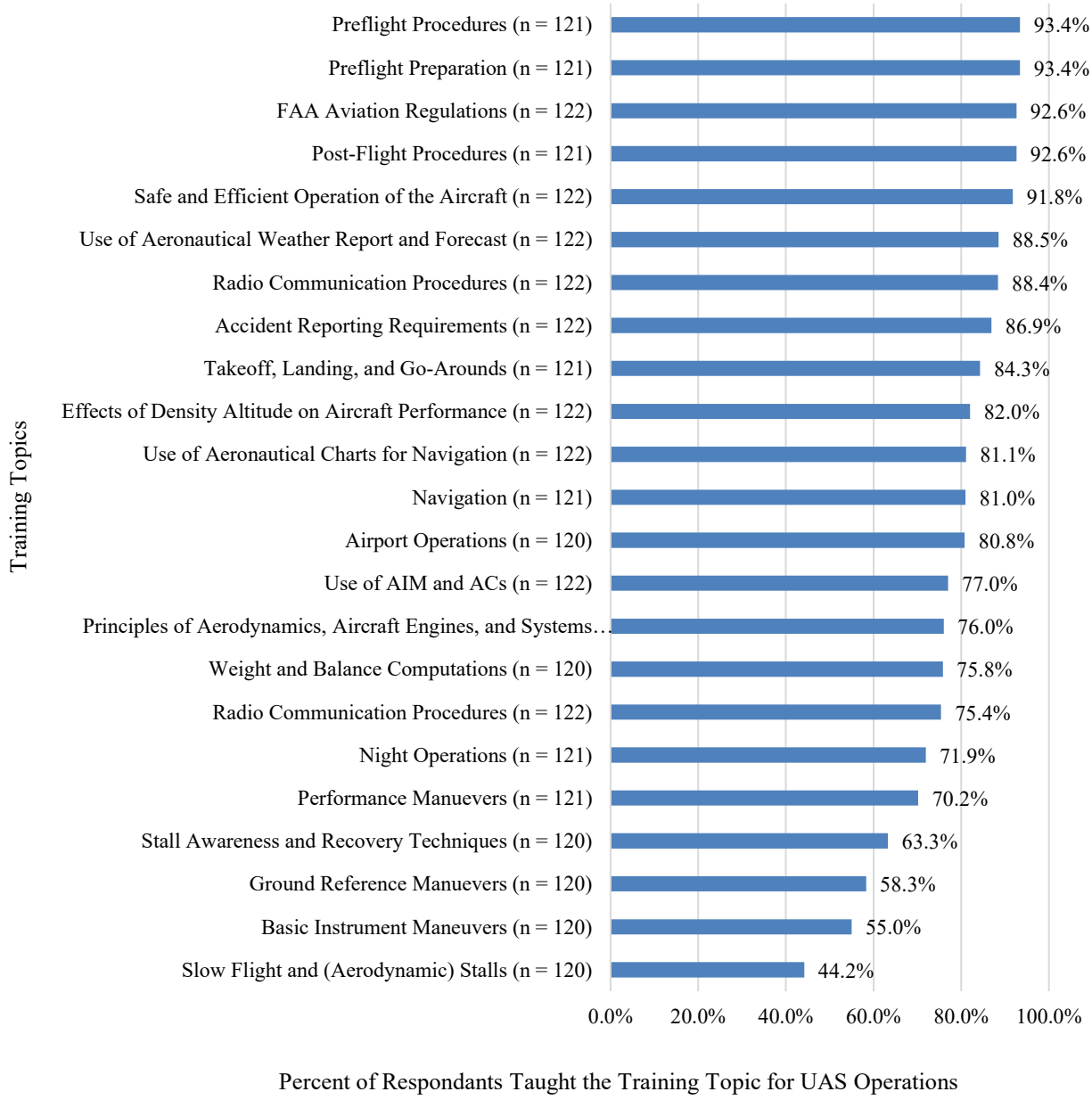
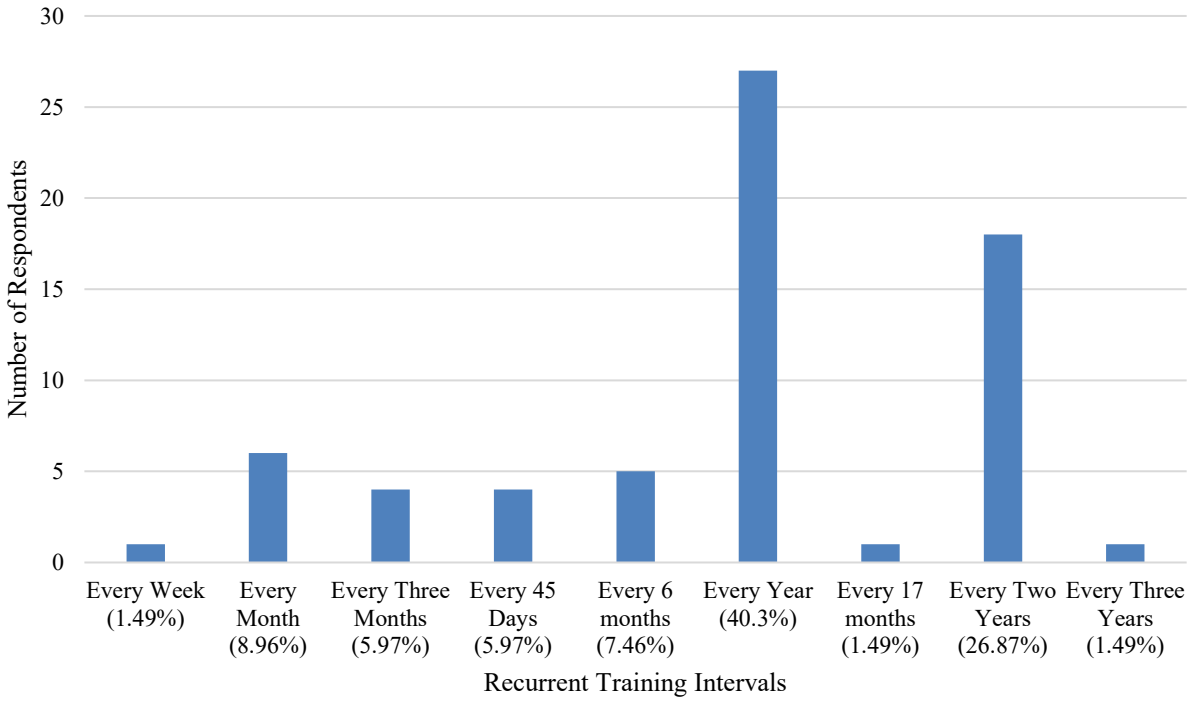


Figure 10

Recurrent Training Intervals (n = 67)



As can be seen in Figure 10, the most common recurrent training was once a year (40.3%), followed by once every two years (26.87%). All other recurrent training periods were a much smaller percentage.

Discussion

It was not surprising to find a majority of the respondents worked for organizations employing 10 or fewer pilots (Figure 2). However, it was disappointing that we were not able to include a larger sample of respondents for the Large UAS Pilot, UAS Cargo operator, or Sensor Operator categories (see Table 3). Respondents represented sectors engaged in both for-profit and not-for-profit activities (Table 5). The large majority of respondents (90.5%) indicated having a remote pilot certificate (14 CFR § 107); in addition, a substantial number (31.6%) had a manned pilot certificate as well (Table 6). A majority of respondents (56.5%; see Table 4) indicated their organizations were either conducting or planning UAS operations, and a sizeable minority of respondents indicated that their organizations were providing (or were planning to provide) training programs (see Table 9).

Industry type varied, with no apparent standouts as a leading area of employment among the respondents. Notably, only 3 respondents reported being associated with organizations expected to be involved with air carrier-like operations and only 23 were associated with package delivery (Table 5); however, evidence suggests that these particular industries will grow

in the future (see Durham et al., 2020; Hu et al., 2022; Torrence et al., 2021). Interestingly, only about 60% of respondents work for an organization that has established qualification requirements for crewmembers (Figure 1). Further, there were no established requirements for instructors across organizations, with some instructors responding “no formal requirements”, but the large majority (90.2%) stated that a remote pilot certification was required (Table 7).

Responses varied regarding the type of certification offered to students upon completion of their respective training programs. For instance, only 50% of respondents are awarded a remote pilot certification upon completion of their training, while 31.2% of the respondents stated that they were not provided any recognized certification (Table 8). Much of the training provided by organizations is operationally specific (e.g., agriculture, real estate, infrastructure inspection; Table 9). Regarding the level of automation taught in the training program, a majority of respondents (86.2%) indicated their training program primarily taught manual control of the drone but a similar percentage (85%) indicated training was largely focused on automated function of the drone, with the exception of the takeoff and landing (Table 10). The types of systems used for training were mostly multi-rotor or fixed wing systems, with a much smaller percentage of tiltrotor or single rotor systems (Table 11).

Respondents reported that not only did a majority of organizations require remote pilot certification (under 14 CFR § 107; 90.2% of respondents), but that their organizations supplemented Part 107 training with their own organization-specific training (58.5%), and with additional field training (86.7%). This finding suggests that certification requirements might have to include operation-specific training or be flexible enough to satisfy requirements across a broad spectrum of operations.

Training topics were largely similar, as no less than 80% of instructors taught a given queried topic (Figure 8). Interestingly, the pattern of topics taught by instructors appears to roughly match the ratings of importance that the instructors attached to each topic, however; when broken down further there are some notable variations (Figure 9). Some topics, such as “basic instrument maneuvers” (55%) and “slow flight and (aerodynamic) stalls” (44.2%) were taught to fewer students than other topics such as “preflight procedures” (93.4%) and “preflight preparation” (93.4%). Although these differences are driven by different needs of the UAS industry, further research will be needed to understand whether this finding represents a need for improvement in training procedures and certifications.

The majority of respondents indicated recurrent training occurred every year (40.3%). However, Given the rapid changes in UAS operations, the finding that over a quarter of respondents received training every two years (26.9%) may indicate an opportunity for improved and up-to-date training practices for these operators.

It should be noted that there are some limitations to the survey itself that must be acknowledged. The primary limitation of this survey pertains to a variety of job roles that were under-represented by respondents (e.g., UAS pilots > 55 lbs. and sensor operators) while some

job roles were over-represented, such as supervisors and UAS instructors making up approximately half of all respondents sampled. Further, a portion of the total respondents belong to an undefined 'other crewmember' job role which could have skewed results related to perceptions and experiences with training, or which could have created other inconsistencies. In addition to issues with representative sample sizes across job roles, it should be recognized that the majority of respondents have no more than 10 years of experience in their current job role, which is both to be expected given the newness of UAS operations, and which could have skewed results in the current and associated reports.

Conclusion

While there is substantial overlap between UAS training topics and those in manned aviation, there are important differences as to which topics are given more emphasis. Many topics dealing with flight control skills are not emphasized in UAS training curricula as much as they are in manned flight training. This finding is most likely due to many current UAS being highly automated, with a large number containing no reversionary modes that require or even allow manual control of aircraft surfaces. While this approach requires higher levels of reliability for automated functionality to maintain a proper level of safety, it also reduces training requirements involving hand-eye coordinated skills.

A second important finding regarding training was the substantial number of organizations that focus on some level of operation-specific training topics. At present, besides the requirements established in 14 CFR § 107, there are no training regimes that allow a graduate of a training program to be prepared to operate across a large variety of operations without some type of operation-specific training. This finding speaks more to the large variety of operations, systems, and pilot/system interface designs than anything else. To date, there are no established control station design standards. This lack of standardization almost guarantees that training on one system will not transfer to other systems. It also creates the possibility of negative transfer between systems, which could create potential safety issues. This possibility becomes more critical as the industry eventually transitions to air carrier-like operations, especially those involving passenger transport.

One approach to handling the large variety of systems and system interfaces suggested by an SAE International working group (SAE International, 2016) was to establish a set of restrictions that could be placed on a UAS pilot certification. Examples of these restrictions include Off-Airport Operations Only, Daytime Operations Only, Automated Landings Only, Automated Takeoffs Only, and others. The reader is directed to SAE document ARP5707 (2016) for more detailed information.

In general, the results of the survey suggest an important role for regulators to provide guidance for how UAS operators should be trained. Interest among respondents to provide training programs is likely due to the growing interest and need in providing UAS services. This,

in turn, suggests a role for FAA to provide guidance and regulations to ensure a safe NAS complemented with operators trained with necessary and sufficient Knowledge, Skills, and Abilities as UAS operations increase over time.

Recommendations include frequent assessment of industry SMEs to identify and understand opportunities for training, and guidance for organizations based on identified best practices. The development and introduction of new levels of certification will also be needed in the future to ensure proper training and knowledge across operators.

Overall, the results suggest that organizations recognize the importance of the FAA's Part 107 certificate, but that real-world operations requires further training provided by organizations. It will be necessary to consider type certifications for UAS operations and systems as there are for manned aircraft operations. For example, a commercial transport pilot requires a different certification than a general aviation pilot. Such considerations will also be required for commercial UAS operations. Different skillsets are required and therefore different certification should be considered for operators carrying large cargo versus operators performing aerial photography. Under current regulations, UAS air carrier operators must apply for an airline certification but as demonstrated by the results of the survey the skills and safety checks between manned air carrier operations and UAS are different and thus may require a new type of certification process.

The variety of industries represented by respondents suggests that UAS are operating in very different use cases. When coupled with the finding that organizations are requiring further organization-specific training for their UAS pilots, the results overall suggest that certification requirements may need to more nuanced, with different training requirements perhaps dependent on use case.

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Appendix A.
Survey Questions Related to UAS Training

The Federal Aviation Administration's (FAA) Civil Aerospace Medical Institute (CAMI) constructed a survey to gather information about the current state of Unmanned Aircraft Systems (UAS) operations considered relevant to air carrier flight activities. The survey polled a variety of people involved in commercial UAS activities from frontline workers to high-level managers to educators. The survey examined areas related to UAS operations such as crew and staffing, operator knowledge and skills, duty/rest, and training requirements.

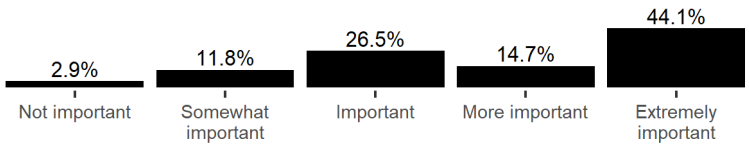
An open invitation to complete the online survey was distributed via email to a sample of potential respondents with UAS industry, training, or crew experience (N=2,524). Of those, 97 invitations were returned undeliverable resulting in 2,427 invitations delivered directly to potential respondents. Invitees were encouraged to share the open invitation with other UAS professionals who met eligibility requirements. Invitees were informed that survey completion was voluntary and that a third-party contractor would compensate respondents for completing the survey.

