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UAS Air Carrier Operations Survey: KSAO 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 regulation, including air taxi services, package delivery, crop dusting, and more. The Code of Federal Regulations for aircraft operations (14 CFR) is restrictive to air carrier applications for UAS. In particular, small UAS (sUAS) regulations (14 CFR § 107) do not explicitly address air carrier operations (14 CFR § 121 and § 135). Knowledge, Skills, Abilities, and Other Characteristics (KSAO) requirements have been researched extensively in traditionally piloted aircraft operations, but recent and continuing developments in UAS applications and UAS automation have resulted in changing roles and responsibilities for crewmembers. The efforts of this survey subject matter experts (SMEs) will help inform current and planned future UAS operations, and support regulators in setting regulations from last-mile to high-altitude-long-endurance operations so that these novel applications of UAS can be integrated safely into the National Airspace System (NAS). Findings will inform future regulations concerning UAS operator KSAOs in air carrier operations. Standardizing UAS operator KSAO requirements will support the safe and efficient integration of UAS into the NAS, and this remains an important initiative for the FAA and industry stakeholders.

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List of Abbreviations

AFOQT	Air Force Officer Qualifying Test
ASVAB	Armed Services Vocational Aptitude Battery
CFR	Code of Federal Regulation
CFR 14	Title 14 (Federal Regulations on Aeronautics and Space)
CRM	Crew Resource Management
FAA	Federal Aviation Administration
JTA	Job Task Analysis
KSAOs	Knowledge, Skills, Abilities and Other Characteristics
NAS	National Airspace System
Part 107	Title 14 CFR Part 107 (Federal Regulation for Commercial sUAS)
Part 121	Title 14 CFR Part 121 (Federal Regulation for Air Carriers)
Part 135	Title 14 CFR Part 135 (Federal Regulation for Commuter Air Operations)
RPA	Remotely Piloted Aircraft
SA	Situation Awareness
SME	Subject Matter Expert
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 regulation, including air taxi services, package delivery, crop dusting, and more. The Code of Federal Regulations for aircraft operations (14 CFR) is restrictive to air carrier applications for UAS. In particular, small UAS (sUAS) regulations (14 CFR § 107) do not explicitly address air carrier operations (14 CFR § 121 and § 135). Knowledge, Skills, Abilities, and Other Characteristics (KSAO) requirements have been researched extensively in traditionally piloted aircraft operations, but recent and continuing developments in UAS applications and UAS automation have resulted in changing roles and responsibilities for crewmembers. The efforts of this survey subject matter experts (SMEs) will help inform current and planned future UAS operations, and support regulators in setting regulations from last-mile to high-altitude-long-endurance operations so that these novel applications of UAS can be integrated safely into the National Airspace System (NAS). Findings will inform future regulations concerning UAS operator KSAOs in air carrier operations. Standardizing UAS operator KSAO requirements will support the safe and efficient integration of UAS into the NAS, and this remains an important initiative for the FAA and industry stakeholders.

Keywords: unmanned aircraft systems, Knowledge, Skills, Abilities, and Other, KSAO requirements, air carrier operations, training, testing, knowledge

Introduction

As the use of Unmanned Aircraft Systems (UAS) continues to expand, the complexity of flight operations is approaching those that are now only performed in onboard-crewed aircraft 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 FAA is working to standardize UAS regulations for air carrier operations. Current air carrier regulations (14 CFR § 121, 14 CFR § 135) were not created with UAS flight operations in mind. UAS operations present a unique set of challenges for regulators that are not addressed adequately by the existing regulatory framework. Knowledge, Skills, Abilities, and Other (KSAO) requirements are effected by control station and operational requirements, which in turn affect training requirements for crew and staff positions. Although the establishment of 14 CFR § 107 provides regulations for commercial small UAS (sUAS) operations, the regulations do not address systems that weigh over 55 pounds, and they do not address the more complex types of operations expected for unmanned air carrier activities.

To begin addressing the expected need to establish new sets of standards regarding the certification and training of crews associated with UAS air carrier-like operations, a research program was initiated. That research program began with the conduct of four separate research literature reviews organized by topic:

- Knowledge, skills, and abilities (KSAs; Torrence et al., 2021).
- Crew and staffing options (Hu et al., 2022).
- Duty time, shiftwork, and fatigue (Durham et al., 2019; Nesthus et al., 2021).

For the second phase of this research program, and partially based on the main findings from the literature reviews, a survey was created to gather information from subject matter experts (SMEs) who were involved in either the manufacture and/or operation of UAS, or were involved in educating personnel for participation in the manufacture and/or operation of UAS. This report is a summary of findings from the survey relevant to KSAOs. Separate reports will summarize other 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 KSAO Issues

The KSAO requirements of UAS have been studied extensively in military operations. Job task analyses (JTAs) concerning UAS operators have identified several knowledge and skill areas that are critical to the operation of UAS (e.g., Mangos et al., 2014; Paullin et al., 2011; Williams et al., 2014). Knowledge of airspace classifications, aeronautical charts, preflight procedures, recovery and landing, and aerodynamics appear to be critical for UAS pilot performance (Adams, 2010). Important UAS pilot skills potentially include flight skill, hand-eye coordination, situation awareness (SA), crew resource management (CRM), mission planning,

task prioritization, and active listening (Adams, 2010). Other non-cognitive and cognitive characteristics identified as important for UAS pilots include dependability, stress tolerance, adaptability, and pattern recognition (Mangos et al., 2014). Currently, research on the KSAOs needed in commercial UAS operations is limited. In particular, several issues emerged following the review of UAS selection and testing requirements including the lack of appropriate performance criteria and methodological issues in the measurement of UAS pilot performance (Carretta & King, 2015; Schnell & Engler, 2014).

Skills vs. Abilities

There is often confusion in the literature over the distinction between skills and abilities, as the difference between the two is not always apparent. In general, skills are proficiencies required to perform a task and are acquired through training and experience (e.g., instrument monitoring, map reading), whereas abilities are innate traits that are enduring and stable over time (e.g., long-term memory, hand-eye coordination). Skills and abilities are highly related, but a main difference between the two is that skills are viewed as more trainable than abilities. To illustrate this point, Pavlas et al. (2009) provide a taxonomy of attributes relevant to UAS training that includes knowledge, skills, and attitudes, but not abilities. While abilities can be improved to some extent through developmental experiences, abilities are considered to have limited potential for improvement.

Another important difference between skills and abilities is that abilities are believed to underlie one's capacity for skill development. Chappelle et al. (2011) state that a minimum level of abilities must be present to gain the level of skill needed to operate successfully as a UAS pilot. For example, individuals with high levels of selective attention and memory may be better suited for developing skills in maintaining SA than individuals who are lower in those abilities. As such, assessing whether an individual possesses the necessary level of ability can help ensure that they are able to acquire critical skills during training (Carretta et al., 2016). Nonetheless, the overlap between skills and abilities leads to potential classification discrepancies within the research literature. For the purposes of this report, we relied primarily on how items were defined within the identified research.

Skill and Ability Testing Requirements

Regardless of whether an item is classified as a skill or an ability, a more important concern is whether the skill or ability can be objectively measured and used as a basis for certifying UAS crewmembers. Tests that measure several of the skills and abilities identified as relevant to UAS pilots/operators have been developed and used for selection/placement purposes; examples include the Air Force Officer Qualifying Test (AFOQT), Armed Services Vocational Aptitude Battery (ASVAB), and Test of Basic Aviation Skills (TBAS). However, while these tests are able to measure one's level of skill or ability, they do not on their own establish or define an acceptable level of proficiency for that skill or ability. Most research

identifies KSAOs that are important and needed upon entry into a job, but does not specify criteria, or minimum levels of proficiency, for those KSAOs. As an exception, all U.S. Army Remotely Piloted Aircraft (RPA) operators must achieve a minimum score on the ASVAB surveillance and communications scale (Carretta et al., 2016). However, whether such a criterion is effective in preventing lapses in safety of operations is unknown. Establishing minimum levels for KSAOs would require further research. This research can consist of a longitudinal study where performance would be tracked across months or even years, or it could consist of a standard setting study in which SMEs are asked about minimum levels of KSAOs required of UAS pilots. For example, (Barron et al., 2016) reviewed three years of performance ratings for UAS pilots and found that certain aptitudes (e.g., perceptual speed) were related to first-year performance ratings, but that none of the aptitude measures predicted performance across the three-year span. However, there were personality traits (i.e., neuroticism and conscientiousness) that were predictive of performance. These findings suggest that tests can be built on assessing these and other KSAOs determined relevant to UAS operations, and that these tests could be validated by longitudinal testing or SME assessment.

Manned Aircraft Experience Requirement

In addition to a sparsity of studies looking at the long-term relationship of KSAOs to job performance (particularly within UAS operations), there is also limited research examining the potential differential effects of various KSAOs on job performance. One example illustrating these effects is the question of whether manned aircraft experience should be required as a part of training for the UAS pilots. As has been pointed out by Williams (2007) and others, some military services have required pilots of their UAS to have experience flying manned aircraft, while other military services view their UAS pilots as operators and do not require manned flight experience. Some research on UAS pilots and operators argues that motor skills for UAS operating should be learned independently of skills for operating onboard personnel aircraft, which suggests that there might be possible negative effects when transferring motor skills from manned to unmanned aircraft environments (Barnes et al., 2000). Others suggest that specific KSAOs might be unique to various types of aircraft and mission operations (Damos, 2011). From the standpoint of manned aircraft training, this might indicate that success in manned aircraft flight performance is not predictive of unmanned flight performance. It also means that some KSAOs that predict success with certain UAS may not necessarily generalize to other unmanned systems. However, both of these claims will require additional empirical investigation.

Method

A survey was constructed to gather information regarding the current state of UAS operations that were considered relevant to air carrier-like activities. Specifically, we wanted to poll a variety of people involved in either commercial UAS activities or instructors focusing on

training personnel for careers in commercial UAS 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, to educators.

Stratification and Sample Selection

Due to surveying UAS air carrier operations that are still new, the strategy employed was to cast a "wide net" of individual experience/knowledge and to probe as many variable viewpoints regarding UAS operations (including UAS air carrier operations) as possible. All respondents were required to meet three eligibility questions 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 operators or plans to operate commercial UAS operation, the organization must employ two or more UAS Pilots/Operators.

Potential respondent names and email addresses were gathered from a variety of sources. The sample consisted of names compiled from publicly available dockets on the Federal Register (which identifies corporations who received blanket waivers from Part 107), the FAA's publicly-available *Part 107 Waivers* website[1] (which identifies individuals who have been granted waivers from Part 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 list. Additionally, respondents were encouraged to forward the survey link to qualified colleagues as a method of snowball sampling. 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.

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

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*

For the purposes of estimation, a statistical power analysis[2] suggested 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.

These included primarily the list of certified remote pilots under FAA Part 107 rules for small commercial UAS and specific company and educational institutions that were known to be involved in commercial UAS activities whose contact information was either available on the internet or through FAA contacts.

Survey Items

Development of the survey questions began by identifying critical areas that needed to be covered by the questions. Besides demographic information, we wanted to cover several factors related to both current and future UAS operations that could be related to air carrier-like activities. These factors include crew and staffing requirements, knowledge, skills, and abilities requirements, duty and shift requirements, and training and certification requirements. Table 2 provides a listing of the sections included in the survey.

[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

The survey was constructed so that not every respondent received the same set of questions. Because the survey was administered electronically, branching points were incorporated to route the respondents to the set of questions appropriate for their particular areas of expertise, meaning the number of respondents per question may vary. Appendix A contains a listing of the questions and graphed responses relevant to the KSAO 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 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], which provides an overview of the study, its voluntary nature and ability to opt-out, informed them about the purposes of the study, and how FAA would use the results. All respondents received the informed consent, and were required 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 each respondent seen 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.

[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).

Results

The survey was active for 90 days, at which recruitment did not reach the 220-respondent target. Final respondent counts are provided in Table 3.

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

A total of 173 respondents met the eligibility requirements for the survey. Of those respondents, 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. Figure 2 provide the number of operators employed by each organization and provides a percentage of organizations with the number of pilots employed per industry sector.

Figure 1

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

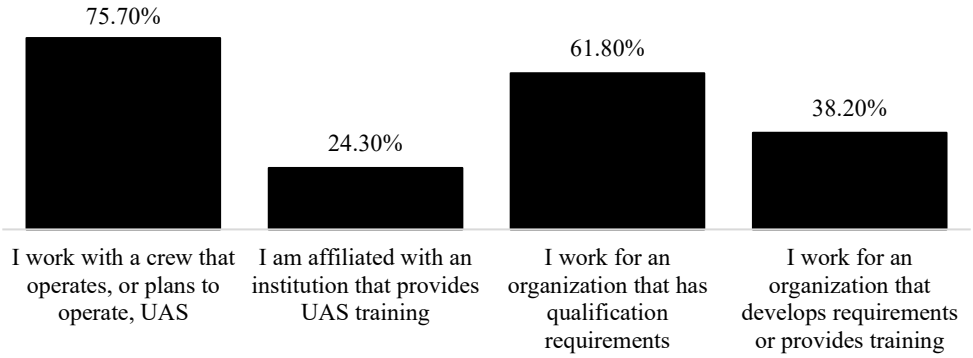
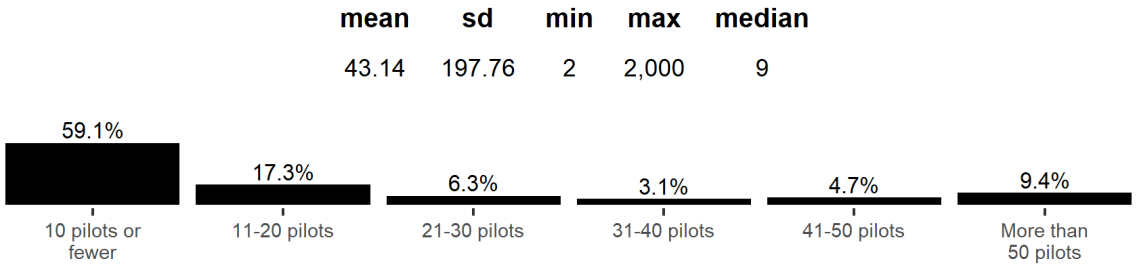