Overall, 173 respondents met the requirements for inclusion: 1) work as crew that operates/plans to operate UAS, or provides UAS training; or 2) work for an organization with UAS pilot qualification requirements; and 3) the organization had more than 1 employee. This report summarizes the survey results for the Training Requirements items.

Example of Report Format

C8b. How important is altitude and distance estimation for your trainees?

n	mean	sd
34	3.85	1.21



Definitions of Descriptive Statistics

Number of Respondents (n): The number of respondents who provided a valid response for an item.

Mean: The arithmetic average, calculated as the sum of response values for an item divided by the number of respondents (n) who answered that item. *Not applicable (N/A), Don't know,* and *No experience to say* responses are excluded from calculations and reporting.

Standard Deviation (sd): The measure of dispersion, or spread of values around the mean. Smaller standard deviation values indicate higher levels of agreement among respondents. *Not*

applicable (N/A), Don't know, and *No experience to say* responses are excluded from calculations and reporting.

Response Distribution (%): The proportion, or percentage, of respondents that selected a given response across item response options. *Not applicable (N/A), Don't know,* and *No experience to say* responses are excluded from calculations and reporting.

Frequency Count (n*): The number of times a response option is selected. A frequency count for 'mark all that apply' items may sum to greater than the number of respondents (n).

Percent (%) of Respondents: The percent is calculated by dividing the frequency count by the number of respondents and multiplying by 100.

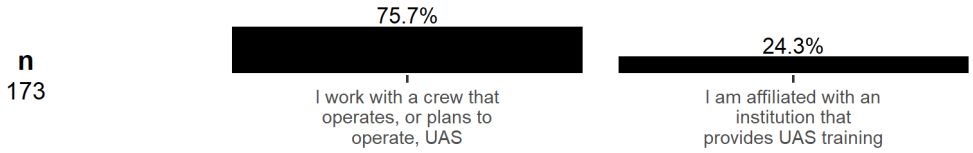
Median (med): The exact middle data point calculated in a set of rank-ordered values. It is less affected by extreme values in comparison to the mean, and thus, is relied upon when extreme values are present in a data set (e.g., total flight hours flown).

Minimum (min): The lowest, or minimum, value provided.

Maximum (max): The highest, or maximum, value provided.

Respondent Eligibility

1. Which of these statements best applies to you?

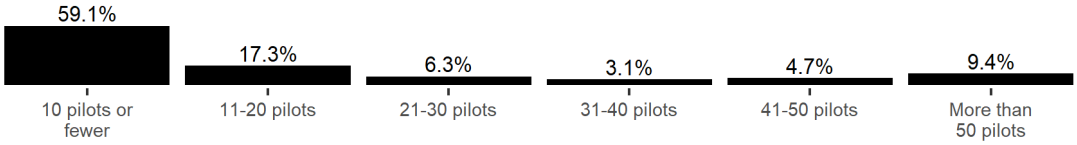


2. Do you work for an organization with established UAS pilot qualification requirements?

Results for *Item 3* include only respondents who indicated 'I work with an organization or crew that operates, or plans to operate, unmanned aircraft systems (UAS)/drones)' on *Item 1*.

3. How many drone operators/pilots does your organization currently employ?

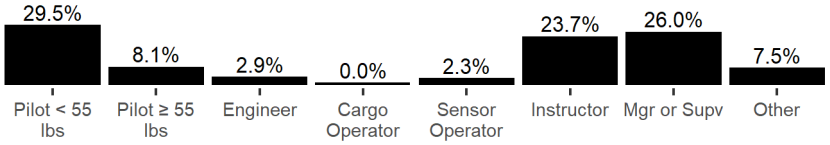
n	mean	sd	min	max	median
127	43.14	197.76	2	2,000	9



Section A. Demographics

A1. Currently, what is your primary job role? (required)

n
173



Results for *Item A1a* include only respondents who indicated 'Other' on *Item A1* and provided a written response.

A1a. In brief, please describe your job role: (See Appendix B. Section A. Demographics for a list of responses)

n
13

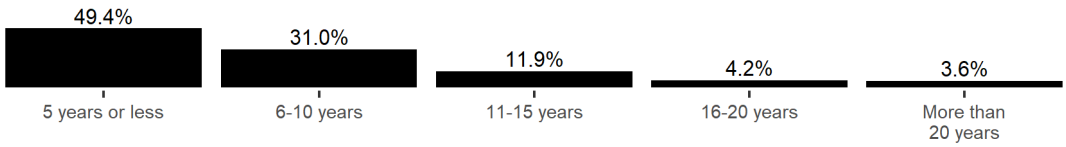
Results for *Item A1b* include only respondents who provided a written response.

A1b. In brief, please describe the main responsibilities of your job: (See Appendix B. Section A. Demographics for a list of responses)

n
166

A2. How many years of experience do you have with your current role(s)?

n	mean	sd	min	max	median
168	7.01	5.58	1	30	6



A3. The organization that I work for is, or plans to be, a: *[mark all that apply]* (required)

n
168

n*		%*
95	Drone service operator (uses drones to make money)	56.5
76	School or training program (teaches students about drones)	45.2
28	Manufacturer of drones (e.g., drone hardware, control station equipment, software)	16.7
38	Works with drones, but none of the above (please describe)	22.6

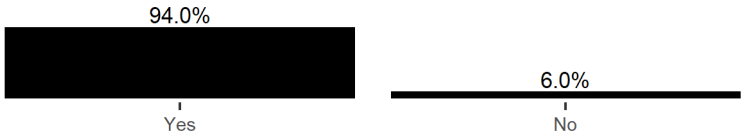
n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Results for *Item A4* include only respondents who indicated 'Works with drones, but none of the above' on *Item A3* and provided a written response.

A4. In what capacity does your organization work with drones? (See Appendix B. Section A. Demographics for a list of responses)

n
38

A6. Are you currently trained, licensed, or certified to fly a drone?



Results for *Item A7* through *Item A8* include only respondents who indicated 'Yes' on *Item A6*.

A7. Which of these certificates do you hold? *[mark all that apply]*

n
158

n*		%*
143	14 CFR Part 107 certificate (i.e., remote pilot certificate)	90.5
50	14 CFR Part 61 certificate (i.e., manned pilot certificate)	31.6
40	Instrument rating	25.3
22	Military-qualified (RPA) pilot	13.9
1	Non U.S. (foreign) license	0.6
43	I fly drones as a hobby	27.2
14	Other (please describe)	8.9
3	I do not hold a certificate	1.9

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Results for *Item A7a* include only respondents who indicated 'Other' on *Item A7* and provided a written response.

A7a. Other certificate(s), please describe: (See Appendix B. Section A. Demographics for a list of responses)

n
14

A8. Which of these certificates are required for your job? *[mark all that apply]*

n
151

A8

n*		%*
132	14 CFR Part 107 certificate (i.e., remote pilot certificate)	87.4
18	14 CFR Part 61 certificate (i.e., manned pilot certificate)	11.9
13	Instrument rating	8.6
13	Military-qualified (RPA) pilot	8.6
0	Non U.S. (foreign) license	0.0
12	Other (please describe)	7.9

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

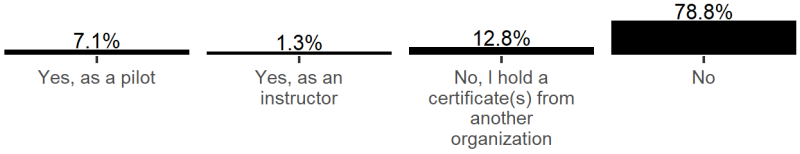
Results for *Item A8a* include only respondents who indicated 'Other' on *Item A8* and provided a written response.

A8a. Other certificate(s), please describe: (See Appendix B. Section A. Demographics A for a list of responses)

n
12

A9. Do you hold a Trusted Operator certificate from the Association for Unmanned Vehicle Systems International (AUVSI)?

n
156



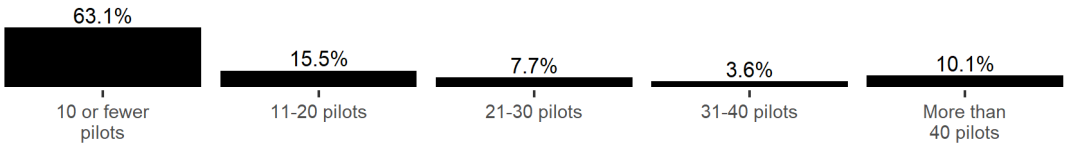
Results for *Item A9a* include only respondents who indicated 'No, I hold a certificate(s) from another organization' on *Item A9* and provided a written response.

A9a. What certificate(s) do you hold from another organization? Please describe. (See Appendix B. Section A. Demographics for a list of responses)

n
18

A10. What is your estimate of the number of certified UAS/drone pilots employed by the organization where you work?

n	mean	sd	min	max	median
168	29.70	111.03	1	1,000	7



A5. Please select the industry or sector that best describes the current or planned drone operations of your organization: *[mark all that apply]* (required)

n
168

n*		%*
41	Military or Military Contractor	24.4
61	Infrastructure (e.g., energy, roads, oil and gas, and construction)	36.3
39	Agriculture	23.2
23	Shipping or Package Delivery	13.7
3	Passenger Transport (Air Taxi)	1.8
54	Emergency Response (e.g., local law enforcement, disaster and accident)	32.1
40	Entertainment and Media (e.g., film-making, pictures)	23.8
24	Real Estate	14.3
47	Academic/Scientific Research	28.0
59	Education	35.1
13	Other (please describe)	7.7

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Results for *Item A5a* include only respondents who indicated 'Other' on *Item A5* and provided a written response.

A5a. Other industry or sector, please describe: (See Appendix B. Section A. Demographics for a list of responses)

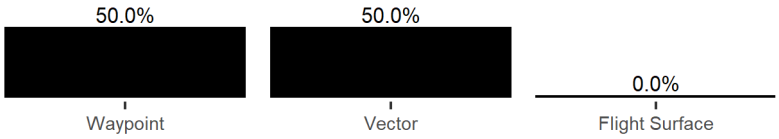
n
13

Section B. Air Carrier Operational Considerations for Unmanned Aircraft Systems

Results for *Item B1* through *Item B2* include only respondents who indicated 'Passenger Transport (Air Taxi)' on *Item A5*.

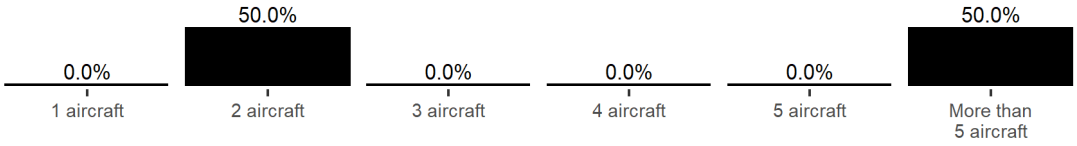
B1. If remote pilot control is possible, what should be the lowest level of flight control automation available to the remote pilot?

n
2



B2. If a remote pilot is monitoring multiple aircraft, how many aircraft should be monitored (maximum)?

n	mean	sd	min	max	median
2	6.00	5.66	2	10	6



Section C. Qualification Requirements

Results for *Item C6* include only respondents who indicated 'Instructor' on *Item A1* and provided a written response.

C6. What are your organization's requirements to become an instructor? (See Appendix B. Section B. Qualification Requirements for a list of responses)

n
39

C33. What are the minimum requirements necessary for instructors to operate drones at your organization? *[mark all that apply]*

n
80

n*		%*
69	Remote pilot certificate	86.2
14	Manned pilot certificate (e.g., commercial, private, sport)	17.5
52	Organization-specific training	65.0
28	Site-specific training	35.0
16	Manufacturer training	20.0
15	Other training (please describe)	18.8
2	N/A or Don't Know	2.5

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Results for *Item C33a* include only respondents who indicated 'Other' on *Item C33* and provided a written response.

C33a. Other, please describe: (See Appendix B. Section B. Qualification Requirements for a list of responses)

n
14

C34. What are the minimum requirements necessary for drone pilots at your organization? *[mark all that apply]*

n
123

n*		%*
111	Remote pilot certificate	90.2
11	Manned pilot certificate (e.g., commercial, private, sport)	8.9
72	Organization-specific training	58.5
36	Site-specific training	29.3
15	Manufacturer training	12.2
19	Other training or experience (please describe)	15.4
3	N/A or Don't Know	2.4

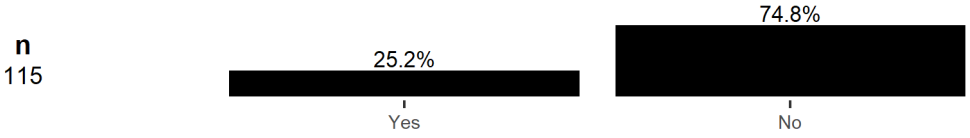
n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Results for *Item C34a* include only respondents who indicated 'Other' on *Item C34* and provided a written response.

C34a. Other training or experience, please describe: (See Appendix B. Section B. Qualification Requirements for a list of responses)

n
19

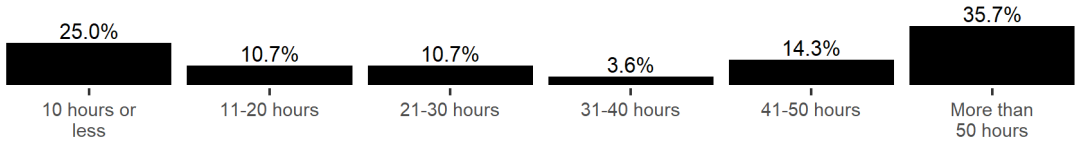
C35. Does your organization require a minimum number of training flight hours at hire?



Results for *Item C35a* include only respondents who indicated 'Yes' on *Item C35*.

C35a. If Yes, what number of flight hours is required?

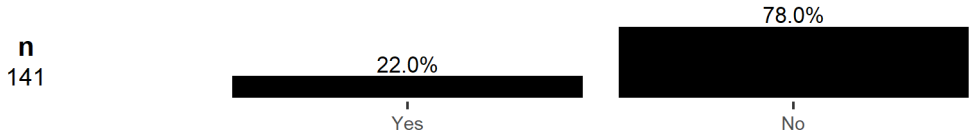
n	mean	sd	min	max	median
28	127.64	226.96	2	1,000	45



Section D. Training

D1. Are your drone pilot education and training materials currently submitted to, or reviewed by, the FAA?

D2. Are your drone pilot education and training materials currently submitted to, or reviewed by, another government agency (not the FAA)?