Figure 2

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

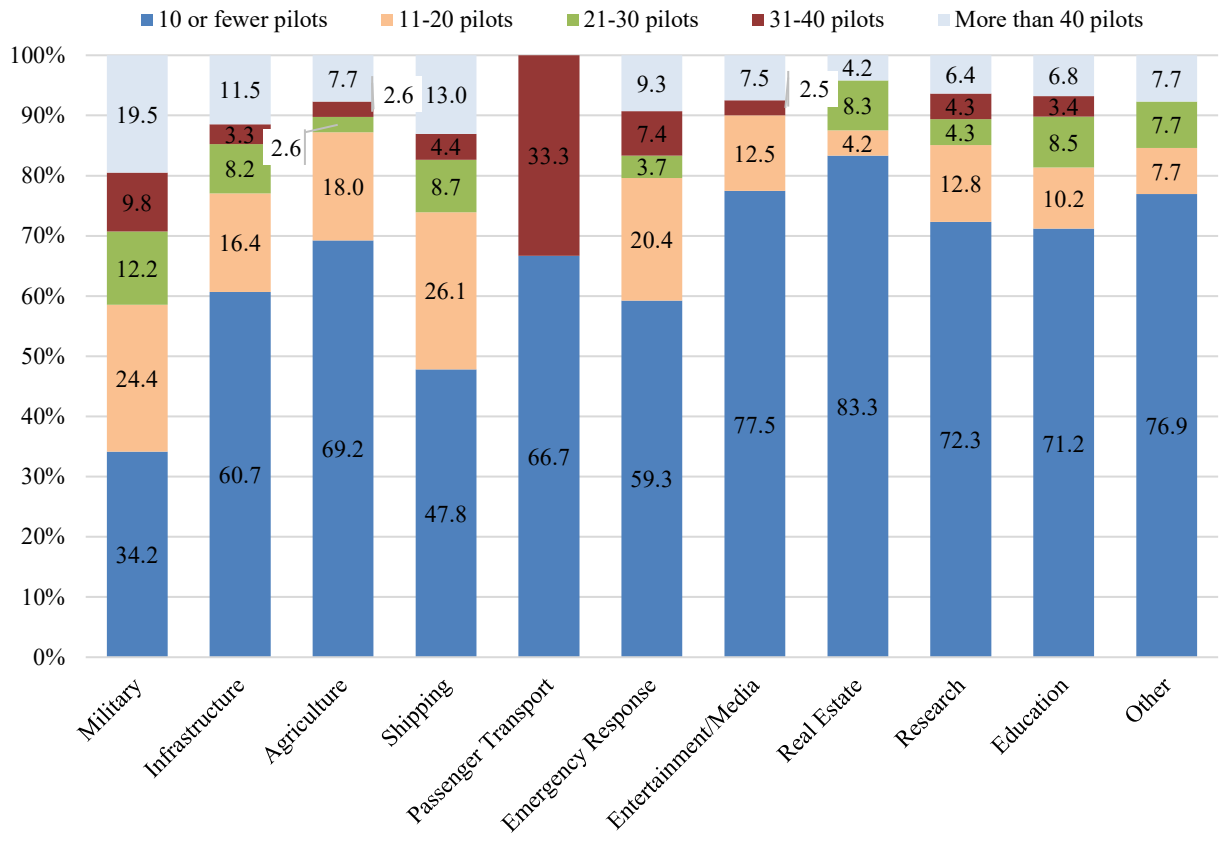


The majority of respondents in the survey worked in organizations with 10 or fewer pilots, a finding that holds true across each industry. The military and shipping industries appear to have the largest percentages of organizations employing more than 40 pilots (see Figure 3). Furthermore, three respondents reported being associated with current or future UAS passenger transport; thus, the response of 33% of the UAS passenger transport sector reporting employing 31 – 40 pilots may be inflated.

[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)



Demographics

Survey respondents reported an average of 7.01 (*SD* = 5.58) years of experience in their current job role (Figure 4). With the majority of survey respondents indicating they work within a drone service organization (Table 4), with services in infrastructure, emergency response, military, and entertainment as top cited sectors (Table 5). The association with a training program was the second most common response (Table 4); within the educational or scientific research sectors (Table 5). Respondents working within an industry sector not listed in the survey options provided a response in text, available in Appendix B (Table B3). Ninety-four percent of respondents currently hold a license or certification to fly a UAS, a list of all respondent certifications are in Table 6. For those who responded they hold other certifications not listed in the survey options, text comments are available in Appendix B Table B5.

Figure 4

Years in Current Job Role (n = 168)

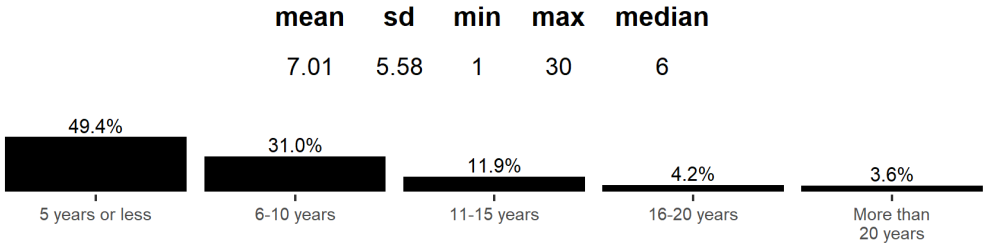


Table 4

Commercial UAS Sector Currently or Planned to Operate Within (n = 168)

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

Note: *May sum to greater than the number of respondents to the item as the response option was a select all that apply, providing an opportunity for respondents to select more than one option. The percentage (%) of respondents is based on the number of respondents to the item.*

Table 5

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

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

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

[5] For responses including 'Other' industries not in the 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]

License or Certification Type	Respondents	
	Count (n*)	Percent (%)
14 CFR Part 107 certificate (e.g., remote pilot certificate)	143	90.5
14 CFR Part 61 certification (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 a select all that apply, providing an opportunity for respondents to select more than one option.*

Identified Knowledge, Skills, Abilities, and Other Characteristics (KSAOs)

Crewmembers[8] responded to a 5-point Likert Scale, identifying important knowledge areas for successful operations. The results indicated the top-five areas of knowledge are: 1) Emergency procedures, 2) FAA regulations, 3) Takeoff/Launch and landing/recovery procedures, 4) Aeronautical decision-making and judgment, and 5) Airspace classification. The list of presented knowledge areas are shown in Table 7, ranked by mean response. Likert scale graphs are presented in Appendix A. Section C: Knowledge, Skills, and Tests (Item C11 – C26).

Managers/Supervisors identified important knowledge areas for UAS Pilots/Operators. Ranking the top-five areas of knowledge by mean response we found: 1) Emergency procedures. 2) Takeoff/launch and landing/recovery procedures, 3) Equipment capabilities and systems, 4) FAA regulations, and 5) Maintenance and preflight inspection. The knowledge areas ranked by

[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) for a list of written responses
[8] Crewmembers refer to respondents who indicated their job role as a UAS Pilot/Operator (<55 & > 55), Cargo/Sensor Operator, Engineer, or Other.

mean response by Manager/Supervisors are presented in Table 8. 5-point Likert graphs are available in Appendix A, Section C: Knowledge, Skills, and Tests (Item C27).

Crewmembers[9] and Managers/Supervisors responded to a 5-point Likert Scale, identifying important skills for UAS Pilots/Operators. The top-five skills by mean response[10] are: 1) situation awareness, 2) judgment and decision-making, 3) risk management, 4) communication, and 5) mission monitoring. The complete list of skills are shown in Table 9, Likert Scale graphs are available in Appendix A. Section C: Knowledge, Skills, and Tests (Item C9).

Similarly, Crewmembers[11] and Managers/Supervisors identified abilities important to successful UAS operations. The top-five abilities ranked by mean response[12] are: 1) attention, 2) vigilance, 3) spatial orientation, 4) reaction time, and 5) sense of direction. The complete list of abilities are shown in Table 10. Likert Scale graphs are available in Appendix A. Section C: Knowledge, Skills, and Tests (Item C10).

[9] UAS Pilot/Operator (<55 & > 55), Cargo/Sensor Operator, Engineer, or Other
[10] Results include combined responses by Crewmember and Managers/Supervisors
[11] UAS Pilot/Operator (<55 & > 55), Cargo/Sensor Operator, Engineer, or Other
[12] Results include combined responses by Crewmember and Managers/Supervisors

Table 7

Knowledge Areas Identified by Crewmembers (n Provided in Table by Topic)

	Likert Scale Score	
Identified Knowledge Area	**Mean**	**SD**
Emergency Procedures (n = 69)	4.54	0.80
FAA Regulations (n = 69)	4.45	0.92
Takeoff/Launch and Landing/Recovery Procedures (n = 68)	4.34	0.96
Aeronautical Decision-Making and Judgment (n = 68)	4.29	0.92
Airspace Classification (n = 69)	4.25	1.09
Weather/Atmospheric Conditions (n = 69)	4.23	0.94
Maintenance and Preflight Inspection (n = 69)	4.23	1.07
Equipment and Software Knowledge (n = 69)	4.16	0.87
Drone Performance (e.g., understanding operational data) (n = 69)	4.04	1.06
Crew Resource Management (CRM) (n = 69)	4.00	1.12
Fatigue (n = 69)	3.80	1.20
Airport Operations (n = 68)	3.79	1.29
Aviation Principles (n = 69)	3.77	1.10
Drone Loading (e.g., weight and balance) (n = 68)	3.74	1.25
Radio Communication Procedures (n = 68)	3.49	1.33
Aerodynamics (n = 69)	3.26	1.22

Note. *Identified Knowledge Areas are ranked by Mean Likert Scale Score.*

Table 8

Knowledge Areas Identified by Managers/Supervisors as Important for UAS Pilots/Operators (n provided by Topic)

	Likert Scale Score	
Identified Knowledge Area	**Mean**	**SD**
Emergency Procedures (n = 41)	4.63	0.70
Takeoff/Launch and Landing/Recovery Procedures (n = 41)	4.61	0.59
Equipment Capabilities and Systems (n = 40)	4.42	0.75
FAA Regulations (n = 41)	4.39	0.83
Maintenance and Preflight Inspection (n = 41)	4.37	0.83
Aeronautical Decision-Making and Judgment (n = 40)	4.25	1.19
Airspace Classification (n = 41)	4.24	0.97
Weather/Atmospheric Conditions (n = 41)	4.05	0.92
Fatigue (n = 40)	4.03	1.03
Drone Performance (e.g., understanding operational data) (n = 41)	4.02	0.91
Crew Resource Management (n = 41)	4.00	1.12
Drone Loading (e.g., weight and balance) (n = 40)	3.67	1.16
Aviation Principles (n = 41)	3.66	1.20
Radio Communication Procedures (n = 41)	3.46	1.40
Aerodynamics (n = 41)	3.37	1.20
Airport Operations (n = 41)	3.32	1.29

Note. *Identified Knowledge Areas are ranked by Mean Likert Scale Score.*

Table 9

Identified Skills for UAS Pilots/Operators (n provided by topic)

	Likert Scale Score	
Identified Skills	**Mean**	**SD**
Situational Awareness (n = 116)	4.73	0.62
Judgment and Decision-Making (n = 117)	4.71	0.62
Risk Assessment (n = 117)	4.60	0.71
Communication (n = 116)	4.44	0.87
Mission Monitoring (n = 116)	4.36	0.89
Problem-Solving (n = 117)	4.29	0.86
Takeoff and Landing (n = 116)	4.28	1.05
Teamwork (n = 116)	4.27	0.94
Flight Skills (n = 118)	4.25	1.04
Weather Identification (n = 117)	4.16	0.96
Stress Management (n = 118)	4.09	0.99
Planning (n = 117)	4.09	0.98
Instrument Monitoring (n = 117)	4.08	1.03
Navigation (n = 118)	4.06	0.97
Multitasking and Time-Sharing (n = 117)	4.03	1.03
Altitude and Distance Estimation (n = 118)	3.95	1.17
Time Management (n = 118)	3.93	1.02
Map Reading (n = 117)	3.74	1.09
Leadership (n = 117)	3.74	1.04

Note. *Identified Skills are ranked by Mean Likert Scale Score.*

Table 10

Identified Abilities for UAS Pilots/Operators (n provided by topic)

	Likert Scale Score	
Identified Abilities	**Mean**	**SD**
Attention (n = 117)	4.61	0.69
Vigilance (n = 117)	4.42	0.81
Spatial Orientation (n = 117)	4.35	0.87
Reaction Time (n = 117)	4.30	0.94
Sense of Direction (n = 117)	4.21	1.00
Spatial Processing (n = 117)	4.21	0.96
Visualization (n = 116)	4.20	1.00
Visual Tracking (n = 116)	4.17	1.02
Hand-Eye Coordination (n = 117)	4.15	1.01
Deductive Reasoning (n = 116)	4.13	0.94
Verbal Comprehension and Expression (n = 117)	4.12	0.97
Inductive Reasoning (n = 114)	4.03	0.94
Vision (i.e., Near and Far Vision) (n = 117)	4.03	0.96
Stress Tolerance (n = 117)	4.01	1.03
Finger Dexterity (n = 116)	3.97	1.07
Short-Term Memory (n = 117)	3.88	1.02
Mental Rotation (n = 106)	3.85	1.05
Assertiveness (n = 117)	3.80	1.05
Pattern Recognition (n = 116)	3.78	1.03
Long-Term Memory (n = 117)	3.73	1.03
Written Comprehension and Expression (n = 117)	3.50	1.09

Note. *Identified Abilities are ranked by Mean Likert Scale Score.*

Company Specific Hiring Requirements and Testing

According to Manager/Supervisor respondents, 70.7% indicated they have established selection criteria for UAS crewmembers (Figure 5). Conversely, only 37% of crewmembers indicated a required on-boarding testing for their current position (Figure 6). Table 11 shows a list of testing requirements considered by Manager/Supervisors and UAS Crewmembers who

indicated they either had established requirements or indicated a test was required for their current position, open text responses are located in Appendix B, Section C (see Table B10 and Table B11). According to the respondents of this survey, the most commonly cited minimum requirement to attain a job as a UAS crewmember is to hold a remote pilot certification, followed by organizational specific training (Table 12). Similar certification and minimum requirements were reported by instructors associated with a training or educational institute (Table 13).

Crewmembers and Manager/Supervisors were asked how important specific areas of training are to the successful UAS operations; a full list of responses is provided in Appendix A, Section C (see items C11b – C26b). Figure 7 provides rankings by UAS crewmembers of how important airport operation training is to pilots/operators parsed by industry sectors. Figure 8 displays a ranking of the importance of drone loading procedures for pilots/operators that is parsed by industry sector. Manager/Supervisors ranked the importance of radio communication testing for their trainees. Results are shown in Figure 9.