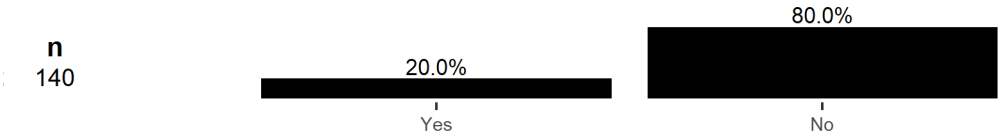


Results for *Item D2a* include only respondents who indicated 'Yes' on *Item D2* and provided a written response.

D2a. Please indicate which government agency reviews your training materials. (See Appendix B. Section C. Training for a list of responses)

n
30

D3. Are your drone pilot education and training materials currently submitted to, or reviewed by, a non-government agency?

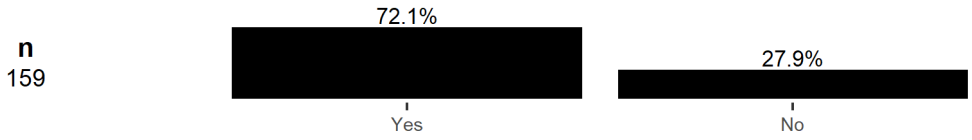


Results for *Item D3a* include only respondents who indicated 'Yes' on *Item D3* and provided a written response.

D3a. Please indicate which non-government agency reviews your training materials. (See Appendix B. Section C. Training for a list of responses)

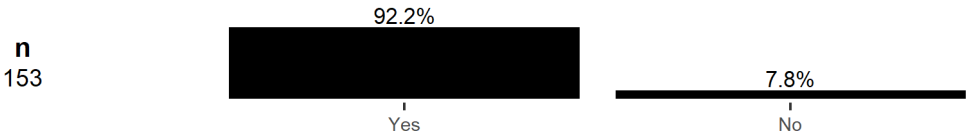
n
28

D4. Is initial training provided within 14 days of hiring a new employee?



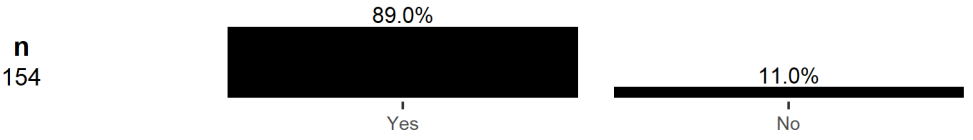
D5. Does your organization train and test drone pilots in the following specific areas?

A requirement to remain clear of and give way to manned aircraft at all times

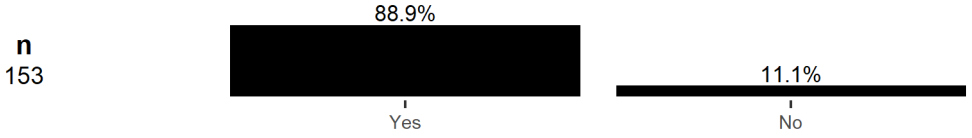


D5. Does your organization train and test drone pilots in the following specific areas?

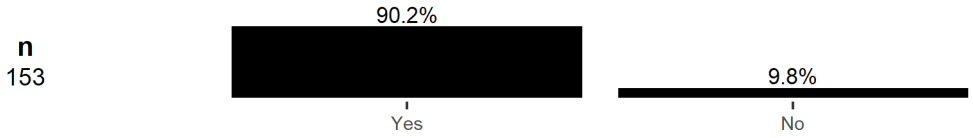
Distance limitations from other aircraft covering takeoff, landing and in-flight phases, obstruction clearance limitations, and airspeed limitations



Prohibition on unauthorized flight beyond visual line of sight of the UAS pilot, and a means to detect-and-avoid other aircraft

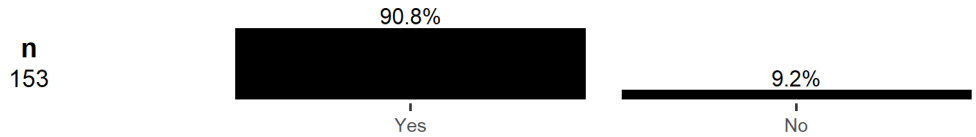


A requirement to plan a route of flight that avoids public use airports and approach and departure corridors, unless prior authorization is obtained, and alternatives if a flight cannot be completed as planned

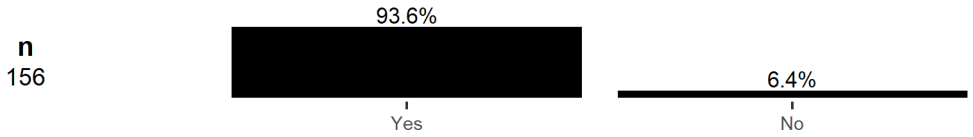


A requirement for remote pilots to communicate with and obtain any necessary authorization from air traffic control or the controlling agency for each flight in controlled airspace

A requirement that any visual observers be trained by the operator and briefed on the operation by the pilot in command before each flight

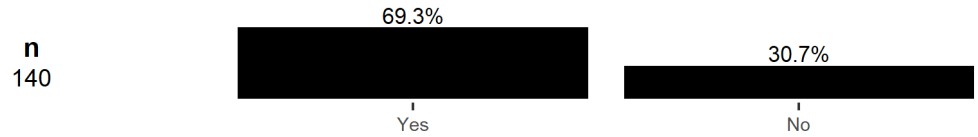


Procedures to cease flight when hazardous conditions arise, or communications or control become degraded, without causing danger to other persons



D5. Does your organization train and test drone pilots in the following specific areas?

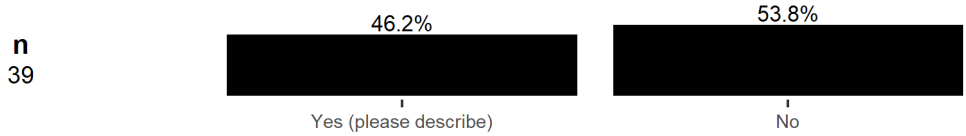
Standards and procedures covering the carriage of hazardous materials



Security procedures and security risks assessments

Results for *Item D7* through *Item D26b* include only respondents who indicated 'Instructor (teaches about drones, regulations, best practices, etc.)' on *Item A1*.

D7. Does your organization hold any certifications or authorizations for training drone pilots and/or operators?

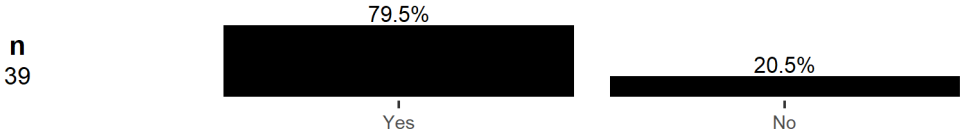


Results for *Item D7a* include only respondents who indicated 'Yes' on *Item D7* and provided a written response.

D7a. What kind of certificates or authorizations does your organization hold? (See Appendix B. Section C. Training for a list of responses)

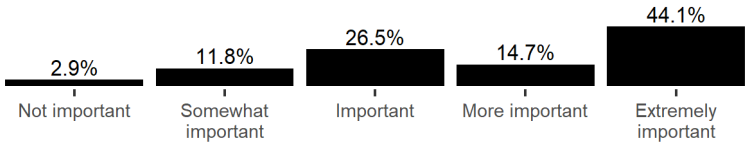
n
18

D8a. Do your trainees receive training in altitude and distance estimation?

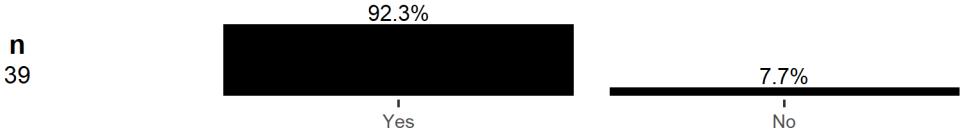


D8b. How important is altitude and distance estimation for your trainees?

n	mean	sd
34	3.85	1.21

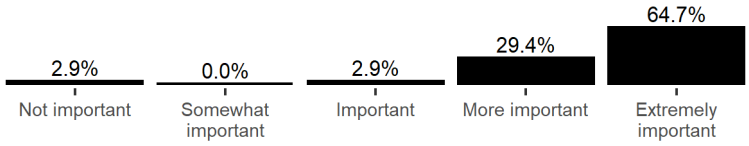


D9a. Do your trainees receive training in flight skill (e.g., changing direction, maintaining speed)?



D9b. How important is flight skill (e.g., changing direction, maintaining speed) for your trainees?

n	mean	sd
34	4.53	0.83



D10a. Do your trainees receive training in multitasking and timesharing?

n
37

D10b. How important is multitasking and timesharing for your trainees?

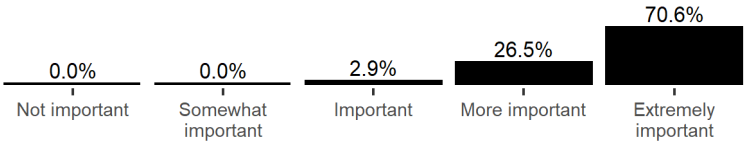
n	mean	sd
30	4.03	1.03

D11a. Do your trainees receive training in judgment and decision-making?

n
38

D11b. How important is judgment and decision-making for your trainees?

n	mean	sd
34	4.68	0.53

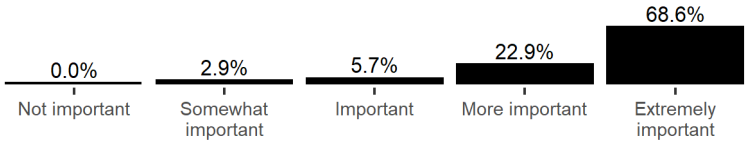


D12a. Do your trainees receive training in communication?

n
39

D12b. How important is communication for your trainees?

n	mean	sd
35	4.57	0.74

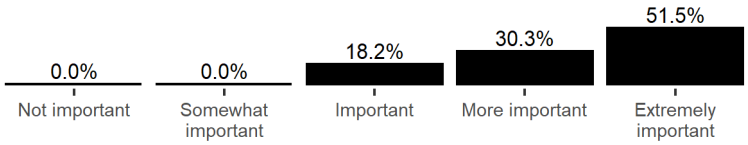


D13a. Do your trainees receive training in problem-solving?

n
38

D13b. How important is problem-solving for your trainees?

n	mean	sd
33	4.33	0.78

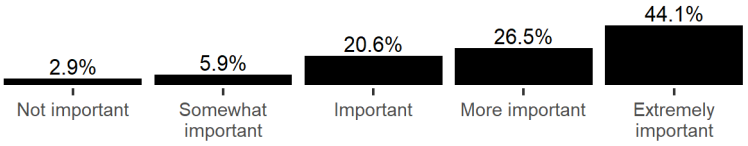


D14a. Do your trainees receive training in stress management?

n
38

D14b. How important is stress management for your trainees?

n	mean	sd
34	4.03	1.09

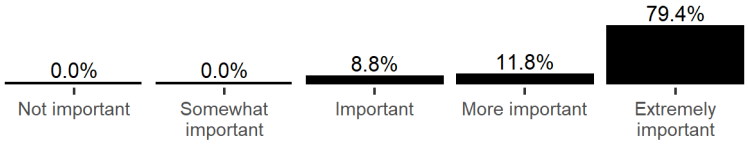


D15a. Do your trainees receive training in mission monitoring?

n
38

D15b. How important is mission monitoring for your trainees?

n	mean	sd
34	4.71	0.63

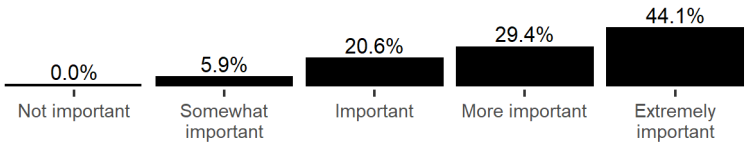


D16a. Do your trainees receive training in map reading?

n
39

D16b. How important is map reading for your trainees?

n	mean	sd
34	4.12	0.95

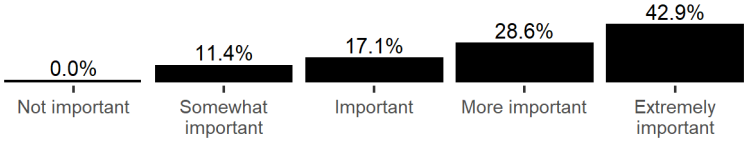


D17a. Do your trainees receive training in weather identification?

n
39

D17b. How important is weather identification for your trainees?

n	mean	sd
35	4.03	1.04

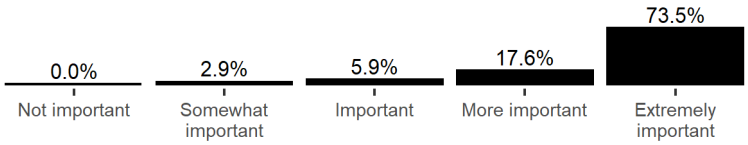


D18a. Do your trainees receive training in planning?

n
38

D18b. How important is planning for your trainees?

n	mean	sd
34	4.62	0.74

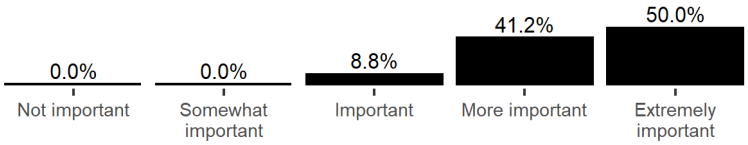


D19a. Do your trainees receive training in teamwork?

n
39

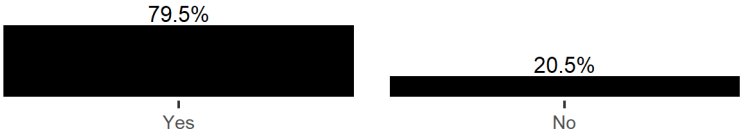
D19b. How important is teamwork for your trainees?

n	mean	sd
34	4.41	0.66



D20a. Do your trainees receive training in leadership?

n
39



D20b. How important is leadership for your trainees?

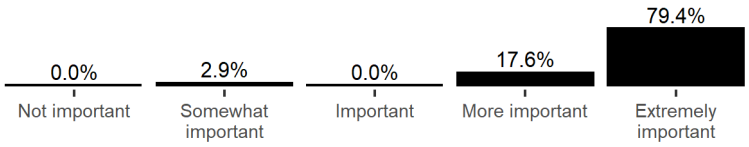
n	mean	sd
33	3.94	1.14

D21a. Do your trainees receive training in takeoff and landing?

n
39

D21b. How important is takeoff and landing for your trainees?

n	mean	sd
34	4.74	0.62

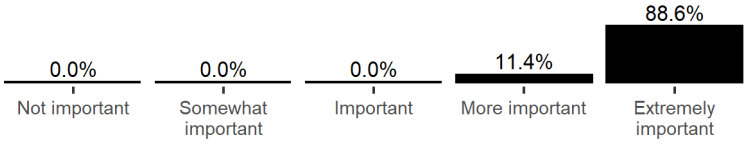


D22a. Do your trainees receive training in situational awareness?

n
39

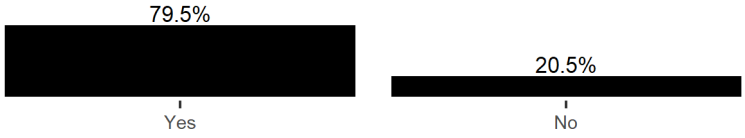
D22b. How important is situational awareness for your trainees?

n	mean	sd
35	4.89	0.32



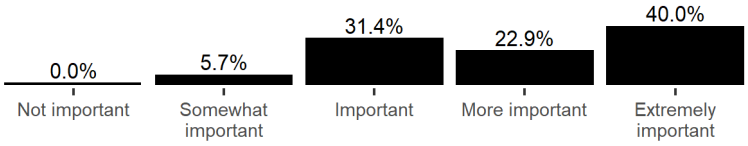
D23a. Do your trainees receive training in time management?

n
39



D23b. How important is time management for your trainees?

n	mean	sd
35	3.97	0.98

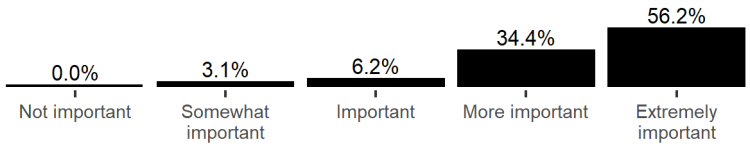


D24a. Do your trainees receive training in instrument monitoring?

n
39

D24b. How important is instrument monitoring for your trainees?

n	mean	sd
32	4.44	0.76

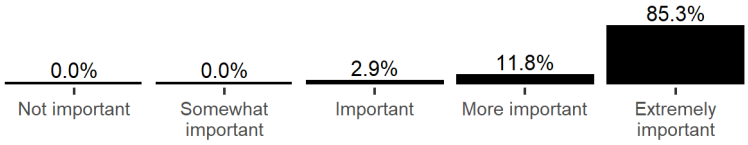


D25a. Do your trainees receive training in risk assessment?

n
39

D25b. How important is risk assessment for your trainees?

n	mean	sd
34	4.82	0.46



D26a. Do your trainees receive training in navigation?

n
39

D26b. How important is navigation for your trainees?

n	mean	sd
33	4.27	1.01

Results for *Item D27* through *Item D33* include only respondents who indicated 'Instructor (teaches about drones, regulations, best practices, etc.' on *Item A1* or 'School or training program (teaches students about drones)' on *Item A3*.

D27. What certifications or degrees do you offer to those who complete your training? *[mark all that apply]*

n
80

n*		%*
11	Two-year degree from a college or university	13.8
12	Four-year degree from a college or university	15.0
2	AUVSI TOP certification	2.5
24	Topic-specific certification	30.0
40	Remote Pilot certificate (Part 107 compliant)	50.0
25	We do not offer any recognized certification to those who complete the training	31.2

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

D28. What type of operations do you provide training for? *[mark all that apply]*

n
78

n*		%*
28	Military	35.9
39	Infrastructure Inspection	50.0
32	Agriculture	41.0
9	Shipping or Cargo Delivery	11.5
0	Passenger Transport	0.0
41	Emergency Response	52.6
30	Entertainment and Media	38.5
31	Real Estate	39.7
27	Oil and Gas	34.6
38	Academic/Scientific Research	48.7
45	Education	57.7
32	Surveillance	41.0
6	Other (please describe)	7.7

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Results for *Item D28a* include only respondents who indicated 'Other' on *Item D28* and provided a written response.

D28a. Other, please describe: (See Appendix B. Section C. Training for a list of responses)

n
6

D29. Do you provide training for night operations (i.e., flights that begin or end after civil twilight)?

n
80

D30. What type of automation techniques are taught during the training program? *[mark all that apply]*

n
80

n*		%*
69	Pilot manually controls the drone, which may include manipulating the actual flight controls, minimal automation	86.2
68	Pilot programs the flight plan, performs takeoffs and landings	85.0
52	Pilot monitors flights and only intervenes when an abnormal event or emergency occurs	65.0
23	Complete autonomy, no human intervention from takeoff to landing	28.7

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

D31. What types of drones do you provide training on? *[mark all that apply]*

n
80

n*		%*
49	Fixed wing	61.3
11	Single rotor wing	13.8
66	Multi-rotor wing	82.5
23	Transition (vertical to horizontal)	28.7
2	Other (please describe)	2.5

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Results for *Item D31a* include only respondents who indicated 'Other' on *Item D31* and provided a written response.

D31a. Other drone type (please describe): (See Appendix B. Section C. Training for a list of responses)

n
2

Results for *Item D31b* include only respondents who indicated 'multi-rotor wing' on *Item D31*.

D31b. Please enter the number of rotors for each multi-rotor wing drone you provide training on.

n
66

n*		%*
4	1 rotor	6.1
3	2 rotors	4.5
2	3 rotors	3.0
63	4 rotors	95.5
0	5 rotors	0.0
24	6 rotors	36.4
0	7 rotors	0.0
20	8 rotors	30.3
0	9 rotors	0.0
1	10 rotors	1.5

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

D32. What types of training do you offer? *[mark all that apply]*

n
33

n*		%*
33	Classroom training	100.0
20	Computer-based/online training	60.6
31	Supervised hands-on flight training	93.9
17	Simulation training (please describe)	51.5

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Results for *Item D32a* include only respondents who indicated 'Simulation training' on *Item D32* and provided a written response.

D32a. Simulation training (please describe): (See Appendix B. Section C. Training for a list of responses)

n
17

D36. What training topics have you received training on?

Applicable Federal Aviation Regulations *[mark all that apply]*

n
122

n*		%*
113	I have received training for flying drones on this topic	92.6
46	I have received training for flying manned aircraft on this topic	37.7
3	I have not received training on this topic	2.5
4	No experience to say	3.3

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

D36. What training topics have you received training on?

Accident reporting requirement of the National Transportation Safety Board *[mark all that apply]*

n
122

n*		%*
106	I have received training for flying drones on this topic	86.9
45	I have received training for flying manned aircraft on this topic	36.9
8	I have not received training on this topic	6.6
3	No experience to say	2.5

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Use of applicable portions of the Aeronautical Information Manual (AIM) and FAA Advisory Circulars (AC) *[mark all that apply]*

n
122

n*		%*
94	I have received training for flying drones on this topic	77.0
46	I have received training for flying manned aircraft on this topic	37.7
17	I have not received training on this topic	13.9
5	No experience to say	4.1

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Use of aeronautical charts for navigation under Visual Flight Rules (VFR) using pilotage, dead reckoning, and navigation systems *[mark all that apply]*

n
122

n*		%*
99	I have received training for flying drones on this topic	81.1
46	I have received training for flying manned aircraft on this topic	37.7
11	I have not received training on this topic	9.0
7	No experience to say	5.7

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

D36. What training topics have you received training on?

Radio communication procedures *[mark all that apply]*

n
122

n*		%*
92	I have received training for flying drones on this topic	75.4
48	I have received training for flying manned aircraft on this topic	39.3
14	I have not received training on this topic	11.5
4	No experience to say	3.3

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Recognition of critical weather situations from the ground and in flight and the procurement and use of aeronautical weather reports and forecasts *[mark all that apply]*

n
122

n*		%*
108	I have received training for flying drones on this topic	88.5
47	I have received training for flying manned aircraft on this topic	38.5
6	I have not received training on this topic	4.9
3	No experience to say	2.5

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Safe and efficient operation of the aircraft *[mark all that apply]*

n
122

n*		%*
112	I have received training for flying drones on this topic	91.8
45	I have received training for flying manned aircraft on this topic	36.9
4	I have not received training on this topic	3.3
3	No experience to say	2.5

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

D36. What training topics have you received training on?

Effects of density altitude on aircraft takeoff and climb performance *[mark all that apply]*

n
122

n*		%*
100	I have received training for flying drones on this topic	82.0
44	I have received training for flying manned aircraft on this topic	36.1
13	I have not received training on this topic	10.7
3	No experience to say	2.5

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Weight and balance computations *[mark all that apply]*

n
120

n*		%*
91	I have received training for flying drones on this topic	75.8
47	I have received training for flying manned aircraft on this topic	39.2
12	I have not received training on this topic	10.0
4	No experience to say	3.3

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Principles of aerodynamics, aircraft engines, and systems *[mark all that apply]*

n
121

n*		%*
92	I have received training for flying drones on this topic	76.0
47	I have received training for flying manned aircraft on this topic	38.8
14	I have not received training on this topic	11.6
5	No experience to say	4.1

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

D36. What training topics have you received training on?

Stall awareness and recovery techniques *[mark all that apply]*

n
120

n*		%*
76	I have received training for flying drones on this topic	63.3
46	I have received training for flying manned aircraft on this topic	38.3
22	I have not received training on this topic	18.3
5	No experience to say	4.2

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Preflight preparation *[mark all that apply]*

n
121

n*		%*
113	I have received training for flying drones on this topic	93.4
46	I have received training for flying manned aircraft on this topic	38.0
2	I have not received training on this topic	1.7
3	No experience to say	2.5

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Preflight procedures *[mark all that apply]*

n
121

n*		%*
113	I have received training for flying drones on this topic	93.4
46	I have received training for flying manned aircraft on this topic	38.0
2	I have not received training on this topic	1.7
3	No experience to say	2.5

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

D36. What training topics have you received training on?

Airport operations *[mark all that apply]*

n
120

n*		%*
97	I have received training for flying drones on this topic	80.8
46	I have received training for flying manned aircraft on this topic	38.3
8	I have not received training on this topic	6.7
3	No experience to say	2.5

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Takeoff, landings, and go-arounds *[mark all that apply]*

n
121

n*		%*
102	I have received training for flying drones on this topic	84.3
44	I have received training for flying manned aircraft on this topic	36.4
8	I have not received training on this topic	6.6
4	No experience to say	3.3

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Performance maneuvers *[mark all that apply]*

n
121

n*		%*
85	I have received training for flying drones on this topic	70.2
44	I have received training for flying manned aircraft on this topic	36.4
16	I have not received training on this topic	13.2
4	No experience to say	3.3

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

D36. What training topics have you received training on?

Ground reference maneuvers *[mark all that apply]*

n
120

n*		%*
70	I have received training for flying drones on this topic	58.3
43	I have received training for flying manned aircraft on this topic	35.8
21	I have not received training on this topic	17.5
11	No experience to say	9.2

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Navigation *[mark all that apply]*

n
121

n*		%*
98	I have received training for flying drones on this topic	81.0
48	I have received training for flying manned aircraft on this topic	39.7
7	I have not received training on this topic	5.8
5	No experience to say	4.1

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Slow flight and (aerodynamic) stalls *[mark all that apply]*

n
120

n*		%*
53	I have received training for flying drones on this topic	44.2
45	I have received training for flying manned aircraft on this topic	37.5
29	I have not received training on this topic	24.2
8	No experience to say	6.7

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

D36. What training topics have you received training on?

Basic instrument maneuvers *[mark all that apply]*

n
120

n*		%*
66	I have received training for flying drones on this topic	55.0
43	I have received training for flying manned aircraft on this topic	35.8
20	I have not received training on this topic	16.7
8	No experience to say	6.7

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Emergency operations *[mark all that apply]*

n
121

n*		%*
107	I have received training for flying drones on this topic	88.4
43	I have received training for flying manned aircraft on this topic	35.5
7	I have not received training on this topic	5.8
4	No experience to say	3.3

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Night operations *[mark all that apply]*

n
121

n*		%*
87	I have received training for flying drones on this topic	71.9
43	I have received training for flying manned aircraft on this topic	35.5
17	I have not received training on this topic	14.0
4	No experience to say	3.3

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

D36. What training topics have you received training on?

Post-flight procedures *[mark all that apply]*

n
121

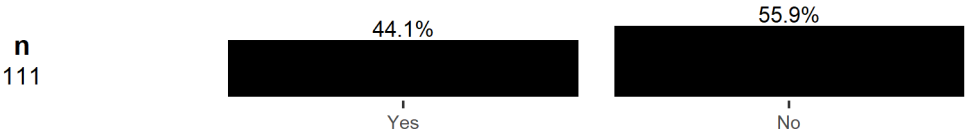
n*		%*
112	I have received training for flying drones on this topic	92.6
43	I have received training for flying manned aircraft on this topic	35.5
4	I have not received training on this topic	3.3
3	No experience to say	2.5

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

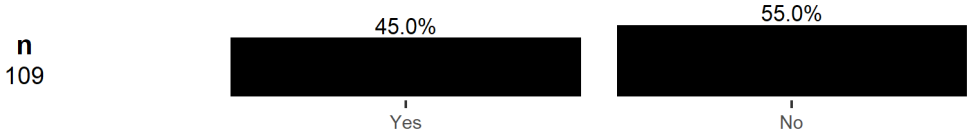
D37. What type of drone/UAS training have you completed, outside of your organization's requirements?

Computer-based/online training course

Classroom operations training



Classroom drone training

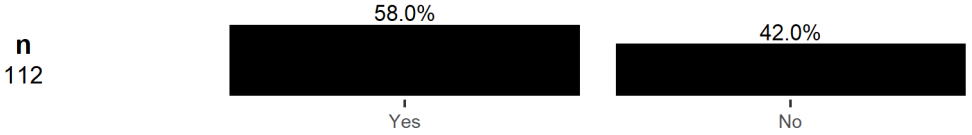


Simulation drone training

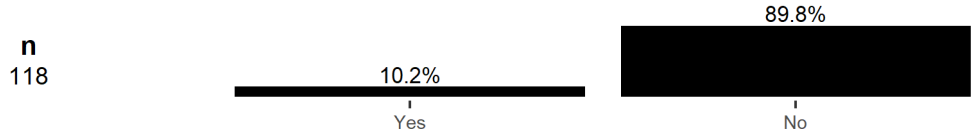
D37. What type of drone/UAS training have you completed, outside of your organization's requirements?

Field training using the drone (i.e., in-person flight training)

Supervised on-the-job training (i.e., supervised operating experience)



D37a. Are there other types of drone/UAS training not listed in the previous question that you have completed outside of your organization's requirements?



Results for *Item D37b* include only respondents who indicated 'Yes' on *Item D37a* and provided a written response.