Figure 5

Percentage of Manager/Supervisor Respondents Indicated They Have Established Criteria for Hiring a Crewmember (n = 41)[13]

Figure 6

Percentage of Crewmembers Required to Complete Organization-specific Testing before Being Hired (n = 81)[14]

[13] Results include only respondents who indicated 'Manager or Supervisor' as their job role.
[14] Results exclude respondents who indicated 'Manager/Supervisor' or 'UAS Instructor' as their job role

Table 11

Required On-board Testing Requirements (n = 59)[15]

	Respondents	
On-Board Required Testing	**Count**	**Percent (%)**
Interview	48	81.4
Knowledge Test	47	79.7
Skill Test	46	78.0
Aptitude Test	22	37.3
Medical Screening	18	30.5
Personality Test	14	23.7
Other	8	13.6

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

Table 12

Minimum Requirements Necessary for UAS Crewmembers at Their Current Organization (n = 123)[16]

	Respondents	
Organizational Minimum Requirements for UAS Crewmembers	**Count**	**Percent (%)**
Remote pilot Certificate	111	90.2
Organization-specific training	72	58.5
Site-specific training	36	29.3
Other training or experience	19	15.4
Manufacturer training	15	12.2
Manned pilot certificate	11	8.9
N/A or no experience to say	3	2.4

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

[15] Results only include respondents who indicated their organization as having established hiring requirements

[16] Results exclude UAS Instructors and those who did not indicate their organization has established hiring requirements.

Table 13

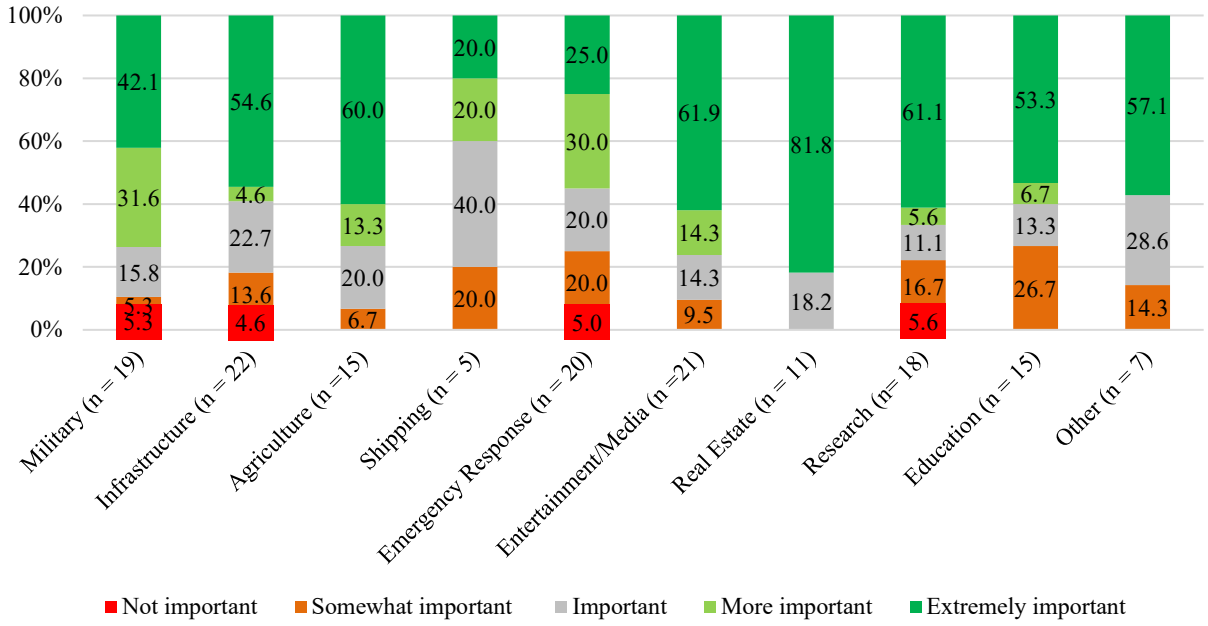
Minimum Requirements Necessary for UAS Instructors (n = 80)[17]

	Respondents	
Organizational Minimum Requirements for Instructors	**Count**	**Percent (%)**
Remote pilot Certificate	69	86.2
Organization-specific training	52	65.0
Site-specific training	28	35.0
Manufacturer training	16	20.0
Other training or experience	15	18.8
Manned pilot certificate	14	17.5
N/A or not experience to say	2	2.5

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

Figure 7

Ratings for Importance of Airport Operations Training for UAS Crewmembers, by Industry Sector (n Provided in Figure by Industry Sector)



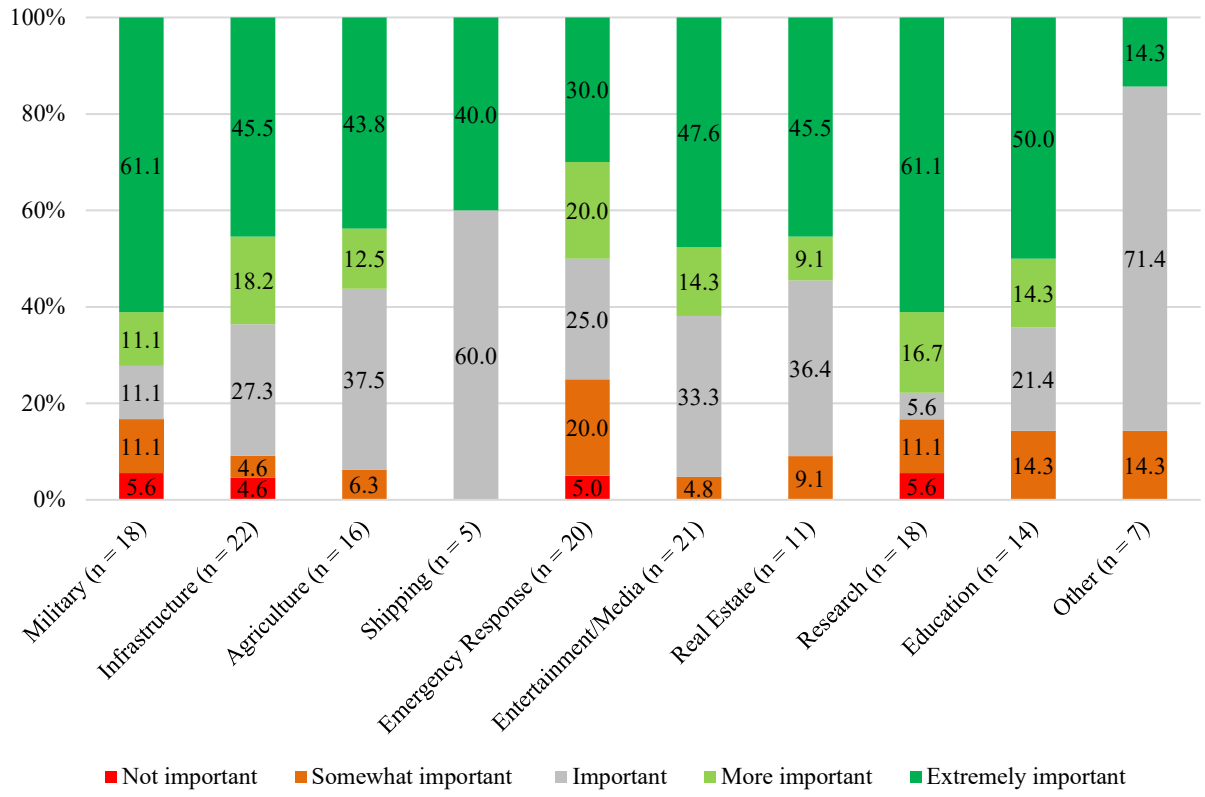
Note. *Respondents included only crewmembers.*

[17] Results include only respondents who indicated their job role was a UAS Instructor OR they are affiliated with a training organization.

Looking at Figure 7, it is interesting to note that the industries with the highest ratings for the importance of airport operations training are not ones that utilize airports for their operations. For example, the real estate industry has the highest importance rating for airport operations training but this industry primarily uses small rotorcraft that operate very close to houses or other buildings. However, these operations do require the pilots to know where airports are located relative to the operation. They also likely use online information to make sure they have the correct permissions to conduct their operations. These requirements probably impress on the operators the importance of knowing about airport activity, thus leading to the higher importance ratings.

Figure 8

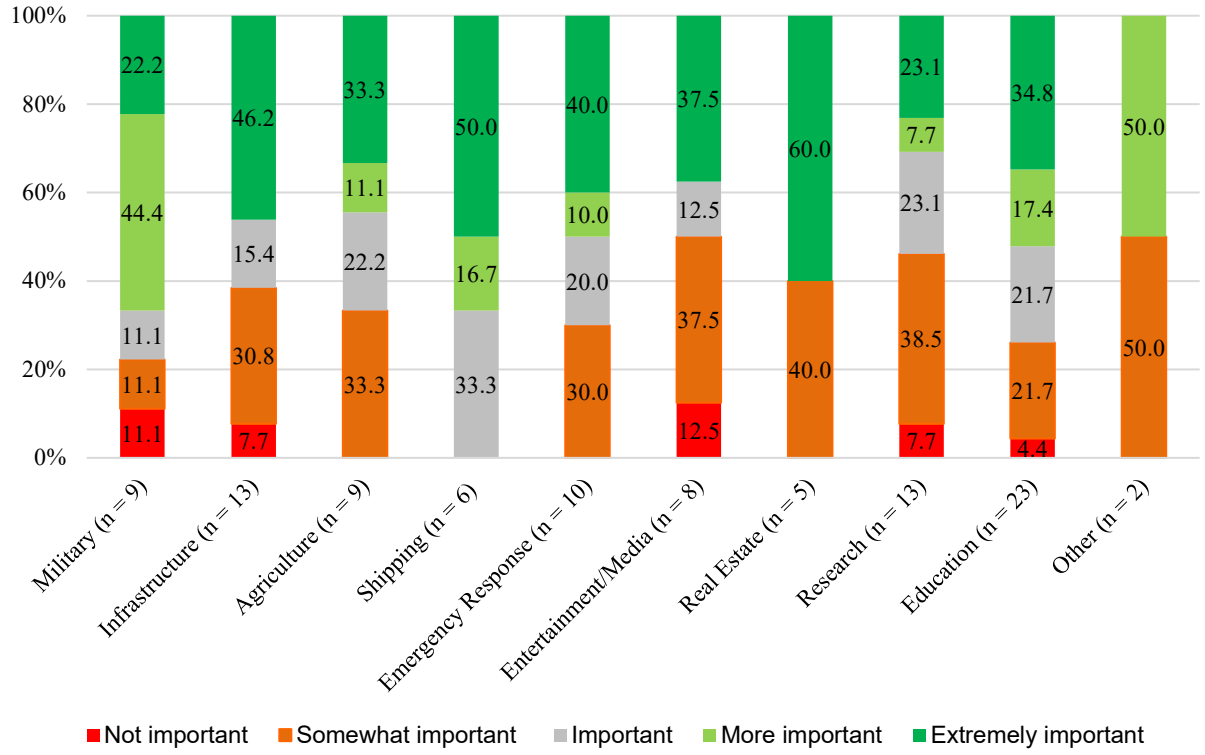
Ratings for Importance of Drone Loading (e.g., Weight and Balance) Training for UAS Crewmembers, by Industry Sector (n Provided in Figure by Industry Sector)



Note. *Respondents included only crewmembers.*

Figure 9

Ratings for Importance of Radio Communication Procedures Training for UAS Crewmembers, by Industry Sector (n Provided in Figure by Industry Sector)



Note. *Respondents included only managers/supervisors.*

Discussion

Although one of the primary reasons for conducting this survey was to provide insight into potential requirements for conducting UAS air carrier-like operations, responses showed that the majority of respondents' organizations do not currently or plan to conduct UAS air carrier delivery operations nor UAS air taxi services. This limits the usefulness of the responses in this survey as far as air taxi services are concerned. The majority of UAS pilot responses were from pilots of sUAS operating under Part 107 regulations. These regulations do not currently allow large cargo operations nor air taxi services. However, more importantly, most Part 107 operations are either commercial endeavors that do not need to expand into cargo or air taxi businesses in order to make reasonable profits, or they are civil service types of operations (e.g., search and rescue, police support) that are able to fulfill their roles without the need to consider air carrier requirements.

Despite these limitations, there are still some interesting results from the survey responses in terms of identifying important KSAOs for UAS operations. Largely, the survey results support previous research on the subject. Knowledge of airspace classifications, recovery and landing procedures, and knowledge of aerodynamics are cited as important areas of

knowledge for UAS operations (Adams, 2010; Torrence et al., 2021). The survey results echo these sentiments as rankings by Crewmembers and Managers/Supervisors listed these areas in the top-five most important areas of knowledge as well. Crewmembers and Managers/Supervisors also cited FAA regulation as one of the more important knowledge areas for UAS Pilots/Operators.

The highest ranked area of knowledge by both groups is for emergency procedures. The high level of automation in these systems may have a role in the high ranking of emergency procedures. In highly automated systems, pilots do not require as much focus on normal aircraft procedures and assume more of a monitoring role during the flight. It is only when something unusual occurs that the pilot must take a more active role in the operations. Being prepared for a number of potential off-nominal procedures is of critical importance.

Skills identified through the literature review such as situation awareness, mission planning, and communication are supported from the survey results (Adams, 2010; Torrence et al., 2021), as these skills are ranked in the top-five most important skills by UAS Crewmembers and Manager/Supervisors. Adding to the list of skills are, judgment and decision-making, risk management, and mission monitoring; Situation Awareness is among the most important skill for UAS operations as supported by the results from the current and previous research.

Abilities identified by survey respondents as the most important were attention, vigilance, spatial orientation, and sense of direction. While these abilities are highly useful for monitoring aircraft, they also feed directly into the top ranked skill of situation awareness (Endsley, 1995). Thus by identifying UAS pilots with high attentional and vigilance abilities, we can identify better-trained pilots to develop top-rated skills.

Conclusions

We found a high correspondence between the results in this survey and our initial literature review (Hu et al., 2022). The higher importance of SA, mission planning, and communication skills over skills more directly related to control of the aircraft is probably the result of the high degree of automation available with the large majority of systems being used for these operations. This finding is supported further by the highest ranked area of knowledge being emergency procedures, as noted in the discussion section.

Other highly ranked areas of knowledge, such as FAA regulations and airspace classifications, were expected because of their importance in the conduct of commercial operations. These areas currently are tested under Part 107 for qualifying as a certificated remote pilot for sUAS.

The high ranking for landing and recovery procedures is likely due to the large variety and uniqueness of methods used for landing and recovery of UAS. Flying into a net, catching on a vertical or horizontal wire, stalling onto an empty field, and several other methods are used

currently. While a large portion of these are highly automated, it is critical for the pilot to have an exact understanding of the procedure to detect and react to any anomalous events.

In translating these KSAO's into training and certification criteria, it is critical to understand how automation affects the importance of some areas more than other areas. Automation often reduces the need for direct control of the aircraft by the pilot, thus placing less emphasis on flight skills but more emphasis on attention, vigilance, and other factors related to the ability to track the progress of the flight and respond to anomalous events. It is also important to understand how the operations being flown affect the importance of areas. However, regardless of automation and operation-specific criteria, there are also areas of knowledge, skills, and abilities that are independent of these criteria. Situation awareness, for example, cuts across all types of automation and operations.

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Appendix A.
Survey Questions Related to UAS KSAOs

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.

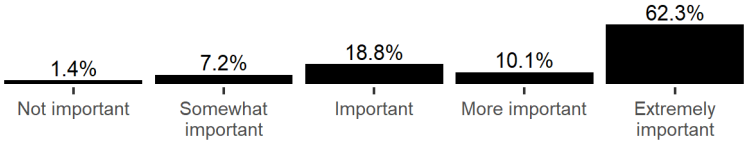
An open invitation to complete the online survey was distributed via email to a sample of potential respondents with UAS industry, training, or crew experience (N=2,524). Of those, 97 invitations were returned undeliverable resulting in 2,427 invitations delivered directly to potential respondents. Invitees 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 knowledge, skills, and tests items of the survey.

Example of Report Format

C11b. How important is airspace classification knowledge for drone pilots/operators to have on the job?

n	mean	sd
69	4.25	1.09



Definitions of Descriptive Statistics

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

Response values: Response options (labels) on response scales are assigned values for use in calculations. For example, values for an item answered on an agreement scale would be assigned 1 through 4 where 'Strongly disagree'=1 and 'Strongly agree'=4. *Not applicable (N/A), Don't know,* and *No experience to say* responses are excluded from calculations and reporting.

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.

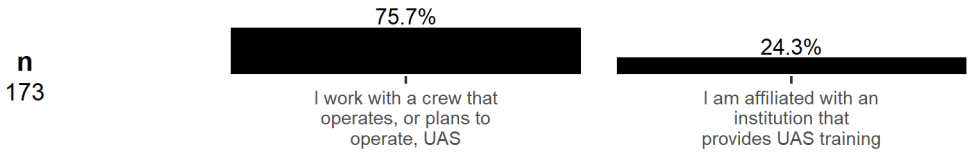
Median (med): The exact middle data point calculated in a set of rank-ordered values. It is less affected by extreme values in comparison to the mean, and thus, is relied upon when extreme values are present in a data set (e.g., total flight hours flown).

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?

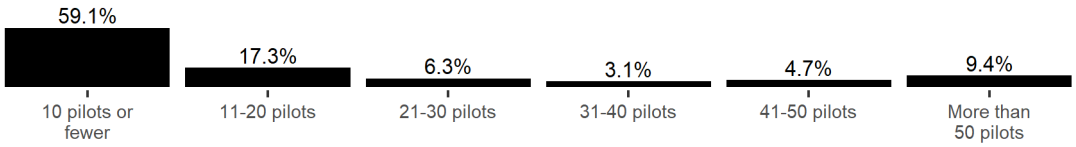


2. Do you work for an organization with established UAS pilot qualification requirements?

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 pilots/operators does your organization currently employ?

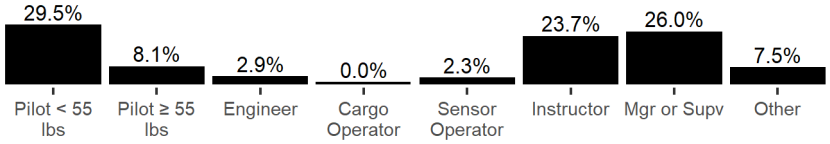
n	mean	sd	min	max	median
127	43.14	197.76	2	2,000	9



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
2022	13

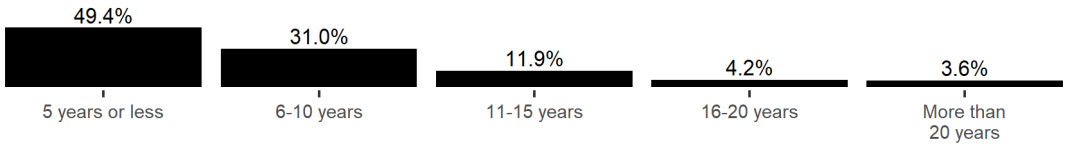
Results for *Item A1b* include only respondents who provided a written response.

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

	n
2022	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

2022 n*		2022 %*
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

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

2022 n*		2022 %*
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

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

2022 n*		2022 %*
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

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 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

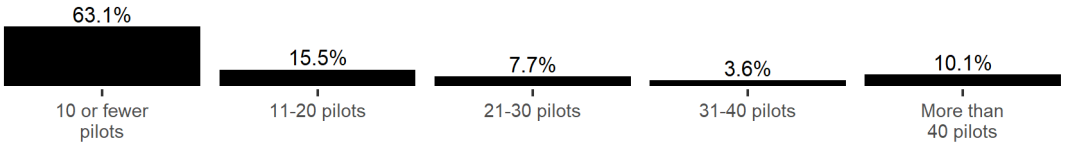
Results for *Item A9a* include only respondents who indicated 'No, I hold a certificate(s) from another organization' on *Item A9* and provided a written response.

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



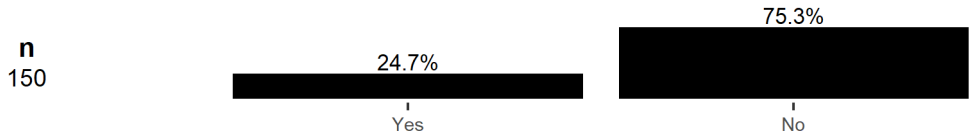
Section B: Air Carrier Operational Considerations for Unmanned Aircraft Systems

B1. What automated functions are available and required on your aircraft?

Takeoff available

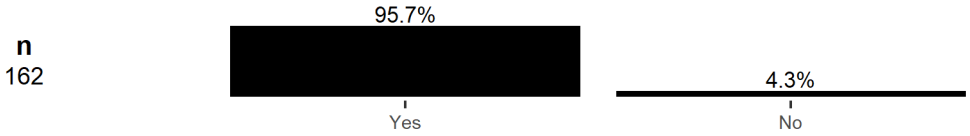
n
160

Takeoff required

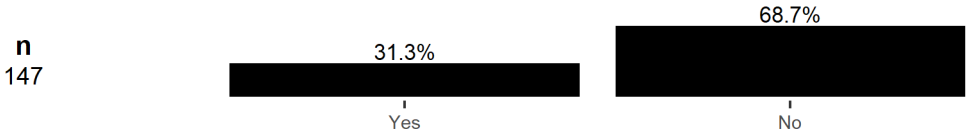


B1. What automated functions are available and required on your aircraft?

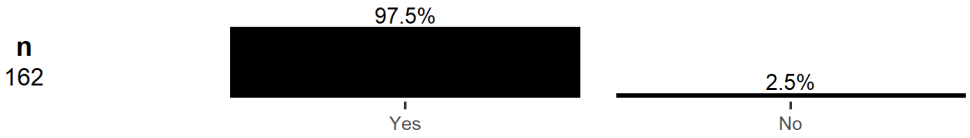
Flight Path (waypoints) available



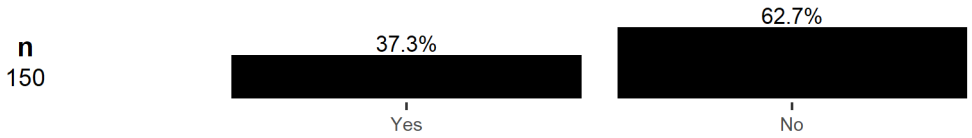
Flight Path (waypoints) required



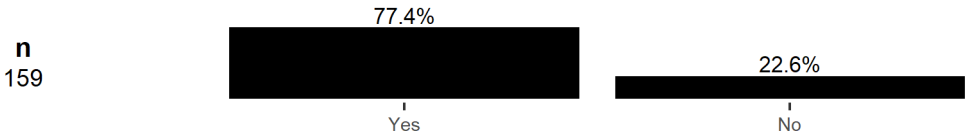
Hover or Holding Pattern available



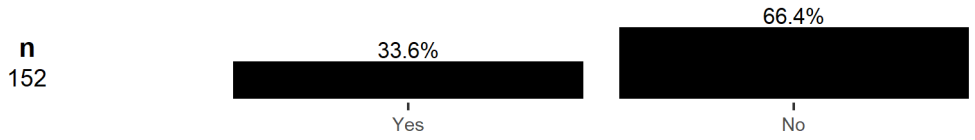
Hover or Holding Pattern required



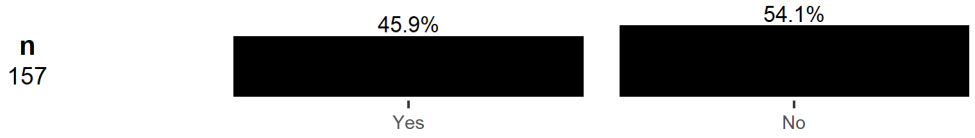
Obstruction Avoidance available



Obstruction Avoidance required

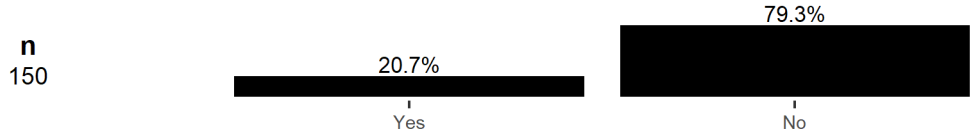


Traffic Collision Avoidance available

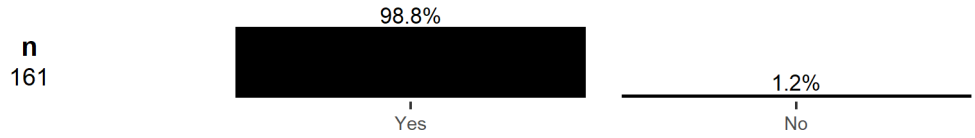


B1. What automated functions are available and required on your aircraft?

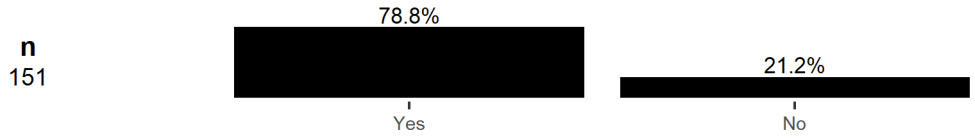
Traffic Collision Avoidance required



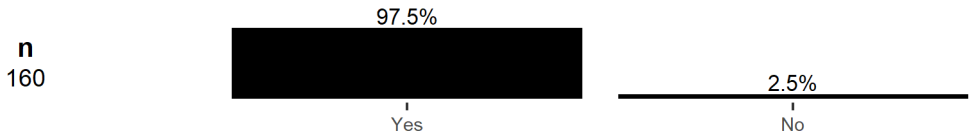
Lost Link Procedure available



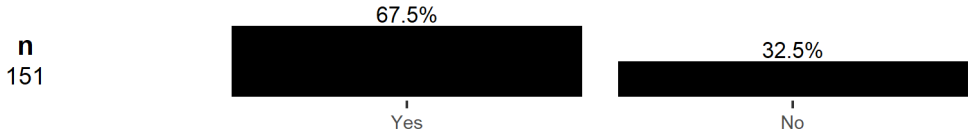
Lost Link Procedure required



Return Home available

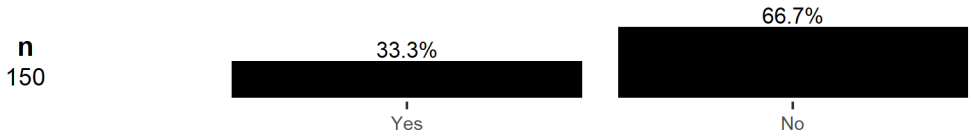


Return Home required

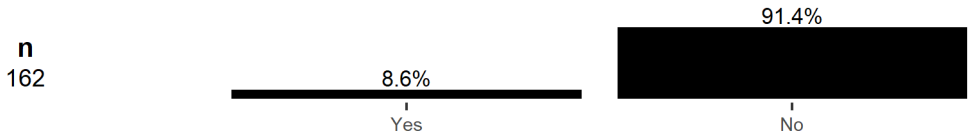


Landing available

Landing required



B2. Are there other functions not listed in the previous question that are available or required for your aircraft?



Results for *Item B2a* through *Item B2b* include only respondents who indicated 'Yes' on *Item B2* and provided a written response.

B2a. Other available automation (please describe): (See Appendix B. section B. Air Carrier Operational Considerations for a list of responses)

n
14

B2b. Other required automation (please describe): (See Appendix B. section B. Air Carrier Operational Considerations for a list of responses)

n
4

Section C: Knowledge, Skills, and Tests

Results for *Item C1* include only respondents who indicated 'Manager or Supervisor' on *Item A1*.

C1. Does your organization have established selection criteria for hiring drone crewmembers?

n
41

Results for *Item C2* include respondents who indicated 'Pilot/Operator with systems less than 55 pounds,' 'Pilot/Operator of systems equal to/greater than 55 pounds,' ' Engineer,' 'Cargo Operator,' 'Sensor Operator,' or 'Other' on *Item A1*.

C2. For your current position, were you required to complete any organization-specific testing before you were hired?

n
81

Results for *Item C3* include respondents who indicated 'Yes' on *Item C1* or 'Yes' on *Item C2*.

C3. If 'Yes', what kind of testing is required? *[mark all that apply]*

n
59

n*		%*
47	Knowledge Test	79.7
48	Interview	81.4
46	Skill Test	78.0
22	Aptitude Test	37.3
14	Personality Test	23.7
18	Medical Screening	30.5
8	Other (please describe)	13.6

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 C3a* include respondents who indicated 'Other' on *Item C3* and provided a written response.

C3a. Other testing required, please describe: (See Appendix B. section C. Knowledge, Skills, and Tests for a list of responses)

n
8

Results for *Item C4* include respondents who indicated 'Pilot/Operator with systems less than 55 pounds,' 'Pilot/Operator of systems equal to/greater than 55 pounds,' 'Engineer,' 'Cargo Operator,' 'Sensor Operator,' 'Manager or Supervisor,' or 'Other' on *Item A1*.

C4. 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 C4a* include only respondents who indicated 'Other' on *Item C4* and provided a written response.

C4a. Other training or experience, please describe: (See Appendix B. section C. Knowledge, Skills, and Tests for a list of responses)

n
19

Results for *Item C5* include only respondents who indicated 'Instructor,' on *Item A1* or 'School or training program' on *Item A3*.

C5. 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 C5a* include only respondents who indicated 'Other' on *Item C5* and provided a written response.