D37b. Other type of training provided outside of your organization, please describe: See Appendix B. Section C. Training for a list of responses)

n
11

D38. The training you completed outside of your organization's requirements was provided by:

Computer-based/online training course *[mark all that apply]*

n
86

n*		%*
34	Provided by your organization	39.5
60	Provided by a 3rd party training provider	69.8

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

D38. The training you completed outside of your organization's requirements was provided by:

Classroom operations training *[mark all that apply]*

n
63

n*		%*
34	Provided by your organization	54.0
33	Provided by a 3rd party training provider	52.4

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Classroom drone training *[mark all that apply]*

n
61

n*		%*
33	Provided by your organization	54.1
32	Provided by a 3rd party training provider	52.5

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Simulation drone training *[mark all that apply]*

n
54

n*		%*
30	Provided by your organization	55.6
30	Provided by a 3rd party training provider	55.6

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

D38. The training you completed outside of your organization's requirements was provided by:

Field training using the drone (i.e., in-person flight training) *[mark all that apply]*

n
76

n*		%*
58	Provided by your organization	76.3
26	Provided by a 3rd party training provider	34.2

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

Supervised on-the-job training (i.e., supervised operating experience) *[mark all that apply]*

n
63

n*		%*
50	Provided by your organization	79.4
20	Provided by a 3rd party training provider	31.7

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

D38a. Are there other training requirements not listed in the previous question that are provided by your organization or by a 3rd party training provider?

n
119

Results for *Item D38b* through *Item D38c* include only respondents who indicated 'Yes' on *Item D38a* and provided a written response.

D38b. Other training, provided by your organization, please describe: (See Appendix B. Section C. Training for a list of responses)

n
1

D38c. Other training, provided by a 3rd party, please describe: (See Appendix B. Section C. Training for a list of responses)

n
2

Results for *Item D39* include respondents who indicated 'Pilot/Operator with systems less than 55 pounds,' 'Pilot/Operator of systems equal to/greater than 55 pounds,' 'Cargo Operator,' 'Sensor Operator,' 'Manager or Supervisor,' or 'Other' on *Item A1*.

D39. What type of training does your organization require *[mark all that apply]*?

n
113

n*		%*
72	Computer-based/online training course	63.7
59	Classroom operations training	52.2
60	Classroom drone training	53.1
43	Simulation drone training	38.1
98	Field training using the drone	86.7
80	Supervised on-the-job training (i.e., supervised operating experience)	70.8
68	Recurrent training (repeated periodically)	60.2
11	Other training (please describe)	9.7

n may sum to greater than the number of respondents to the item (n) due to multiple responses. The %* of respondents is based on the number of respondents to the item (n).*

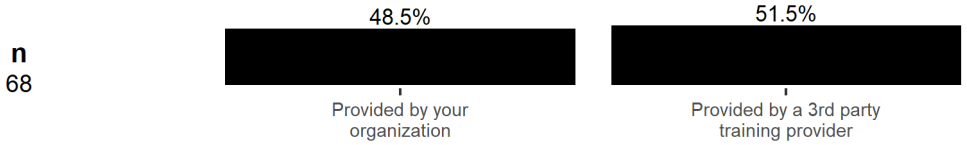
Results for *Item D39a* include only respondents who indicated 'Other training' on *Item D39* and provided a written response.

D39a. Other required training, please describe: (See Appendix B. Section C. Training for a list of responses)

n
11

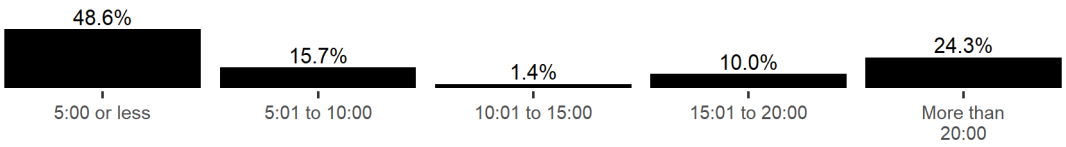
Results for *Item D40* through *Item D41* include only respondents who indicated 'Computer-based/online training course' on *Item D39*.

D40. Your organization requires computer-based/online training course. Is this training:



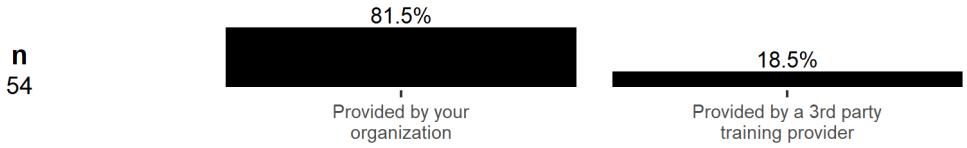
D41. How long is the computer-based/online training course?

n	mean	sd	min	max	median
70	13.92	16.17	0	80	5.8



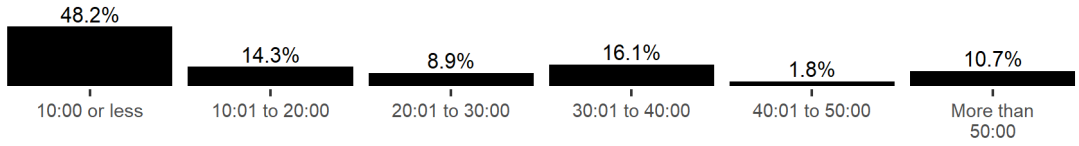
Results for *Item D42* through *Item D43* include only respondents who indicated 'Classroom operations training' on *Item D17*.

D42. Your organization requires classroom operations training. Is this training:



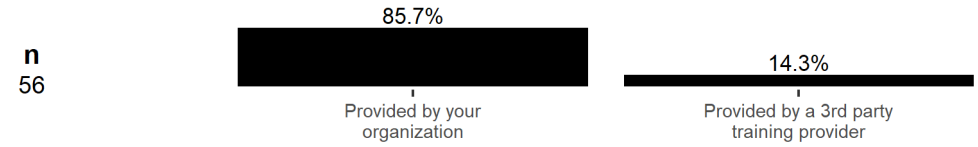
D43. How long is the classroom operations training?

n	mean	sd	min	max	median
56	57.20	265.38	1	2,000	12



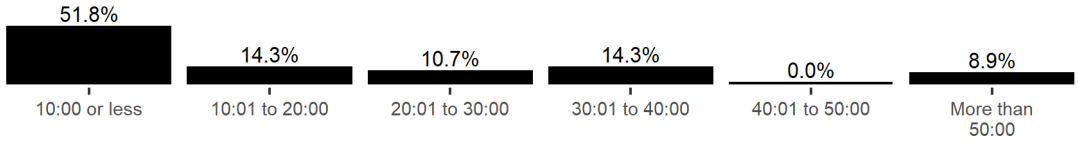
Results for *Item D44* through *Item D45* include only respondents who indicated 'Classroom drone training' on *Item D39*.

D44. Your organization requires classroom drone training. Is this training:



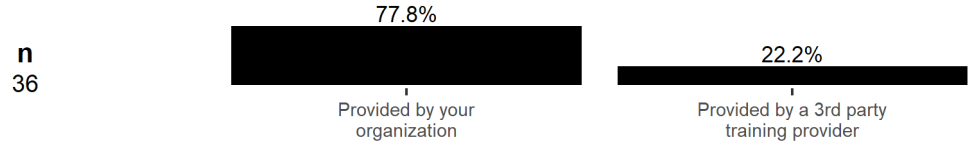
D45. How long is the classroom drone training?

n	mean	sd	min	max	median
56	36.83	132.80	1	1,000	10



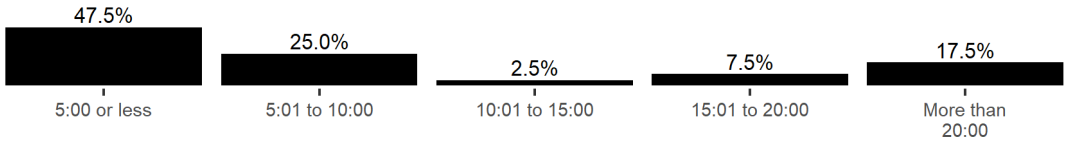
Results for *Item D46* through *Item D47* include only respondents who indicated 'Simulation drone training' on *Item D39*.

D46. Your organization requires simulation drone training. Is this training:



D47. How long is the simulation drone training?

n	mean	sd	min	max	median
40	13.93	22.73	1	120	7



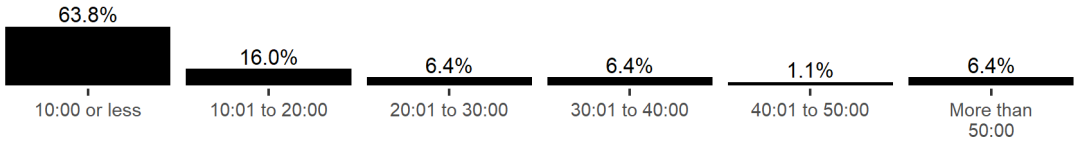
Results for *Item D48* through *Item D49* include only respondents who indicated 'Field training using the drone' on *Item D39*.

D48. Your organization requires field training using the drone. Is this training:

n
92

D49. How long is the field training using the drone?

n	mean	sd	min	max	median
94	18.06	33.60	1	250	8



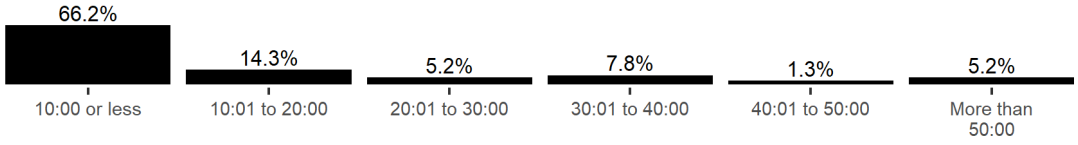
Results for *Item D50* through *Item D51* include only respondents who indicated 'Supervised on-the-job training (i.e., supervised operating experience)' on *Item D39*.

D50. Your organization requires supervised on-the-job training. Is this training:

n
80

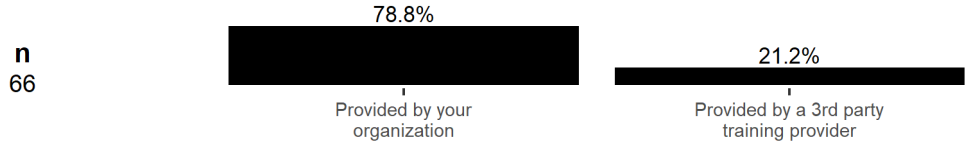
D51. How long is the supervised on-the-job training?

n	mean	sd	min	max	median
77	17.53	34.00	1	250	8



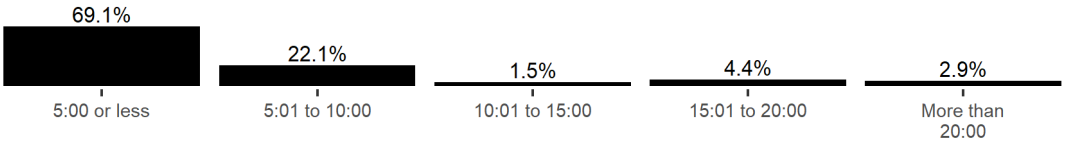
Results for *Item D52* through *Item D53* include only respondents who indicated 'Recurrent training (repeated periodically)' on *Item D39*.

D52. Your organization requires recurrent training. Is this training:



D53. How long is the recurrent training? (See Appendix B. Section C. Training for a list of responses)

n	mean	sd	min	max	median
68	5.63	6.55	0	40	4

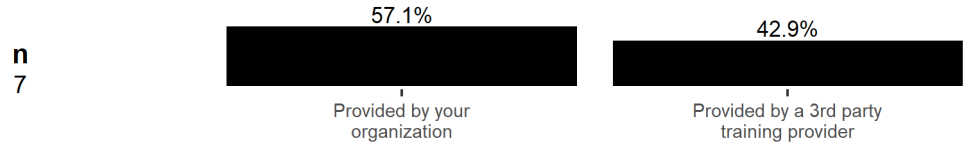


D54. How often is recurrent training required?

n
68

Results for *Item D55* through *Item D56* include only respondents who indicated 'Other' *Item D39*.

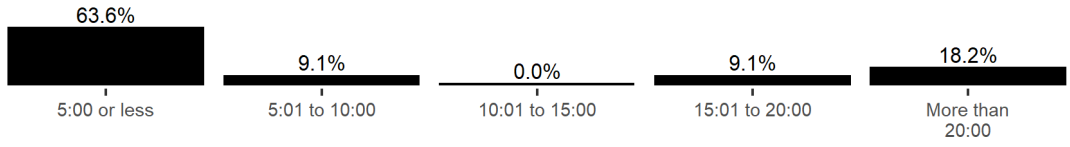
D55. Your organization requires Other required training. Is this training:



D56. How long is the Other required training?

n	mean	sd	min	max	median
11	9.82	13.98	0	40	4

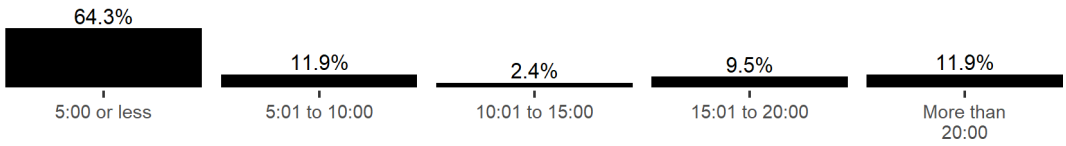
D56



Results for *Item D57* include respondents who indicated 'Manager or Supervisor' on *Item A1* and provided a written response.

D57. If your organization requires training when integrating a new drone, how long is the new training? (See Appendix B. Section C. Training for a list of responses)

n	mean	sd	min	max	median
42	8.40	11.58	0	40	4



Appendix B. Text Response to Open Ended Questions for Air Carrier Operational Considerations for UAS: Training

The FAA constructed a survey to gather information about the current state of UAS operations considered relevant to air carrier flight activities. The survey examined four areas related to UAS operations: operator knowledge, skills, and tests; duty and rest; training requirements; and crew and staffing requirements.

The items addressing training requirements included 24 open response items formatted for text entry. These items typically asked respondents to explain the job roles and training requirements for UAS operators within their organization. Of those 24 open response items, one (1) had no response, and is not presented in this report: D37.

This appendix provides responses for the remaining 23 UAS training open response items. These are verbatim responses with the exception of removing any personally identifying information and expletives, as needed.

A. Demographics

Item A1a, Item A1 asked for the primary job role of the respondent. Respondents who indicated 'Other' were asked to describe the job role (A1a) as well as the main responsibility of the job (A1b), Table B1 and Table B2 respectively.