C5a. Other, please describe: (See Appendix B. section C. Knowledge, Skills, and Tests for a list of responses)

n
14

C6. What training topics have you received training on? *[mark all that apply]*

Applicable Federal Aviation Regulations

n
161

n*		%*
149	I have received training for flying drones on this topic	92.5
70	I have received training for flying manned aircraft on this topic	43.5
4	I have not received training on this topic	2.5
4	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).*

C6. What training topics have you received training on? *[mark all that apply]*

Accident reporting requirement of the National Transportation Safety Board

n
159

n*		%*
138	I have received training for flying drones on this topic	86.8
67	I have received training for flying manned aircraft on this topic	42.1
10	I have not received training on this topic	6.3
3	No experience to say	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).*

Use of applicable portions of the Aeronautical Information Manual (AIM) and FAA Advisory Circulars (AC)

n
159

n*		%*
122	I have received training for flying drones on this topic	76.7
69	I have received training for flying manned aircraft on this topic	43.4
20	I have not received training on this topic	12.6
6	No experience to say	3.8

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).*

Use of aeronautical charts for navigation under Visual Flight Rules (VFR) using pilotage, dead reckoning, and navigation systems

n
159

n*		%*
129	I have received training for flying drones on this topic	81.1
69	I have received training for flying manned aircraft on this topic	43.4
12	I have not received training on this topic	7.5
8	No experience to say	5.0

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).*

C6. What training topics have you received training on? *[mark all that apply]*

Radio communication procedures

n
159

n*		%*
123	I have received training for flying drones on this topic	77.4
71	I have received training for flying manned aircraft on this topic	44.7
16	I have not received training on this topic	10.1
4	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).*

Recognition of critical weather situations from the ground and in flight and the procurement and use of aeronautical weather reports and forecasts

n
159

n*		%*
142	I have received training for flying drones on this topic	89.3
70	I have received training for flying manned aircraft on this topic	44.0
7	I have not received training on this topic	4.4
3	No experience to say	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).*

Safe and efficient operation of the aircraft

n
159

n*		%*
146	I have received training for flying drones on this topic	91.8
68	I have received training for flying manned aircraft on this topic	42.8
5	I have not received training on this topic	3.1
3	No experience to say	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).*

C6. What training topics have you received training on? *[mark all that apply]*

Effects of density altitude on aircraft takeoff and climb performance

n
159

n*		%*
131	I have received training for flying drones on this topic	82.4
67	I have received training for flying manned aircraft on this topic	42.1
14	I have not received training on this topic	8.8
4	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

n
157

n*		%*
117	I have received training for flying drones on this topic	74.5
70	I have received training for flying manned aircraft on this topic	44.6
15	I have not received training on this topic	9.6
5	No experience to say	3.2

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).*

Principles of aerodynamics, aircraft engines, and systems

n
158

n*		%*
120	I have received training for flying drones on this topic	75.9
69	I have received training for flying manned aircraft on this topic	43.7
15	I have not received training on this topic	9.5
7	No experience to say	4.4

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).*

C6. What training topics have you received training on? *[mark all that apply]*

Stall awareness and recovery techniques

n
157

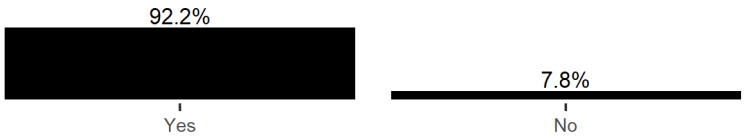
n*		%*
101	I have received training for flying drones on this topic	64.3
68	I have received training for flying manned aircraft on this topic	43.3
23	I have not received training on this topic	14.6
7	No experience to say	4.5

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).*

C7. Does your organization train and test drone pilots in the following specific areas?

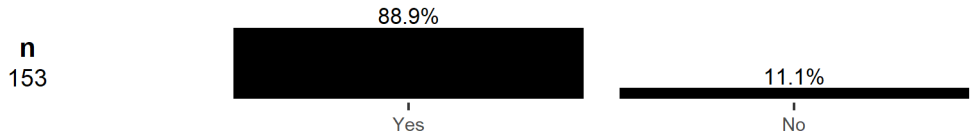
A requirement to remain clear of and give way to manned aircraft at all times

n
153

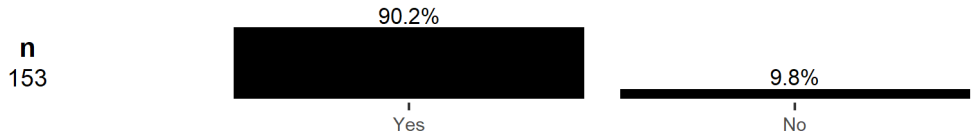


Distance limitations from other aircraft covering takeoff, landing and in-flight phases, obstruction clearance limitations, and airspeed limitations

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

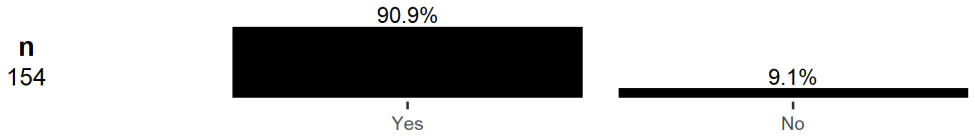


A requirement to plan a route of flight that avoids public use airports and approach and departure corridors, unless prior authorization is obtained, and alternatives if a flight cannot be completed as planned



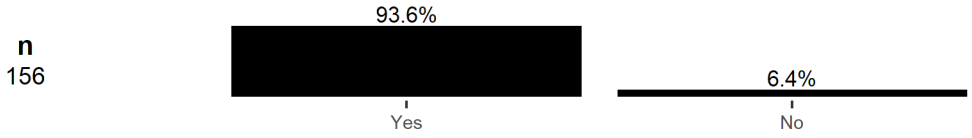
C7. Does your organization train and test drone pilots in the following specific areas?

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

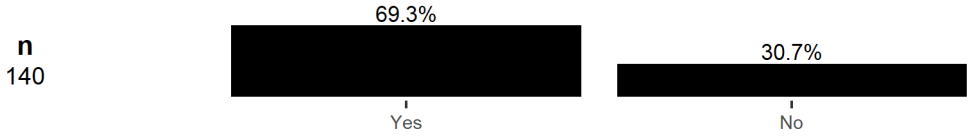


A requirement that any visual observers, be trained by the operator and briefed on the operation by the pilot in command before each flight

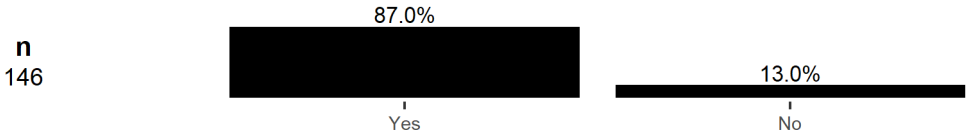
Procedures to cease flight when hazardous conditions arise, or communications or control become degraded, without causing danger to other persons



Standards and procedures covering the carriage of hazardous materials



Security procedures and security risks assessments



Results for *Item C8* 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*.

C8. 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 C8a* include only respondents who indicated 'Other training' on *Item C8* and provided a written response.

C8a. Other required training, please describe: (See Appendix B. section C. Knowledge, Skills, and Tests for a list of responses)

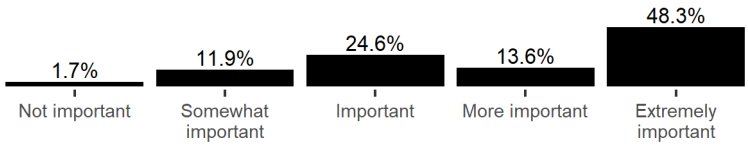
n
11

Results for *Item C9* through *Item C10* include respondents who indicated 'Pilot/Operator with systems less than 55 pounds,' 'Pilot/Operator of systems equal to/greater than 55 pounds,' 'Engineer,' 'Cargo Operator,' 'Sensor Operator,' 'Manager or Supervisor,' or 'Other' on *Item A1*.

C9. How important is this skill for drone pilots/operators to have on the job?

Altitude and distance estimation

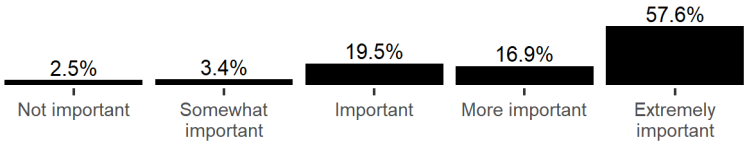
n	mean	sd
118	3.95	1.17



C9. How important is this skill for drone pilots/operators to have on the job?

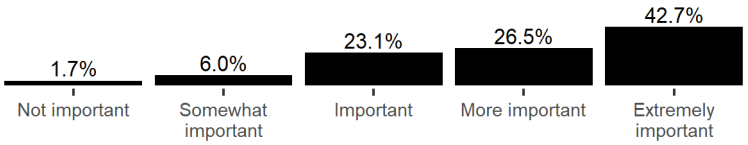
Flight skill (e.g., changing direction, maintaining speed)

n	mean	sd
118	4.24	1.04



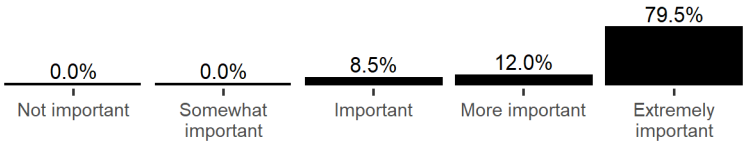
Multitasking and time-sharing

n	mean	sd
117	4.03	1.03



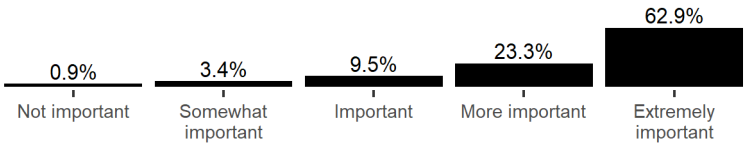
Judgment and decision-making

n	mean	sd
117	4.71	0.62



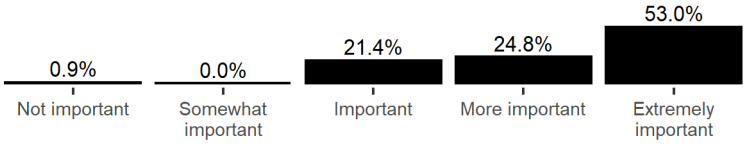
Communication

n	mean	sd
116	4.44	0.87



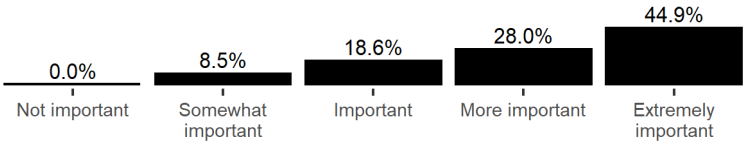
Problem-solving

n	mean	sd
117	4.29	0.86



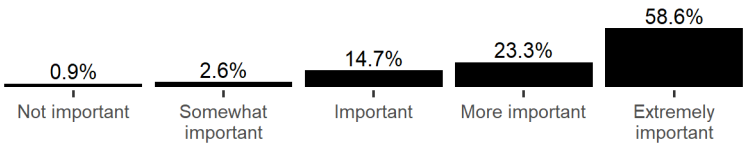
Stress management

n	mean	sd
118	4.09	0.99



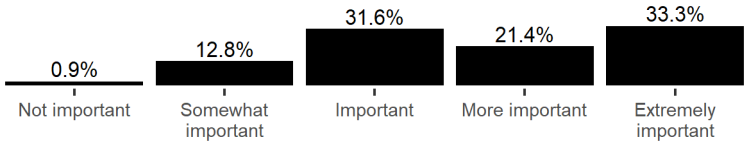
Mission monitoring

n	mean	sd
116	4.36	0.89



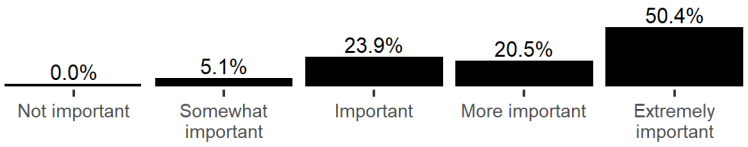
Map reading

n	mean	sd
117	3.74	1.09



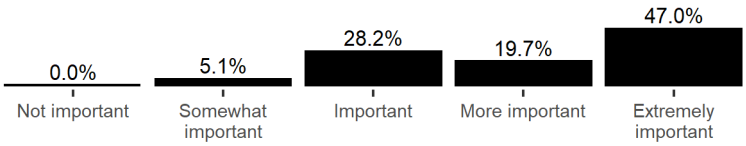
Weather identification

n	mean	sd
117	4.16	0.96



Planning

n	mean	sd
117	4.09	0.98

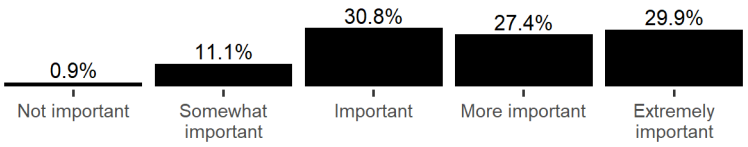


Teamwork

n	mean	sd
116	4.27	0.94

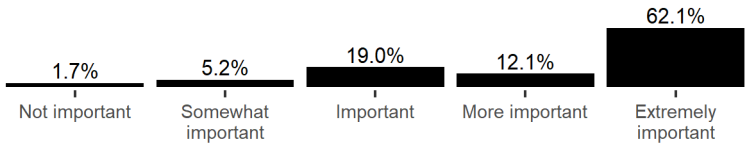
Leadership

n	mean	sd
117	3.74	1.04



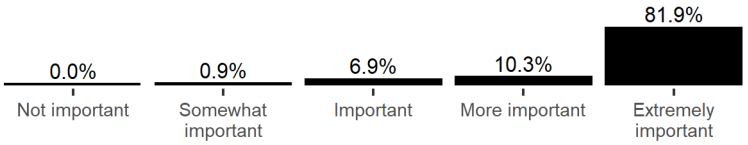
Takeoff and landing

n	mean	sd
116	4.28	1.05



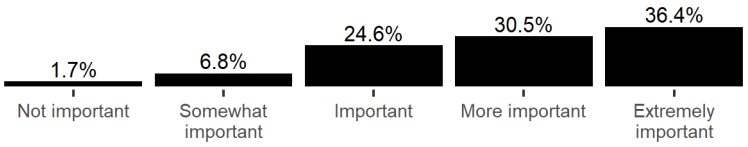
Situation awareness

n	mean	sd
116	4.73	0.62



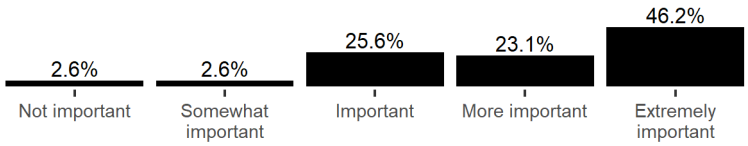
Time management

n	mean	sd
118	3.93	1.02



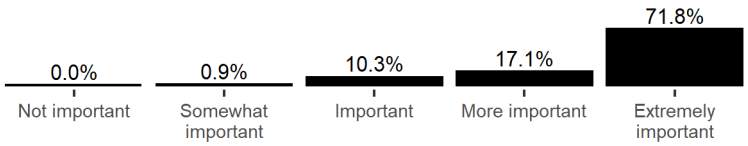
Instrument monitoring

n	mean	sd
117	4.08	1.03



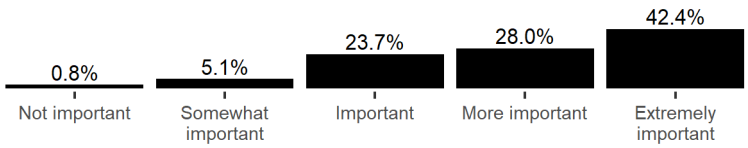
Risk assessment

n	mean	sd
117	4.60	0.71



Navigation

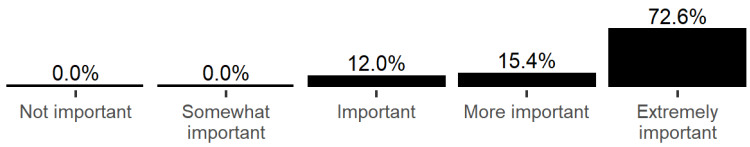
n	mean	sd
118	4.06	0.97



C10. How important is this ability for drone pilots/operators to have on the job?

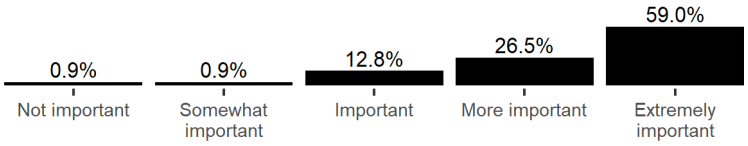
Attention (visual/auditory)

n	mean	sd
117	4.61	0.69



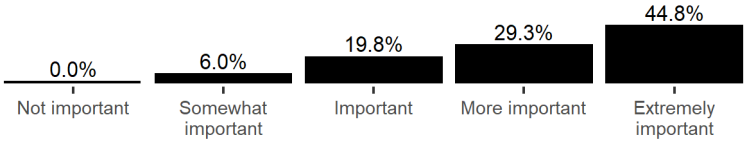
Vigilance

n	mean	sd
117	4.42	0.81



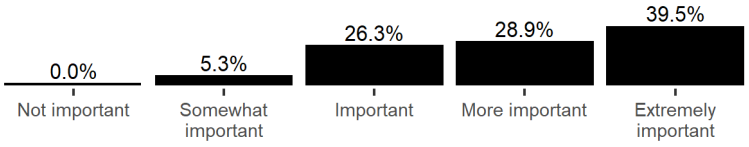
Deductive reasoning

n	mean	sd
116	4.13	0.94



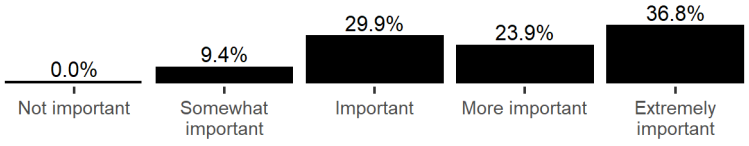
Inductive reasoning

n	mean	sd
114	4.03	0.94



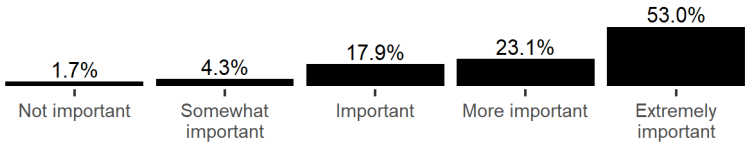
Short-term memory

n	mean	sd
117	3.88	1.02



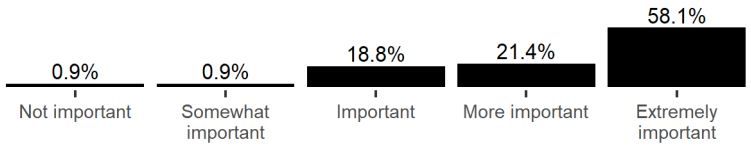
Sense of direction

n	mean	sd
117	4.21	1.00



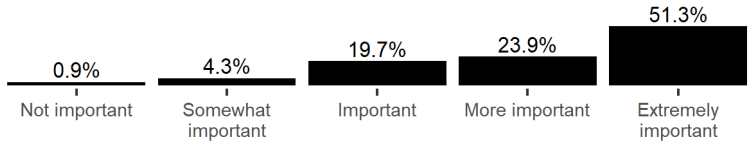
Spatial orientation

n	mean	sd
117	4.35	0.87



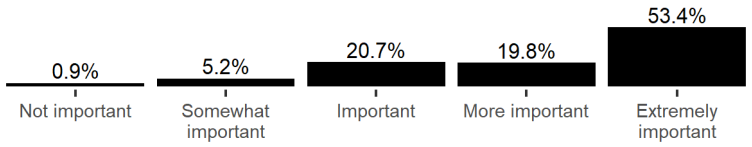
Spatial processing

n	mean	sd
117	4.21	0.96



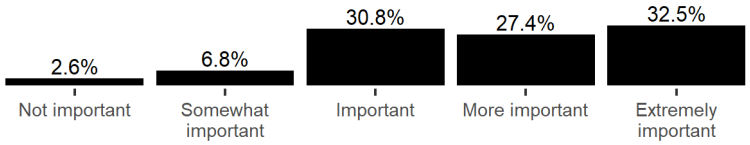
Visualization

n	mean	sd
116	4.20	1.00



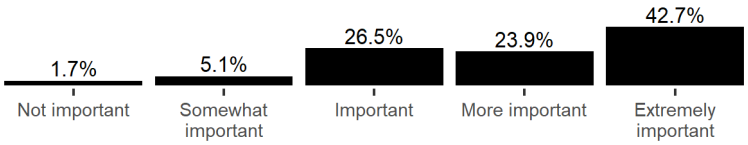
Assertiveness

n	mean	sd
117	3.80	1.05



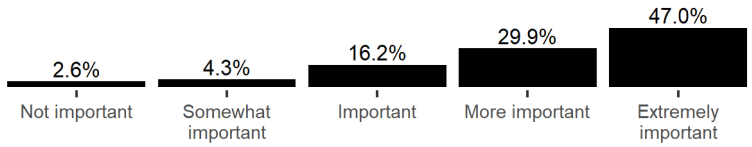
Stress tolerance

n	mean	sd
117	4.01	1.03



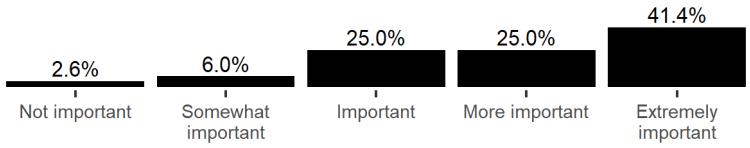
Hand-eye coordination

n	mean	sd
117	4.15	1.01



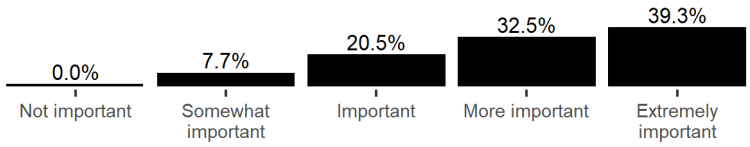
Finger dexterity

n	mean	sd
116	3.97	1.07



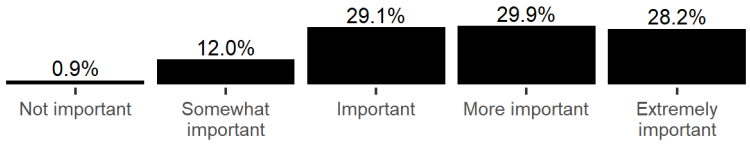
Vision (i.e., near and far vision)

n	mean	sd
117	4.03	0.96



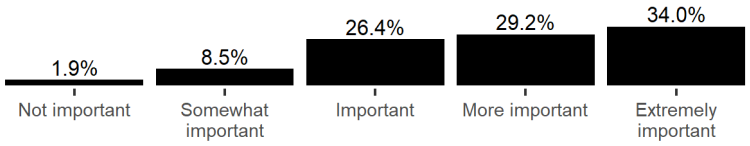
Long-term memory

n	mean	sd
117	3.73	1.03



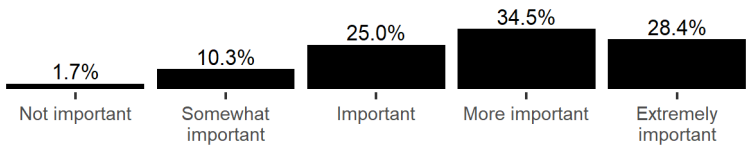
Mental rotation

n	mean	sd
106	3.85	1.05



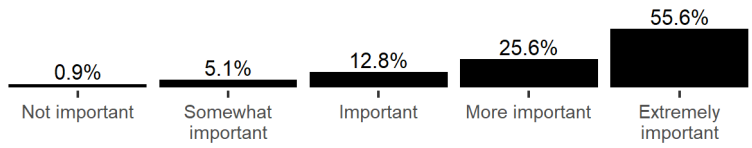
Pattern recognition

n	mean	sd
116	3.78	1.03



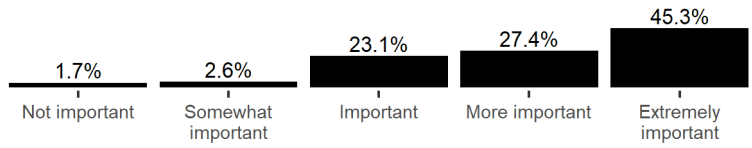
Reaction time

n	mean	sd
117	4.30	0.94



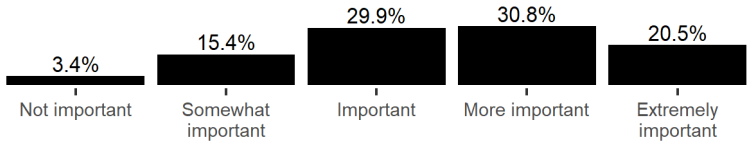
Verbal comprehension and expression

n	mean	sd
117	4.12	0.97



Written comprehension and expression

n	mean	sd
117	3.50	1.09



Visual tracking

n	mean	sd
116	4.17	1.02

Results for *Item C11a* through *Item C26b* include respondents who indicated 'Pilot/Operator with systems less than 55 pounds,' 'Pilot/Operator of systems equal to/greater than 55 pounds,' 'Engineer,' 'Cargo Operator,' 'Sensor Operator,' or 'Other' on *Item A1*.

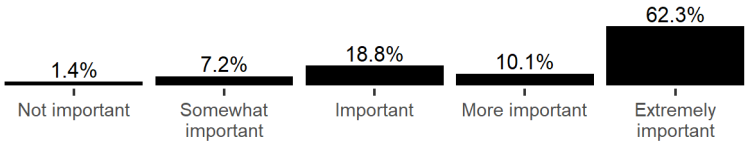
Respondents were asked to review a set of knowledge items relevant to drone pilots/operators, and indicate if they had received training on the knowledge area, and then identify how important each knowledge area is to the job of drone pilots/operators.

C11a. Have you received training on airspace classification?

n
74

C11b. How important is airspace classification knowledge for drone pilots/operators to have on the job?

n	mean	sd
69	4.25	1.09

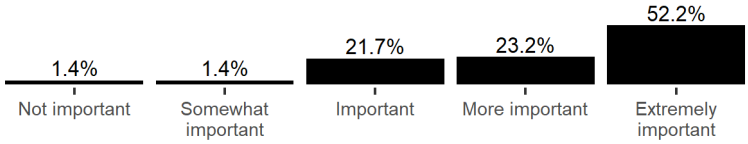


C12a. Have you received training on weather/atmospheric conditions?

n
74

C12b. How important is weather/atmospheric conditions knowledge for drone pilots/operators to have on the job?

n	mean	sd
69	4.23	0.94

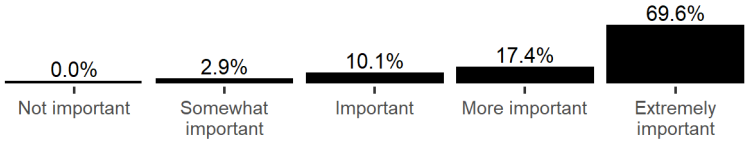


C13a. Have you received training on emergency procedures?

n
74

C13b. How important is emergency procedures knowledge for drone pilots/operators to have on the job?

n	mean	sd
69	4.54	0.80

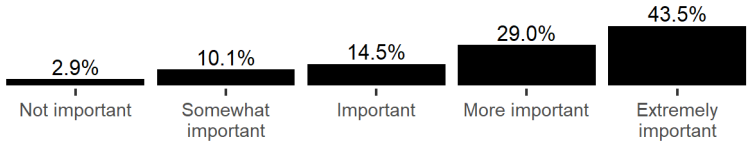


C14a. Have you received training on crew resource management?

n
74

C14b. How important is crew resource management knowledge for drone pilots/operators to have on the job?

n	mean	sd
69	4.00	1.12

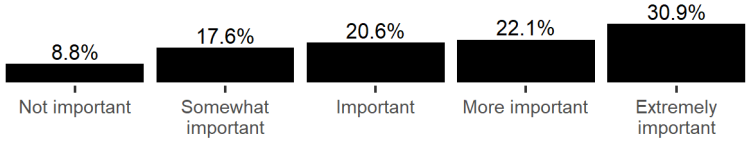


C15a. Have you received training on radio communication procedures?

n
74

C15b. How important is radio communication procedures knowledge for drone pilots/operators to have on the job?

n	mean	sd
68	3.49	1.33

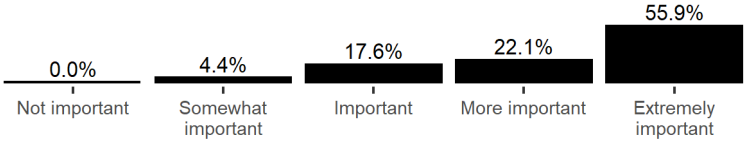


C16a. Have you received training on aeronautical decision-making and judgment?

n
73

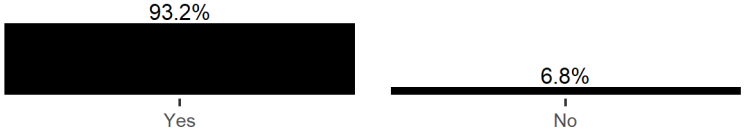
C16b. How important is aeronautical decision-making and judgment knowledge for drone pilots/operators to have on the job?

n	mean	sd
68	4.29	0.92



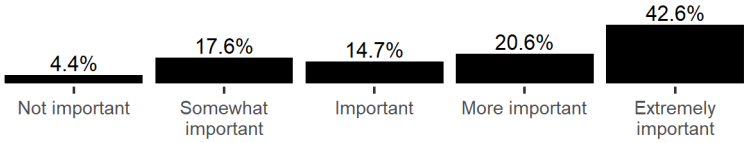
C17a. Have you received training on airport operations?

n
74



C17b. How important is airport operations knowledge for drone pilots/operators to have on the job?

n	mean	sd
68	3.79	1.29

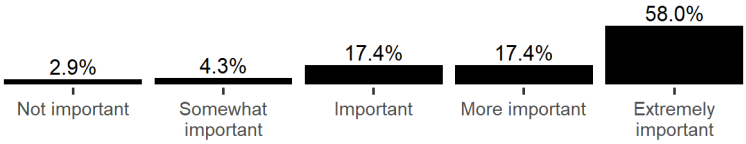


C18a. Have you received training on maintenance and preflight inspection?

n
74

C18b. How important is maintenance and preflight inspection knowledge for drone pilots/operators to have on the job?

n	mean	sd
69	4.23	1.07

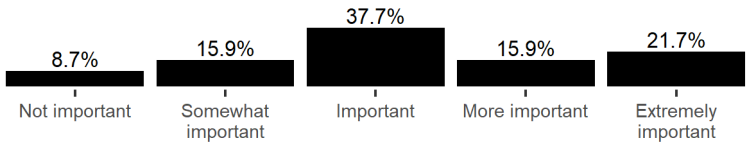


C19a. Have you received training on aerodynamics?

n
74

C19b. How important is aerodynamics knowledge for drone pilots/operators to have on the job?

n	mean	sd
69	3.26	1.22

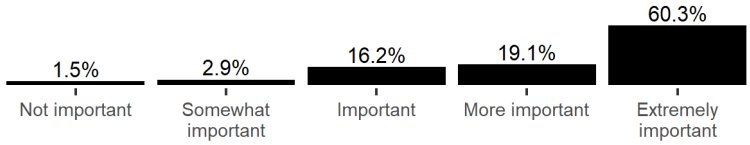


C20a. Have you received training on takeoff/launch and landing/recovery procedures?

n
74

C20b. How important is takeoff/launch and landing/recovery procedures knowledge for drone pilots/operators to have on the job?

n	mean	sd
68	4.34	0.96



C21a. Have you received training on equipment and software knowledge?

n
74

C21b. How important is equipment and software knowledge for drone pilots/operators to have on the job?