Table B1; *Item A1*, Table B2; *Item A1b*,

Table B3; *Item A3a*, Table B4; *Item A5a*,

Table B5; *Item A7a*,

Table B6; *Item A8a*, Table B7; *Item A9a*

B. Qualification Requirements

Item C6, Table B6; provides responses from UAS instructors who indicated their job role as an Instructor and provided a written response for other requirements to be an Instructor at their organization. The type of requirements for instructors to fly a UAS at their organizations are presented in Table B9 and requirements for UAS Pilot/Operators are in Table B10.

C. Training

Item D2a, Table B11 presents responses from instructor for what government agency reviews their training material, other than the FAA. Item D3a, Table B12 provides a list of non-government agencies who review UAS training material. Organization level certifications and authorizations are shown in Table B13 (item D7a). Respondents who answered 'other' on Item D28 (What type of operations do you provide training for) are given in Table B14 (Item D28a). Six respondents indicated their organization provides training on other system than those presented in the survey list (item D31), their written responses are shown in Table B15 (item D31a). The type of simulation training provided by the organizations are given in Table B16. Additional training provide from outside training provides and within the

organization are provided in Table B17 and Table B18, respectively. Third-party training organization are listed in Table B19. Required training and required reoccurring training types are in Table B20 and Table B21.

For all tables, each new comment is denoted by an asterisk (*) in the far left column.

Section A. Demographics

Item A1 asked for the primary job role of the respondent. Respondents who indicated 'Other' were asked to describe the job role (A1a) as well as the main responsibilities of the job (A1b), Table B1 and Table B2, respectively.

Table B1

Responses Provided by Respondents Who Indicated 'Other' on Item A1 and Who Provided a Description of Their Job Role (n = 13)

A1. Currently, what is your primary job role? (*required*) *Other (please describe)*	
a. In brief, please describe your job role:	
*	Business Owner
*	CEO
*	Director, UAS Flight Operations
*	I am a Detective with the Sheriff's Office and also the lead UAS pilot/program coordinator
*	I am the VP of our company, and manage, operate and maintain UAS above and below 55 lbs
*	Marketing Manager
*	Operations and also Pilot
*	owner/exec
*	Part 141 assistant chief flight instructor, airplane
*	Pilot and Manager of pilots
*	Public Safety Representative
*	Research UAS applications, and in that also pilot, but also instruct
*	Supervisor and Pilot/Operator of systems equal to/less than 55 pounds.

Table B2

Descriptions of Job Responsibilities Provided by Respondents on Item A1b (n = 166)

A1b. In brief, please describe the main responsibilities of your job:	
*	Working with engineers and former NASA astronauts by researching, preparing and producing media content (Videography, Photography, and/or Drone Content, etc.) for documentation, training, promotion, sales, and other communicative purposes for both internal and external audiences. • Monitor and track manufacturing schedule of important programs • Remote camera operations for static tests
*	As a professor of Aeronautical Science teaching our Bachelor of Science in Unmanned Systems Applications and our Master of Science in Unmanned Systems at [University], I teach the concepts about UAS operations and safety management. Later, in advanced classes, I lead students through applications of UAS-related student projects.
*	As CEO of our Part 107 test prep and drone flight instruction company, I manage each of our key team members and set strategy.
*	As operations manager, prepare estimates for clients to obtain traffic data for engineering companies.
*	As President I run the business and co-manage field operations which I also participate in at times
*	Associate professor providing ground and flight instruction utilizing sUAS.
*	Build and fly drones for various government sponsors.
*	Camera operation and weapons guidance on the MQ-9
*	CEO/Owner [Company] an unmanned systems and services company
*	Chief pilot and instructor, also cfi/i/mei/agi for small growing company, I bring the mindset of GA part 61 aviation and apply to part 107
*	Chief Pilot, team management as well as current/qualified RPIC
*	Co-designee, develop, edit, and author Unmanned Aerial System (UAS) training programs. Ensure federal, state, and local law regulatory compliance for all administrative and operational documents. Ensure all Safety Management System (SMS) administrative and operational documents meet all regulatory guidance standards. Perform academic, hands-on system training, and various UAS simulation and flight operations instruction for civilian (foreign/domestics), military (foreign/domestics), and other governmental agencies.

A1b. In brief, please describe the main responsibilities of your job:	
*	Co-Founder of [Company]. I am responsible for business development and the managing member of the company. I join the crew on service jobs, provide instructional training and work with the Airborne Public Safety Association on the NIST sUAS Standard Test Methods program.
*	Conduct training and evaluations for a P135 UAS operation. I also participate in flight operations.
*	Contract MQ-9 Pilot/Instructor for the U.S. Air Force, [Address]
*	COO - Operations Management. Flight planning, drone operations and maintenance, planning and development, FAA and waiver management.
*	Coordinate Geospatial program at the college and other public safety programs.
*	Criminal Division Commander, UAS Program Commander
*	Curriculum development and instruction
*	Define operational requirements form local missions. Maintain your aircraft and log flights. Tran our group of volunteer spotters in operations and safety standards
*	Department Chair over the training for our UAS dept.
*	Deputy Director of Emergency Management for a County government
*	Develop and disseminate testing procedures and standards for response robotics.
*	Develop core competencies for UAS operators and sensor operators; help select equipment to meet mission requirements; train operators; obtain all necessary approvals; oversee safety; responsible for safe and effective execution of the mission.
*	Develop, maintain and teach and 1 year UAS certificate program at a community college
*	Direct a non-profit that facilitates the use of unmanned technologies for environmental research and monitoring.
*	Director of Operations
*	Director of UAS Operations and Safety - Review operational safety plans, set policies and procedures for drone use, provide flight instruction and analyze safety metrics.
*	Director of UAS Programs. EP for grp 1-3 UAS, Primary UAS Instructor
*	Drone & field operator flying under and above the canopy as well as conducting radio tower inspections
*	Drone Pilot for [University] Extension Communications Department for Photo and Video purposes

A1b. In brief, please describe the main responsibilities of your job:	
*	Emergency Management
*	Ensures that all flight operations are conducted safely and in compliance with all FAA regulations, OpSpecs and company policies. Coordinates with the POI on regulatory requirements and OpSpecs, to ensure the highest level of safety and regulatory compliance.
*	Executive Director, [Company], [Company], responsible for "all things uncrewed" for the [Company].
*	Filming and editing all videos for my organization
*	Flight and regulatory instructor for a UAS training company.
*	Flight instructor for public safety UAS
*	flight of uav in response to wildfires
*	Flight operations and mission planning
*	Flight Operations Manager: I manage upwards of 15 pilots currency and medical requirements, as well as a fleet of SUAS.
*	Flying for the film industry
*	Founder and President of [Company], a drone service company that specializes in provide aerial film to sports teams.
*	Geospatial Program Manager and sUAS Pilot and Data Specialist for Emergency Responses.
*	GIS Administrator for company. Gathering, managing data and imagery.
*	Help teach the teacher and kids in school about drones and the rules to govern them
*	I am a Director of the [University] Drone Center. A research based educational center that build, maintains, operates, educates, integrates, and provides training with UAS systems.
*	I am a drone operator and program administrator for the UAS program of the [Company].
*	I am a professor and department chair in the Department of Wildlife at [University] (aka [University]), as well as a Principal Investigator for projects run through [University] Sponsored Programs Foundation. For two of my projects, I serve as the primary UAS pilot for externally-funded research - it is this role that I am writing about in the survey.
*	I am a professor at a university. My primary responsibilities include developing course content, instructing in a lecture setting, instructing in a project setting, supervising a UAS instructor team, grading, advising, and mentorship.

A1b. In brief, please describe the main responsibilities of your job:	
*	I am a scientist that uses drones for animal surveys, we have agency oversight that liaises with the FAA and has established further protocols in addition to part 107
*	I am a software engineer. I develop web based applications and streaming systems to deliver content to paid students.
*	I am a Video Producer/Director at a local PBS affiliate TV station tasked with producing commercial/educational content for public broadcast.
*	I am primarily a civil engineer (previously engineer in training). I maintain a Remote Pilot Certification for the purpose of operating a small UAS for land surveying purposes. I develop plans for surveys including verifying airspace, altitudes, and planning ground control point locations. I often act as the person manipulating the controls for the small UAS as well.
*	I am responsible for building our drone fleet for last mile delivery and other applications
*	I am responsible for the operation of the UAS. I collect assets typically video footage used for marketing purposes. I then edit the footage into marketable deliverables and deliver them to the client. I also serve as my companys software engineer providing web development support as needed.
*	I am the aviation coordinator and UAS pilot for a large agency.
*	I am the Deputy Chief of Special Operations, Research and Training. I supervise our UAS Unit.
*	I am the Director of [Company] UAS Flight Operations. I am a SME for UAS Operations worldwide both Civil and Military. I design UAS flight operations Airspace, and the Documented Programs of record.
*	I am the drone RPIC that operates and performs various drone jobs.
*	I am the founder/CEO of [Company]. We are a Drone Technology company. I am an FAA Part 107 Pilot having flown 4,000 UAS missions
*	I am the Leadin Instructor for the [Company] Fire Academy UAS program
*	I am the Lieutenant and Program Manager of our Aviation Unit.
*	I am the owner of a Drone Service Provider company, [Company name].
*	I am the program coordinator, curriculum designer, and lead instructor at a university UAS degree program.
*	I am the UAS Program Manager and lead FAA Part 107 Pilot in our organization.

A1b. In brief, please describe the main responsibilities of your job:	
*	I am the UAS Program Manager for a collegiate UAS program. I develop and oversee the training for students and professionals
*	I am [Company] COO - responsible for national operations and flight management for our UAS systems.
*	I build, own, and operate 12 electric and gas powered RC aircraft and helicopters, some with FPV or HD recording cameras. I operate these under the FAA rules, and with AMA insurance as provided by my RC flying organization, of which I am the Vice President.
*	I co-coordinate the drone certificate and degree program at [Name] College. I teach students how to operate drones and process drone data for mapping and surveying applications.
*	I handle sensor integration as well as airframe design. Over the development of the platform I train and educate or internal personnel.
*	I lead the unmanned systems division within a large industrial services company. I oversee operations, sales, and the backend business in general.
*	I manage DOD programs and several are either UAS or C-UAS customers.
*	i manage FPL's drone organization that is responsible for the safety, training and integration of UAS into the company and also all FAA waivers and authorizations as well.
*	I manage our UAS program. I am responsible for developing new uses for drones in our organization and am generally responsible for managing our fleet.
*	I oversee advanced technology Initiatives within the [Company], including oversight and management of the [Company] and oversight of the [Company] participation in the FAA BEYOND program (the [Company] is the only tribal lead participant in the BEYOND program).
*	I provide private training for customers of small, medium, and large businesses to adopt drones, learn the Part 107 test, and develop workflows for UAS mapping, GIS analysis, data collection, and inspection.
*	I run the drone studies program at [Name] Junior College, including course development and delivery.
*	I teach young research students how to become FAA Part 107 certified and how to operate UAVs.
*	I train unmanned aircraft system pilots in Part 107 rules and regulations in order to get them ready for the written qualification test.
*	I work as a City emergency manager as well as a communications specialist.

A1b. In brief, please describe the main responsibilities of your job:	
*	I’m the Vice President of our company. I operate drones, operate payloads, maintain, and manage drones for inspection purposes. Above and below 55 lbs. I used to fly for government contracts overseas in the SUAS, and MEUAS fields
*	I'm a Land Surveyor and on some jobs we use a drone to capture imagery above the site. Sometimes we build an orthomosaic from the drone photos and sometimes we build a 3D model with the drone photos using Structure from Motion software to get X, Y and Z data of features on the site.
*	IN FIELD PIOT RESPOSIBLE FOR MULTISPECTRAL INSPECTION OF AGGRIGULTURE
*	Instruct
*	Instruct military/civilian personnel on the use of UAVs
*	Instructing UAS systems for military
*	Instructor & Evaluator. When new pilots join the team, I will assist in ground training, application training, drills, and on-the-job training. Once they have met the minimum requirements, I conduct checkrides which are oral and practical, as well as conducting annual line and competency checks.
*	Instructor MQ-9 Launch & Recovery Pilot, Instructor MQ-9 Mission Control Element Pilot, USAF
*	Instructor sensor operator operating and teaching camera manipulation, synthetic aperture radar use, and other equipment usage
*	Investigate felony level crimes UAS Program coordinator/lead UAS pilot
*	IT director for a construction company
*	Launch and recovery instructor for sensor operators. In an FTU school house
*	Lead a 4 man operations of a Group 3 UAS
*	Lead electrical and firmware engineer for avionics, chief UAS pilot, CEO.
*	Maintain automation for building and lighting energy consumption. Maintain HVAC equipment controls and I use the drone to do visual assessments on buildings faster and more economical for building sustainability
*	Maintain Clients Fly and Maintain Aircraft Compliance
*	manage a team of pilots worldwide with the largest number in the USA.

A1b. In brief, please describe the main responsibilities of your job:	
*	Manage global Company Unmanned Aerial System program consisting of over 100 drones of various types and more than 100 drone operators operating in four countries focused on supporting mining activities.
*	Manage group of pilots charged with selling, supporting sUAS.
*	Manage team of UAS pilots performing public safety and commercial UAS flights.
*	Manage the curriculum and resources for [Name] University's UAS, aviation maintenance, and aviation administration programs.
*	Managing Member/Chief Pilot of an Agricultural Aerial application Company
*	My company works with private corporations and government entities looking to establish drone programs. We write the SOP's, safety procedures, train the trainer programs, risk mitigation strategies, assist in identifying platforms that satisfy their use-cases and finally manage/oversee the programs (fleet, pilots, software, etc.).
*	Oil and Gas Training, including drone training.
*	Operate a commercial delivery drone
*	Operate an MQ-9 Reaper as pilot-in-command; conduct intelligence collection (ISR) and precision strike as required in pursuit of US interests and Joint Forces Air Component Commander objectives
*	Operate drones
*	Operate the gimbal and sensor on the aircraft. Assist pilot with checklists and scanning GCS instruments and warnings. Assist pilot in scanning for traffic during critical phases of flight. Fly the aircraft and operate the sensor payload when using aircraft that do not require a 2 person crew.
*	Operate UAS drone
*	Oversee the management of our UAS program
*	Owner of aerial imagery company using Mavik 2 and 3 drones
*	owner operator of commercial drone business oversee day to day operations and pilots I also am licensed and can do pilot work
*	owner/Executive: President, Flight Operations
*	P107 certified pilot for company Service jobs. VO for company Service jobs. Sales director for USA retail business. Sourcing and Supply chain manager. Office Administrator.
*	Part 107 pilot, cinematographer and photographer.