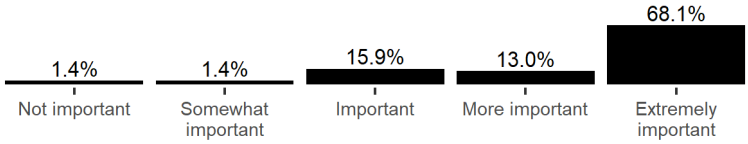
n	mean	sd
69	4.16	0.87

C22a. Have you received training on FAA regulations?

n
74

C22b. How important is FAA regulations knowledge for drone pilots/operators to have on the job?

n	mean	sd
69	4.45	0.92

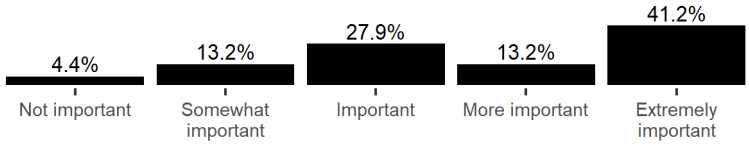


C23a. Have you received training on drone loading (e.g., weight and balance)?

n
74

C23b. How important is drone loading (e.g., weight and balance) knowledge for drone pilots/operators to have on the job?

n	mean	sd
68	3.74	1.25

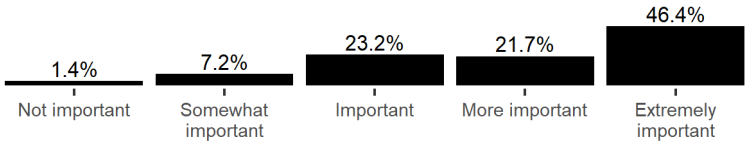


C24a. Have you received training on drone performance (e.g., understanding operational data)?

n
74

C24b. How important is drone performance (e.g., understanding operational data) knowledge for drone pilots/operators to have on the job?

n	mean	sd
69	4.04	1.06

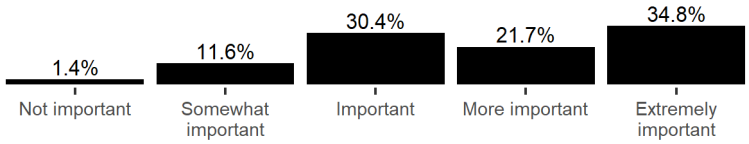


C25a. Have you received training on aviation principles?

n
74

C25b. How important is aviation principles knowledge for drone pilots/operators to have on the job?

n	mean	sd
69	3.77	1.10

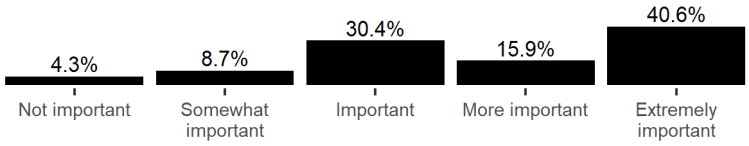


C26a. Have you received training on fatigue?

n
71

C26b. How important is fatigue knowledge for drone pilots/operators to have on the job?

n	mean	sd
69	3.80	1.20

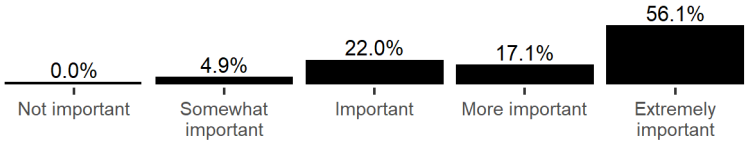


Results for *Item C27* include respondents who indicated 'Manager or Supervisor' on *Item A1*.

C27. How important is this knowledge for your drone pilots to have?

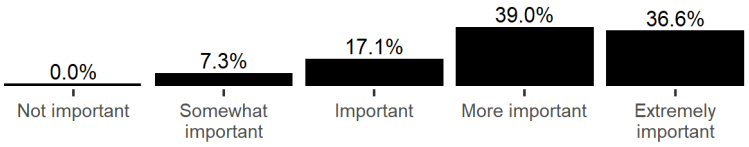
Airspace classification

n	mean	sd
41	4.24	0.97



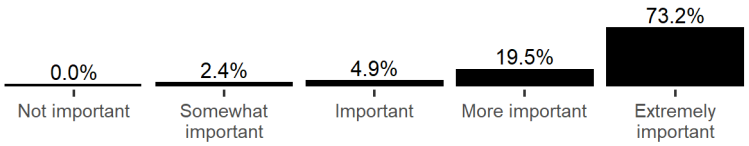
Weather/atmospheric conditions

n	mean	sd
41	4.05	0.92



Emergency procedures

n	mean	sd
41	4.63	0.70



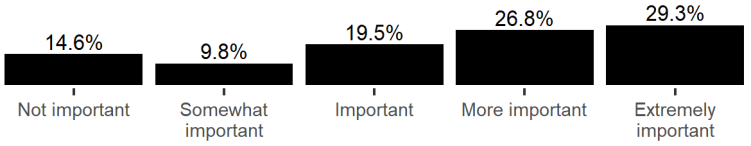
Crew resource management

n	mean	sd
41	4.00	1.12

C27. How important is this knowledge for your drone pilots to have?

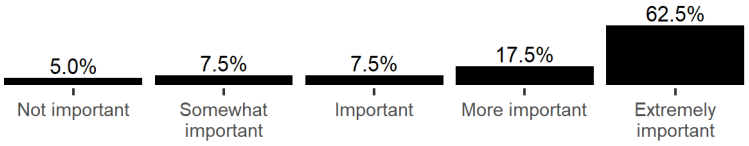
Radio communication procedures

n	mean	sd
41	3.46	1.40



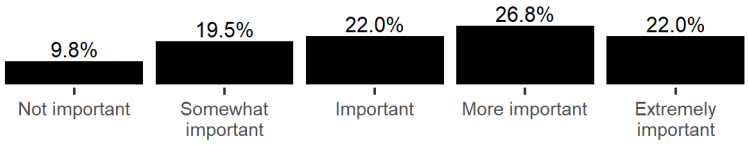
Aeronautical decision-making and judgment

n	mean	sd
40	4.25	1.19



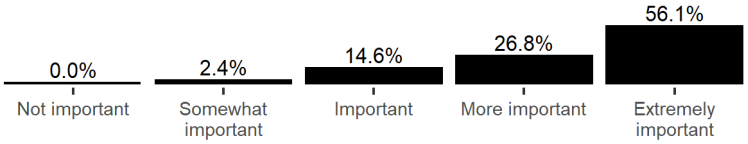
Airport operations

n	mean	sd
41	3.32	1.29



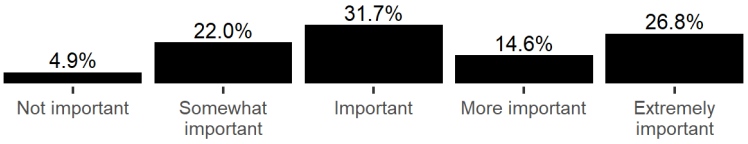
Maintenance and preflight inspection

n	mean	sd
41	4.37	0.83



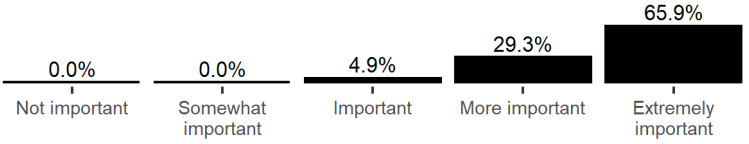
Aerodynamics

n	mean	sd
41	3.37	1.24



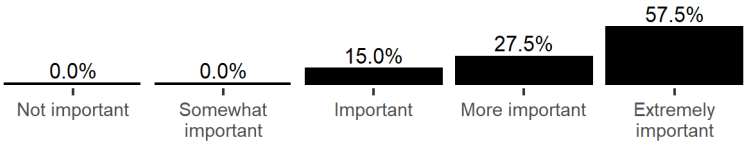
Takeoff/launch and landing/recovery procedures

n	mean	sd
41	4.61	0.59



Equipment capabilities and systems

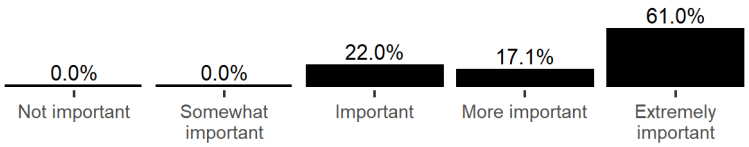
n	mean	sd
40	4.42	0.75



C27. How important is this knowledge for your drone pilots to have?

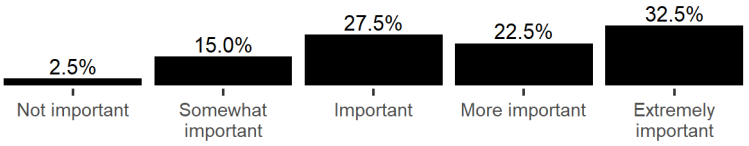
FAA regulations

n	mean	sd
41	4.39	0.83



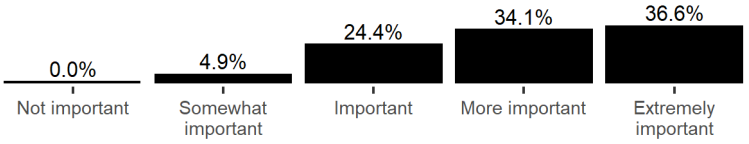
Drone loading (e.g., weight and balance)

n	mean	sd
40	3.67	1.16



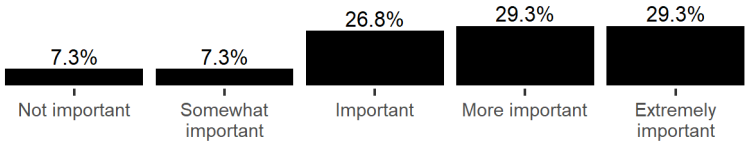
Drone performance (e.g., understanding operational data

n	mean	sd
41	4.02	0.91



Aviation principles

n	mean	sd
41	3.66	1.20



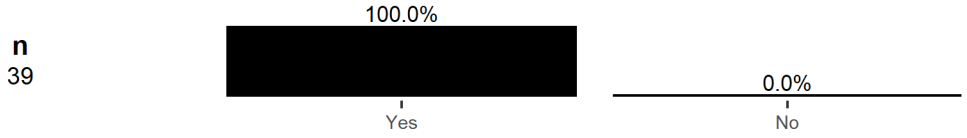
Fatigue

n	mean	sd
40	4.03	1.03

Results for *Item C28a* through *Item C62b* include only respondents who indicated 'Instructor' on *Item A1*.

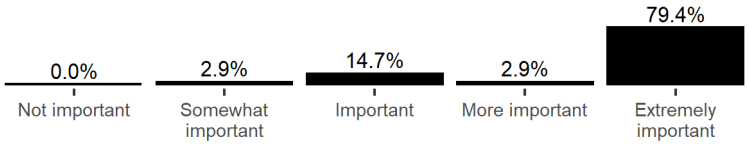
Respondents were asked to review a set of knowledge items relevant to drone pilots/operators, and indicate if their trainees received training on the knowledge area, and then identify how important each knowledge area is to trainees.

C28a. Do your trainees receive training on airspace classification?



C28b. How important is airspace classification knowledge for your trainees?

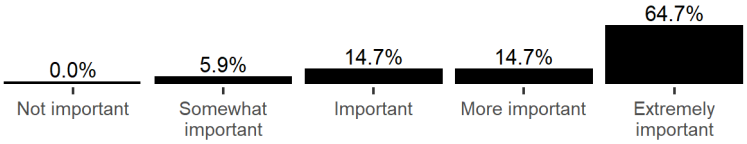
n	mean	sd
34	4.59	0.86



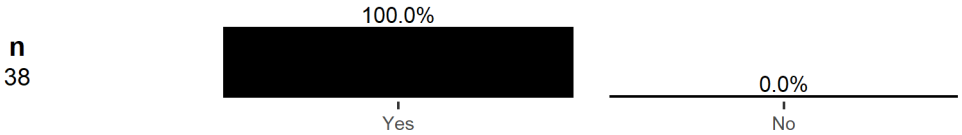
C29a. Do your trainees receive training on weather/atmospheric conditions?

C29b. How important is weather/atmospheric conditions knowledge for your trainees?

n	mean	sd
34	4.38	0.95

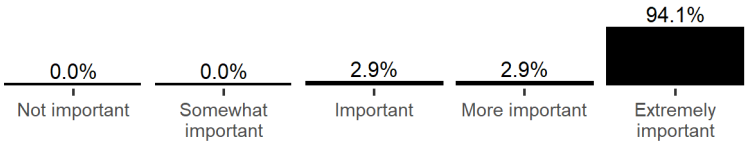


C30a. Do your trainees receive training on emergency procedures?