A1b. In brief, please describe the main responsibilities of your job:	
*	Part 141 Assistant Chief Flight Instructor, airplane
*	Pilot
*	Pilot drone for forest data collection. Chief pilot responsible for compliance with national airspace.
*	Pilot drone for land survey
*	Piloting RC helicopters, quadcopters, hexacopters, and fixed wing aircraft and full size fixed wing aircraft for aerial photography, videography and 3D modeling.
*	Plan and operate drone operations
*	plan, coordinate and supervise the completion of drone flight operations.
*	Police Supervisor over traffic Team. Team employs sUAS platforms for crash/crime scene documentation.
*	Primary Part 107 Certified pilot and trainer.
*	Professor and Director of Research Laboratory (teaching, research, and service)
*	Professor, Information Systems and Aviation Studies Department [Name] Community College
*	Provide leadership to a collegiate aviation program.
*	Provide Search and Rescue services to [County]
*	Provide UAS instruction relating to UAS Operations. Serve as the university UAS Operations program coordinator.
*	Provide uas training to disabled veterans for commercial operations and adaptive recreational therapy utilizing drones
*	Provide water rescue service to the town of [County]
*	Providing contract training and consulting to major UAS company.
*	Public Safety Agency UAS Representative
*	Rated aviator, RQ-7 Shadow operator. Engineer for design of survivability requirements for Army FUAS systems.
*	Regulatory compliance
*	Remote PIC of sUAS aircraft for residential survey work
*	Remote Sensing Lead at [Company], LLC and Manager, University of [Name] Drone Lab

A1b. In brief, please describe the main responsibilities of your job:	
*	Research scientist/professor
*	Research UAS applications, build and flight test instrumented UA, instruct students
*	Responsible for developing targeted strategies to promote [Company] and all its divisions including Charter, Production, Electronic News Gathering (ENG), Air Medical, Aircraft Management, and Technology Solutions for Law Enforcement Agencies.
*	Sales Manager/COO I take aerial photos for construction projects for both estimating and marketing.
*	Sensor Operator Evaluator and Instructor for MQ-9A. Performs, evaluates and instructs MQ-9A launch and recovery operations worldwide. Performs, evaluates and instructs mission support element IMINT, SIGINT and ELINT devices onboard MQ-9A.
*	Standardization Instructor Operator
*	SUAS instructor
*	sUAS Operations and maintenance Instructor/ Large UAS maintenance instructor
*	Submit Waivers and ATC Authorizations under FAR Part 107. Support staff with reviewing airspace and interpreting FARs. Review all incident and accident reports and council pilots as needed. Assist with staff hiring, write articles for the company email newsletter, and provide online training to pilots.
*	Supervise our UAV program and am a part 107 licensed pilot.
*	[Name] training specialist
*	Takeoff and landing copilot, checklist reading, data monitoring, camera manipulation. During flight- aircraft monitoring, communications and camera manipulation.
*	Teaching computer programming, manufacturing, and system integration
*	Technical Director Archaeology and Drone Pilot for research
*	The main responsibilities of my job are to oversee production of a local community access station and the department that runs the drone division.
*	The Owner and operator.
*	To test new configurations of a VTOL aircraft, and maintain proficiency in the event a contract requires deployment.
*	To train and educate potential drone pilots in the safe operation of sUAS.
*	Training public safety on drone use, regulation, and policy. Also curriculum development
*	UAS Coordinator and Remote Pilot

A1b. In brief, please describe the main responsibilities of your job:	
*	UAS Detail Coordinator for the [Company] State Police
*	UAS operations over agricultural land. We are a team of 15 operators.
*	UAS safety standards instructor and flight trainer for potential Part 107 pilots and Part 107 pilots.
*	UAS Standardization Pilot
*	UAV pilot / aerial videographer, photographer
*	UAV remote pilot in command for LLC. Research assistant professor.
*	We are a marketing firm that also specializes in content generation where we use drones to aide in the visuals for people to identify with local business.
*	Work with public safety agencies to start and expand UAS programs. COA writing, trainer, pilot.
*	[Company] is a drone delivery platform.

Table B3

Responses Provided by Respondents Who indicated 'Works with drones, but none of the above' on Item A3, and Who Provided the Capacity in Which Their Organization Worked With Drones on Item A4 (n = 38)

A3. The organization that I work for is, or plans to be, a: *[mark all that apply]* (required) *Works with drones, but none of the above (please describe)*	
A4. In what capacity does your organization work with drones?	
*	Animal and environment surveying
*	capture college event images
*	Crime scene reconstruction, search and rescue
*	Develops the standards for drones and pilots to be evaluated in the us and abroad.
*	Drone service operator, but not for monetary compensation.
*	Emergency services
*	Federal Emergency Responses
*	Full spectrum of operations including public safety, agriculture operations, GIS, research and development, and marketing/communications.

A3. The organization that I work for is, or plans to be, a: *[mark all that apply]* (required) *Works with drones, but none of the above (please describe)*	
A4. In what capacity does your organization work with drones?	
*	Gathering updated aerial imagery and asset inspection.
*	In support of Military Operations
*	Land surveys
*	Law Enforcement/First Responder
*	less than 55 LBS
*	Local government use for public safety (not for-profit)
*	Military
*	national defense and security
*	Owner/Operator as a hobby.
*	Photo/Video/Agriculture and Natural Resources
*	Police drone operator.
*	Public Safety
*	Public Safety Agency
*	Public Safety Agency using Drones for law enforcement purposes
*	Research
*	search and recon
*	Supplies worldwide ready MQ-9A aircrew for DOD.
*	Supporting UAS Government Programs including the FAA.
*	survey jobsites, create 3d models from drone pictures
*	Use the camera and maneuverability to assess rooftops and maintenance
*	Uses drones as tools for scientific research
*	We are a public safety/law enforcement entity. We use drones for in-progress emergencies, planned large-scale events, and video/photos for evidence and promotional items.
*	We are a state agency that utilizes drones for environmental uses and also for search and rescue and documentation of different work activities.
*	We are an archaeological unit and use drones to look at the landscape

A3. The organization that I work for is, or plans to be, a: *[mark all that apply]* (required) *Works with drones, but none of the above (please describe)*	
A4. In what capacity does your organization work with drones?	
*	We use drone for search and rescue
*	We use drones for aerial footage to enhance our projects/videos for community based pieces.
*	We use drones for life safety missions.
*	We use drones to enhance operational efficiency and safety aspects of various mining operations.
*	We use drones to film.
*	We use them for searches, crime/accident scene photography/videography, and over watch

Table B4

Responses Provided by Respondents Who Indicated 'Other' on Item A5, and Who Described Their Organization's Current or Planned Drone Operations (n = 13)

A5. Please select the industry or sector that best describes the current or planned drone operations of your organization: *[mark all that apply]* (required) *Other (please describe)*	
a. Other industry or sector, please describe:	
*	all public safety
*	Athletics
*	construction
*	Film
*	Imagery for large property management companies and building owners
*	Law enforcement
*	Natural Resources Monitoring
*	Providing adaptive recreational drone therapy for neurological disorders like TBI, and PTSD to name a few.
*	Residential Construction
*	Search and Rescue
*	Space Industry
*	Tribal Government

A5. Please select the industry or sector that best describes the current or planned drone operations of your organization: *[mark all that apply]* (required) *Other (please describe)*	
a. Other industry or sector, please describe:	
*	We fly for fun.

Table B5

Responses Provided by Respondents Who Indicated 'Other' on Item A7, and Who Described the Certificates They Hold (n = 14).

A7. Which of these certificates do you hold? *[mark all that apply]* *Other (please describe)*	
a. Other certificate(s), please describe:	
*	ATP
*	ATP, commercial, single and multi-engine land.
*	CFI
*	CFI, CFII
*	Commercial Cert and CFI.
*	FAA Class II certification to perform MQ-9A senor operator LR and MCE duties.
*	Flight Instructor, Airplane Single Engine, Airplane Multi-Engine, Instrument Airplane
*	Former military officer/pilot
*	My 14 CFR Part 107 certificate expired in SEP 2018 and is not needed in my current position. I am trained, certified DCMA Military UAS Pilot (equivalent).
*	Part 137 Agricultural Operations for UAS Part 61 Student Pilot Certificate
*	Part 61 student pilot certificate
*	PPL, CPL, ATP
*	Technical training…aircrew fundamentals initial qualification training, launch and recovery training
*	[Company] Crew Member- Operator and Maintainer

Table B6

Responses Provided by Respondents Who Indicated 'Other' on Item A8, and Who Described the Certificates Required for Their Job (n = 12)

A8. Which of these certificates are required for your job? *[mark all that apply]* Other (please describe)	
a. Other certificate(s), please describe:	
*	Basic Law Enforcement Academy certificate of completion.
*	Commercial
*	Experience satisfies the requirement for the company. Flown a variety of UAS for 10 years
*	FAA Class II certification.
*	I fly under the FAA rule 49 USC 44809
*	My 14 CFR Part 107 certificate expired in SEP 2018 and is not needed in my current position. I am trained, certified DCMA Military UAS Pilot (equivalent).
*	No certificate required, just training provided by employer.
*	None
*	OSHA 10, OSHA 10 Construction.
*	PPL, CPL
*	SUAS certification
*	[Company] Crew Member- Operator and Maintainer

Table B7

Responses Provided by Respondents Who Indicated 'No, I hold a certificate(s) from another organization' on Item A9, and Who Listed the Certificates They Hold from Another Organization (n = 18)

A9. Do you hold a Trusted Operator certificate from the Association for Unmanned Vehicle Systems International (AUVSI)? *No, I hold a certificate(s) from another organization (please describe).*	
a. What certificate(s) do you hold from another organization? Please describe.	
*	Advanced Safety Levels One and Two Certificates from the Unmanned Safety Institute.
*	advanced sUAS operator, payload operator, [Company] Drones, Inc. National Emergency Services Academy - advanced sUAS course graduate
*	Aerial Applicator [Company]
*	AMA pilot
*	AMA Pilot instructor
*	FAA Part 107
*	FAA UAS
*	I have FAA approval [Number] for aircraft less than 55 lbs. I am AMA Member # [Number]
*	I hold a Safety Certification from Unmanned Systems Institute
*	Military Form 8, MQ-9 Instructor Pilot
*	Multiple UAS platform certifications, Instructor certification, Standardization certification, multiple UAS autopilot certifications, safety certification, laser operation certification, crash investigation certification
*	NCDOT UAS Operator Permit
*	NIST sUAS Standard Test Methods (1) Basic Proficiency; (2) Advanced Proficiency; and (3) Instructor Certificate issued by the Airborne Public Safety Association
*	NIST sUAS Standard Test Methods BPERP and Instructor.
*	PRO Level 3 from Unmanned Safety Institute, OSHA 30, 50+ FEMA certifications, Master UAS Instructor from USI, Certified SAR Drone Pilot with the Civil Air Patrol
*	Qualifications through the military
*	Safety, VLOS, systems and BVLOS certificates from the Unmanned Safety Institute (USI)
*	Unmanned Safety Institute PRO Pilot/Instructor

Section B. Qualification Requirements

Table B8

Responses Provided by Respondents Who Indicated 'Instructor' on Item A1, and Who Listed Their Organization's Requirements to Become an Instructor on Item C6 (n = 39)

C6. What are your organization's requirements to become an instructor?	
*	2-year degree minimum, Community College of the Air Force certification, Instructor upgrade, minimum 25 hours of drone flight.
*	500 hours observed flight time with instructor Part 107. In-house three week training class, must pass with 85 percent or better.
*	500hrs for mission instructor, for launch and recovery IP you must be a mission IP and have an additional 250hrs of launch and recovery time
*	6 months of training
*	75 hours of launch and recovery and knowledgeable.
*	an organization that is authorized to train and certificate, such as the FAA or NIST or similar
*	at least 5 years experience, within the last three years.
*	At least a master's degree or bachelor's with certifications or industry experience.
*	Be current on a UAV and have 25 hours flying that UAV. Must teach all PPTs and flight operations.
*	BS degree, Part 61 Comm Pilot Certificate, Part 107 Remote Pilot Certificate.
*	Certification from myself, Remote Sensing Lead, or ownership team.
*	Due to the relatively inconsistent nature of "UAV flight hours" we do not have a formal flight hours requirement at the moment but 3+ years of demonstrated UAS experience on a resume (and a flight checkout with a chief instructor) are our typical requirements. We tend to prioritize geospatial or engineering experience over pilot proficiency due to the nature of the work as training mostly for GIS, survey + data collection. The drone instructor role and data capture/processing instructor role are usually one and the same.
*	Extensive part 107 knowledge and EP Experience.
*	FAA Part 107, supervised flight demonstration of abilities
*	FAA remote pilot certification
*	Have a 107 and 100 hrs of flight time
*	Hold Part 107 certification.
*	Internally developed training program, including training on advanced operations, policy and flight instruction
*	Long process that extensive knowledge must be demonstrated
*	Manned private pilot, remote pilot certificate, first or second class medical, 6 months on the job experience and 120 hours crew duty hours, FAA line/observation check post 135-certificate
*	Meet the minimum state qualifications for teaching in the discipline and a current holder of the Part 107 certificate.
*	Minimum 6 months experience in operations at the company. Must have P61 pilot certificate. Must complete instructor training.
*	Minimum Part 107 certification with a high level of UAS experience
*	Minimum number of hours and experience

C6. What are your organization's requirements to become an instructor?	
*	Part 107 Certificate Adult Education Experience
*	Part 107 certification Internal safety and operation training
*	Part 107 certification and Part 61 certificate
*	Part 107 Remote Pilot certificate
*	Part 107, 100 flight hours, public safety experience
*	Part 107, 5 years industry experience
*	Part 107, flight review, in-depth FARAIM knowledge
*	Part 61 rating and or extensive UAS experience.
*	Pass our AVIA 235 and 236 courses, Pass a checkride, have a part 107
*	Remote pilot certificate, teaching adult learners certificate, background check, child abuse clearance
*	System knowledge, 150 flight hours on system, total time as operator, flight exam, knowledge test exam, additional required training
*	taken our in house instructor course taught by chief instructor
*	To be qualified as a Remote Pilot Instructor, a person must possess a Remote Pilot Certificate, and AUVSI TOP Level 3 Remote Pilot Instructor certification and complete either our SUAS4000FOI or the Worldwide_Student_TOP_Instructor_Addon course; and be designated by the Chief Pilot.
*	UAS certificate, Part 61 pilot certificate or Ground Instructor certificate.
*	Verifiable prior RPAS instructional experience (military or civilian), Part 61 CFI preferred

Table B9

Responses Provided by Respondents Who Indicated 'Other training' on Item C33, and Who Listed the Minimum Organizational Requirements Necessary for Instructors to Operate Drones (n = 14)

C33. What are the minimum requirements necessary for instructors to operate drones at your organization? *Other training (please describe)*	
a. Other, please describe:	
*	APSA NIST Proctor/Instructor
*	Continuing education training, semi annual examinations
*	Illinois state basic operations firefighter
*	Industry specific training on Safety, Regulatory Guidance, or other as directed by contract.
*	Instructor Training
*	internal RFI training
*	Minimum 50 hours of operational experience for instructor selection training. Minimum 100 hours of operational experience for evaluator selection training and a management course.
*	NIST UAS
*	Sworn Law Enforcement experience.

C33. What are the minimum requirements necessary for instructors to operate drones at your organization? *Other training (please describe)*	
a. Other, please describe:	
*	Teaching training
*	TOP Level 3 Remote Pilot Instructor training and certification at our Worldwide Campus.
*	Train the Trainer course
*	Training involving learning types and ethical testing procedures.
*	We require each of our instructors to have a minimum number of multirotor flight hours. And coaching/teaching experience that we suss out during our application.

Table B10

Responses Provided by Respondents Who Indicated 'Other training or experience' on Item C34, and Who Listed Their Minimum Training or Experience Requirements (n = 19)

C34. What are the minimum requirements necessary for drone pilots at your organization? ***[mark all that apply]*** *Other training or experience (please describe)*	
a. Other training or experience, please describe:	
*	Aircraft specific and operation-specific training
*	At least 50 hours of Part 107 UAS operations time.
*	Basic Law Enforcement Academy Completion Certificate
*	Cinematography & Photography skills
*	Co tracts provide additional requirements as specific to the job location or industry including DoD specific requirements. Some Civil operations require Industry specific compliance or safety training.
*	Different clients may require additional training for each pilot with various platforms or proprietary software.
*	FAA TrUST Certificate for our pilots and technicians. NIST
*	Flight hours and inhouse training for BVLOS operations (where BVLOS operations are approved)
*	LOGGED HR REQUIREMENT FAMILIARARITY WITH PLATFORM
*	Manuel tree audit tasks, driving tasks, radio communications tasks
*	Manufacture training when available.
*	Military form 8
*	New crew members shadow experienced team before becoming full company authorized pilot.
*	Our own operational safety courses classroom, and in the field hands on flight training and evaluation
*	Pesticide, Herbicide, Right of way
*	Previous experience with the autopilot software necessary to operate aircraft
*	Time as an effective police officer.

C34. What are the minimum requirements necessary for drone pilots at your organization? ***[mark all that apply]*** *Other training or experience (please describe)*	
a. Other training or experience, please describe:	
*	We do a comprehensive in house flight training which includes a practical and or oral exam. Also require all students to pass a timed indoor flight course (using Syma's) and after the flight training exams also needs to complete two missions before becoming a RPIC for our agency.
*	We require each of our instructors to have a minimum number of multirotor flight hours. And coaching/teaching experience that we suss out during our application.

Section C. Training

Table B11

Responses Provided by Respondents Who Indicated 'Yes' on Item C5, and Indicated Which Government Agency Provided Review of Their Training Materials (n = 30)

	D2. Are your drone pilot education and training materials currently submitted to, or reviewed by, another government agency (not the FAA)? Yes (please describe)
	a. Please indicate which government agency reviews your training materials:
*	AFSOC
*	Air Force
*	Army Aviation Training and Doctrine
*	California Community College Chancellor's Office, as part of certificate approval.
*	Civil Air patrol
*	Department of Defense
*	Department of Navy
*	Department of the US Air Force
*	Different classes and programs have different potential governing bodies. Out manned flight courses go through a lot of FAA review. Our UAS courses have no governing body other than the accreditation standards at the college level.
*	DoD
*	DOD
*	DOD
*	DOD customers
*	DoD, FAA, DOI, DOJ, CBP, DHS, Kansas Department of Transportation, Florida Emergency Management
*	DOD, US State Department, UN, others depending on contract requirements
*	DOI
*	DOI IAT program and Region Training Coordinator
*	Idaho Division of Career and Technical Education
*	Maryland department of education
*	Military
*	NASA, NOAA, DOE
*	NOAA agency manages drone pilots and reviews/approves our paperwork and missions. Any communications with the FAA are conducted and funneled through NOAAs aircraft operations centers UAS program

*	NOAA, USDA, FAA, DOD, DHS and Cherokee Nation
*	Several, most notably the department of homeland security uses them for training and APSA uses them for credential in. Developed by the department of commerce
*	State of North Carolina
*	U.S. Air Force
*	United States Air Force
*	United States Army government liaison
*	USA, USN, USAF, USMC, DOE, DOI, DOJ
*	USAF

Table B12

Responses Provided by Respondents Who Indicated 'Yes' on Item C3, and Indicated Which Non-Government Agency Provided Review of Their Training Materials (n = 28)

D3. Are your drone pilot education and training materials currently submitted to, or reviewed by, a non- government agency? *Yes (please describe)*	
a. Please indicate which non-government agency reviews your training materials:	
*	AABI
*	Accrediting body
*	All program documents are reviewed as directed under specific contract. This may include State agencies, Educational Institutions, other Industry certifying agencies. Too many to list here.
*	APSA - NIST
*	ARGUS
*	ASA
*	ASTM International
*	AUVSI
*	AUVSI for our TOP Training Provider certification.
*	Aviation Accreditation Board International's (AABI)
*	Clients and Universities as required
*	Clients. Specific and determined per project. Based on complexity, location, airspace and scope of work/deliverables.
*	CTI
*	Customers
*	DCJS
*	Disney, Universal Studios

D3. Are your drone pilot education and training materials currently submitted to, or reviewed by, a non- government agency? *Yes (please describe)*	
a. Please indicate which non-government agency reviews your training materials:	
*	General Atomics
*	Internal as well as some of our training clients are law enforcement and first responders
*	IS-BAO
*	Kansas State University, North Carolina University, Auburn University, Embry-Riddle Aeronautical University, Colorado University, United States Air Force Academy
*	MABAS Illinois
*	Our client flight departments may choose to review our program.
*	Our training materials have been submitted and are disseminated by the National Science Foundation funded National Center for Autonomous Technology (NCAT) and Geospatial Technology Center of Excellence.
*	Program is guided by a Technical Advisory Committee comprised of numerous industry UAS operators
*	The Aviation Modelers Association of America, the AMA.
*	Unmanned Safety Institute
*	Virginia and Maryland Community College system
*	Wounded Eagle UAS

Table B13

Responses Provided by Respondents Who Indicated 'Yes' on Item C7, and Who Listed the Certificates or Authorizations Held by Their Organization (n = 18)

D7. Does your organization hold any certifications or authorizations for training drone pilots and/or operators? *Yes (please describe)*	
a. What kind of certificates or authorizations does your organization hold?	
*	2 year collage Degree
*	Airborne Public Safety Association NIST BPERP Proctors (most instructors).
*	AMA Flight Instructor
*	Auvsi TOP
*	AUVSI TOP Level 3 Remote Pilot Instructor.
*	CCAF and initial qualification training on several group 1 systems
*	Certificate of training
*	Certified to teach military personnel
*	Created BUQ Level II courseware certified by Department of Navy
*	FAA colligent UAS trainers
*	FAA part 61 cfi/i/mei/agi, NIST proctor and one person in organization is an authorized NIST Instructor

D7. Does your organization hold any certifications or authorizations for training drone pilots and/or operators? *Yes (please describe)*	
a. What kind of certificates or authorizations does your organization hold?	
*	Form 8 qualifications.
*	In the process of obtaining our part 135 certificate
*	levels of UAS operators, visual observers, mission briefer, mission coordinator, PIC, mission approval
*	military formal training
*	part 107 and drone center flight authorization
*	teaching adult learners (24 hr course)
*	Unmanned Safety Institute PRO Pilot Level 1 and 2 curriculum.

Table B14

Responses Provided by Respondents Who Indicated 'Other' on Item C28, and Described the Type of Operations Provided for Training (n = 6)

D28a. What type of operations do you provide training for? *[mark all that apply]* *Other (please describe)*	
Other, please describe:	
*	2D and 3D mapping.
*	Aerial Mapping
*	all public safety
*	Disaster Response, Data Gathering
*	Drone training workshops for hands on flight instruction
*	Mapping and surveying

Table B15

Responses Provided by Respondents Who Indicated 'Other' on item C31, and Indicated the Type of Drones They Provide Training on (n = 2)

D31. What types of drones do you provide training on? *Other (please describe)*	
a. Other drone type (please describe):	
*	Multicopter
*	Rear prop

Table B16

Responses Provided by Respondents Who Indicated 'Simulation training' on Item C32, and Indicated the Type of Simulation Training They Provide (n = 17)

D32. What types of training do you offer? *Simulation training (please describe)*	
a. Simulation training (please describe):	
*	Computer simulations.
*	Drone Flight Simulators
*	Flight skill development and also flight software training
*	Laptop and hand controls
*	Mission Planner, Zephyr, DJI Flight Sim
*	Real Flight R/C simulator
*	Real flight Simulator, Drone Racing Simulator, and DJI flight simulator,
*	SimLat simulator training
*	Simulation used on all systems that have one. Mainly used for buttonology
*	Simulations used for initial training and poor weather days
*	Simulators.
*	The students preform take off, mission planning, flight of the UAV and emergency procedures.
*	Use of simulator prior to actual flights for training on controls to operate the SUAS
*	Use Real Flight for entry level training. Use simulator feature in Mission Planner for automated flight training.
*	Utilize Aero-SimRC and included simulator training course to provide initial fixed-wing manual control training.
*	We use simulation training to prepare our students for BVLOS operations. We call this operation Remote Split Operations (RSO), whereas the instructor (RPIC) and VO are local with the aircraft and maintain VLOC at all times; however, we transfer control to our students (persons manipulating the controls), who are not at the local flying site. We group students as a team of two or three. They each have a role in the operation (i.e., remote pilot, visual observer, data exploiter). The training is required by the FAA-issued COA. For this operation, we use either UgCS or Swift GCS software (depending on the aircraft flown) in both simulation and live flight. We also use RealFlight and an internally-developed simulator in our online courses. Our sister campus at Daytona Beach uses Piccolo Command Center (PCC) in simulation and live flight.
*	Zepher

Table B17

Responses Provided by Respondents Who Indicated 'Yes on item C37a, and Described the Training Provided outside Their Organization (n = 11)

D37a. Are there other types of drone/UAS training not listed in the previous question that you have completed outside of your organization's requirements? Yes *(please explain)*	
D37b. Other type of training provided outside of your organization, please describe:	
*	Annual Check ride

D37a. Are there other types of drone/UAS training not listed in the previous question that you have completed outside of your organization's requirements? Yes *(please explain)*	
D37b. Other type of training provided outside of your organization, please describe:	
*	Business Training
*	Cinematic bitrates and smooth drone operation speeds for different cinematic effects.
*	FAA's remote-pilot computer-based training/testing.
*	Flight Training
*	Flight training for ATP license
*	NIST UAS
*	Self study for test
*	Skills class
*	sUAS platforms for personal and entertainment use.
*	UAS Night Flying

Item C38a assessed other training requirements not listed on Item C38 that provided training by your organization or by a 3rd party training provider. Item asked if the respondent's other training was provided by your organization (C38b) or by a 3rd party provider (C38c). Those respondents who indicated 'Yes' were asked to describe (C38b) Table 18 and (C38c).

Table B18

Responses Provided by Respondents Who Indicated 'Yes' on Item C38a, and Described the Additional Training Provided by Their Organization on Item C38b (n = 1)

D38a. Are there other training requirements not listed in the previous question that are provided by your organization or by a 3rd party training provider? *Yes (please describe)*	
b. Other training provided by your organization, please describe:	
*	NIST UAS

Table B19

Responses Provided by Respondents who Indicated 'Yes' on Item C38a, and Described the Training Provided by a 3rd Party on Item C38c (n = 2)

D38a. Are there other training requirements not listed in the previous question that are provided by your organization or by a 3rd party training provider? *Yes (please describe)*	
c. Other training provided by a 3rd party, please describe:	
*	Area Safety Council offers our client training programs for other than drone specific training.
*	CRM Crew Resource Management, provided by a contractor, Crew Training International (CTI)

Table B20

Responses Provided by Respondents Who Indicated 'Other training' on Item C39, and listed Training Required by Their Organization (n = 11)

	D39. What type of training does your organization require? *[mark all that apply]* Other training (please describe)
	a. Other required training, please describe:
*	Agricultural Aerial Applications
*	Industry safety training and client site specific.
*	Instructor Training when required
*	Integration of multi-agency air operations such as Search and Rescue.
*	Manufactures Training, Payload Training, Specialized Sensor Training.
*	My agency covers all of those "training" categories mentioned in the earlier pages through policy documents and many of those training aspects are covered via the remote pilot exam studying. We do not have official training in many of those items but we have policies outlining those aspects and the agency is always available for further consultation if we have any questions. Our pilots are very precautionary and ensure we are compliant with all FAA and agency policies
*	night operations refresher
*	Not required, but it's recommended that the drone pilots attend drone flights accompanied by an experienced pilot for on-location "training".
*	Other Industry Specific training as required by individual contract.
*	Prior military UAS training
*	software, payload specific, hazard identification and risk mitigation strategies

Table B21

Responses Provided by Respondents who Indicated 'Recurrent training' on Item C39, and Listed Frequency of Recurrent Training on Item C54 (n = 68)

	D54. How often is recurrent training required?
*	1 year
*	1 year
*	1 Year
*	12 months
*	12 times a year
*	17 months
*	2
*	2 years
*	2 years
*	2 Years

D54. How often is recurrent training required?	
*	2 Years
*	45 days
*	45 days
*	6 months
*	6 months
*	6mo
*	annual
*	annual
*	Annual
*	annually
*	annually
*	annually
*	Annually
*	Annually
*	Annually
*	Annually
*	Annually
*	Annually or as needed
*	annually or as required due to other events - illness, life event, etc.
*	Annually, or if currency lapses every 90 days
*	anually
*	bi-annual
*	biannual
*	Depends on currency, 60/90/180. 60 consist of a evaluated flight, 90 consist of a written test and a evaluated flight, and 180 consist of an abbreviated qualification course, written test, and an evaluated flight.
*	Every 12 months
*	every 2 years
*	every 2 years
*	Every 2 years
*	Every 2 years
*	Every 2 years
*	Every 2 years
*	Every 24 months.
*	Every 3 months
*	every 3 years
*	every 45 to 60 days
*	Every 6 Months or if new hardware being used

D54. How often is recurrent training required?	
*	every 6-months
*	Every Quarter
*	every two years
*	every year
*	monthly
*	monthly
*	monthly
*	Monthly
*	Monthly or every other month depending on the skill
*	Once a week
*	Once every two years
*	Once per year or more frequent if needed.
*	one flight, at least once every 45 days.
*	Quarterly
*	Quarterly flights for currency and every other year recurrent training
*	semi annual
*	semi annual
*	yearly
*	yearly
*	Yearly
*	Yearly
*	Yearly