C30b. How important is emergency procedures knowledge for your trainees?

n	mean	sd
34	4.91	0.38

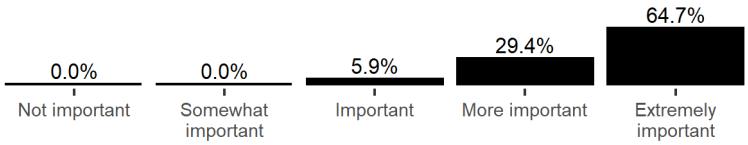


C31a. Do your trainees receive training on crew resource management?

	n
2022	38

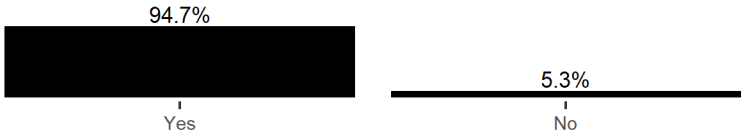
C31b. How important is crew resource management knowledge for your trainees?

n	mean	sd
34	4.59	0.61



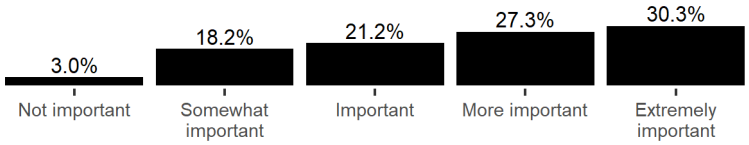
C32a. Do your trainees receive training on radio communication procedures?

n
38



C32b. How important is radio communication procedures knowledge for your trainees?

n	mean	sd
33	3.64	1.19

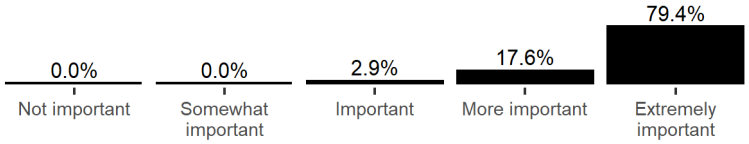


C33a. Do your trainees receive training on aeronautical decision-making and judgment?

n
38

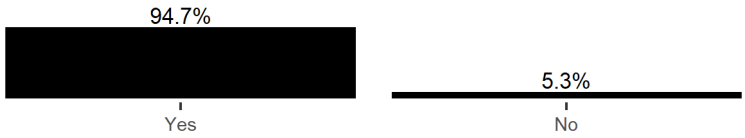
C33b. How important is aeronautical decision-making and judgment knowledge for your trainees?

n	mean	sd
34	4.76	0.50



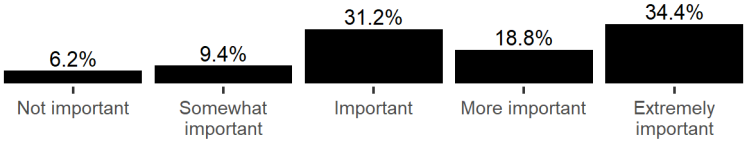
C34a. Do your trainees receive training on airport operations?

n
38



C34b. How important is airport operations knowledge for your trainees?

n	mean	sd
32	3.66	1.23

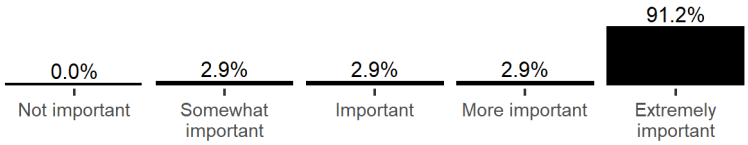


C35a. Do your trainees receive training on maintenance and preflight inspection?

n
37

C35b. How important is maintenance and preflight inspection knowledge for your trainees?

n	mean	sd
34	4.82	0.63

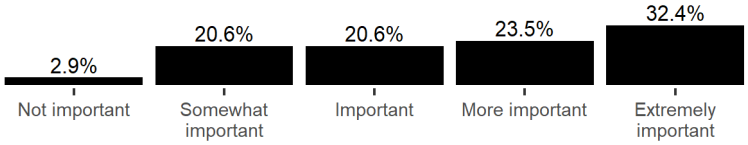


C36a. Do your trainees receive training on aerodynamics?

n
37

C36b. How important is aerodynamics knowledge for your trainees?

n	mean	sd
34	3.62	1.23

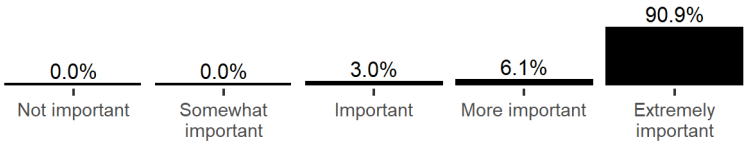


C37a. Do your trainees receive training on takeoff/launch and landing/recovery procedures?

n
37

C37b. How important is takeoff/launch and landing/recovery procedures knowledge for your trainees?

n	mean	sd
33	4.88	0.42

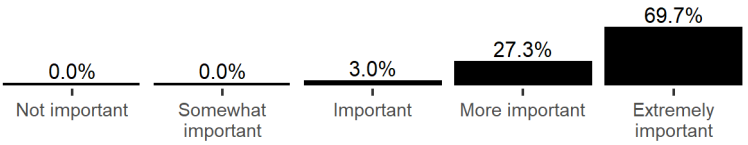


C38a. Do your trainees receive training on equipment and software knowledge?

n
38

C38b. How important is equipment and software knowledge for your trainees?

n	mean	sd
33	4.67	0.54

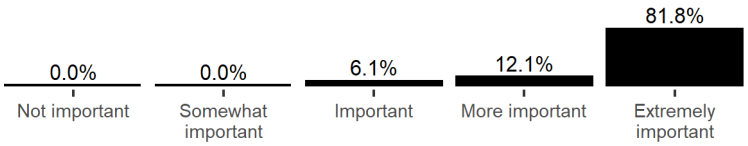


C39a. Do your trainees receive training on FAA regulations?

n
38

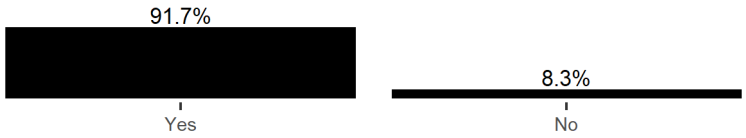
C39b. How important is FAA regulations knowledge for your trainees?

n	mean	sd
33	4.76	0.56



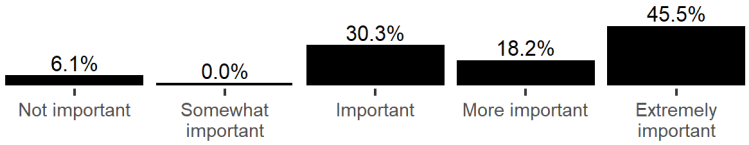
C40a. Do your trainees receive training on drone loading (e.g., weight and balance)?

n
36



C40b. How important is drone loading (e.g., weight and balance) knowledge for your trainees?

n	mean	sd
33	3.97	1.16

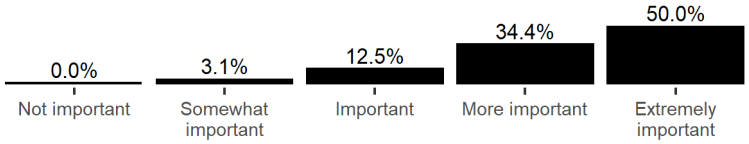


C41a. Do your trainees receive training on drone performance (e.g., understanding operational data)?

n
38

C41b. How important is drone performance (e.g., understanding operational data) knowledge for your trainees?

n	mean	sd
32	4.31	0.82

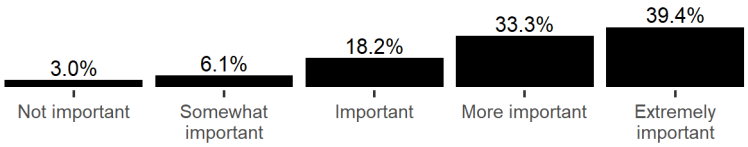


C42a. Do your trainees receive training on aviation principles?

n
38

C42b. How important is aviation principles knowledge for your trainees?

n	mean	sd
33	4.00	1.06

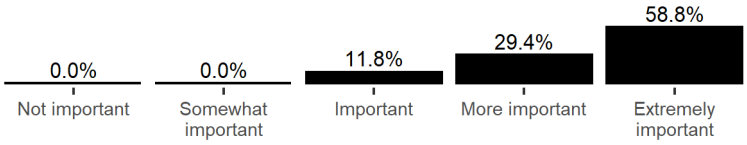


C43a. Do your trainees receive training on fatigue?

n
38

C43b. How important is fatigue knowledge for your trainees?

n	mean	sd
34	4.47	0.71

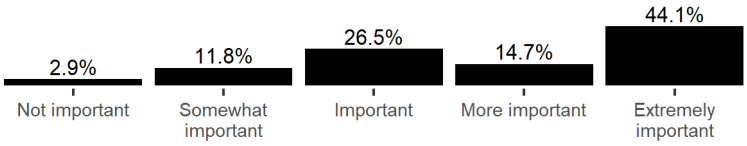


C44a. Do your trainees receive training in altitude and distance estimation?

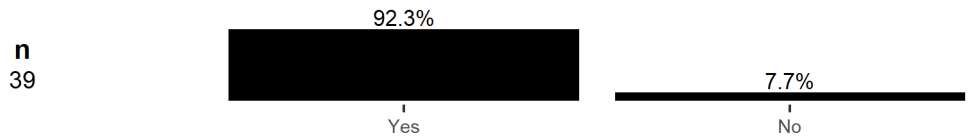
n
39

C44b. How important is altitude and distance estimation for your trainees?

n	mean	sd
34	3.85	1.21

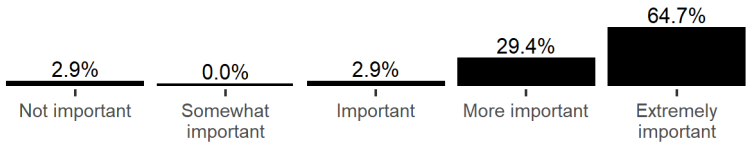


C45a. Do your trainees receive training in flight skill (e.g., changing direction, maintaining speed)?

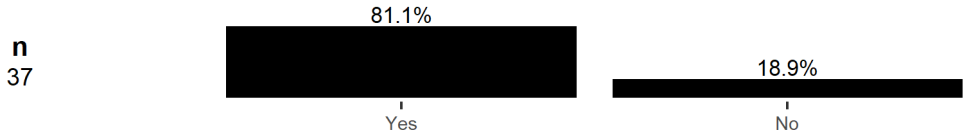


C45b. How important is flight skill (e.g., changing direction, maintaining speed) for your trainees?

n	mean	sd
34	4.53	0.83



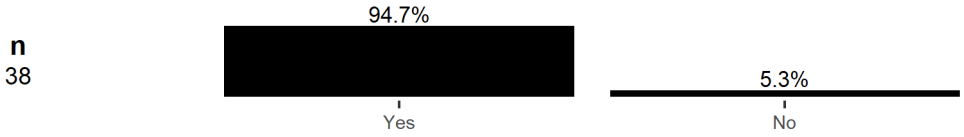
C46a. Do your trainees receive training in multitasking and timesharing?



C46b. How important is multitasking and timesharing for your trainees?

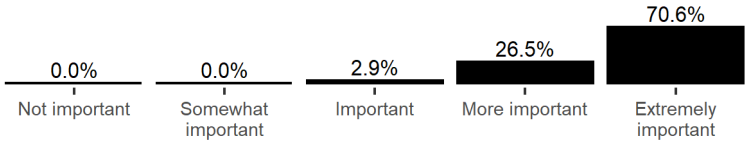
n	mean	sd
30	4.03	1.03

C47a. Do your trainees receive training in judgment and decision-making?



C47b. How important is judgment and decision-making for your trainees?

n	mean	sd
34	4.68	0.53

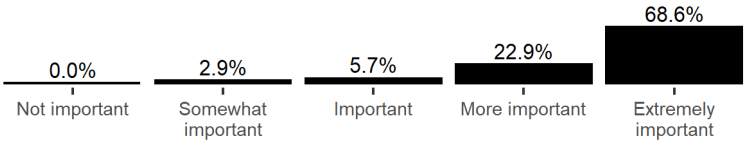


C48a. Do your trainees receive training in communication?

n
39

C48b. How important is communication for your trainees?

n	mean	sd
35	4.57	0.74

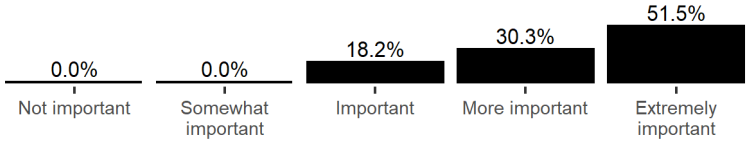


C49a. Do your trainees receive training in problem-solving?

n
38

C49b. How important is problem-solving for your trainees?

n	mean	sd
33	4.33	0.78

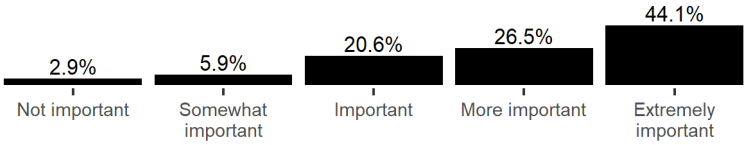


C50a. Do your trainees receive training in stress management?

n
38

C50b. How important is stress management for your trainees?

n	mean	sd
34	4.03	1.09

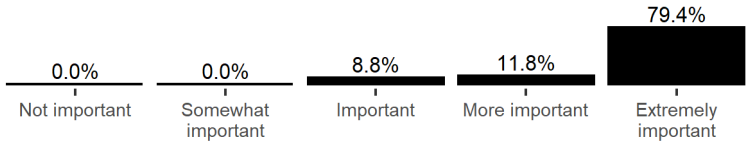


C51a. Do your trainees receive training in mission monitoring?

n
38

C51b. How important is mission monitoring for your trainees?

n	mean	sd
34	4.71	0.63

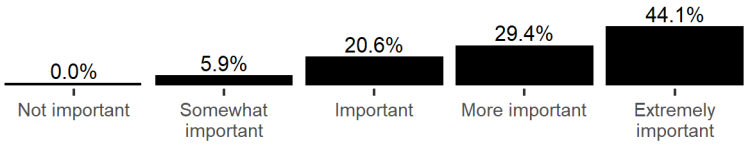


C52a. Do your trainees receive training in map reading?

n
39

C52b. How important is map reading for your trainees?

n	mean	sd
34	4.12	0.95

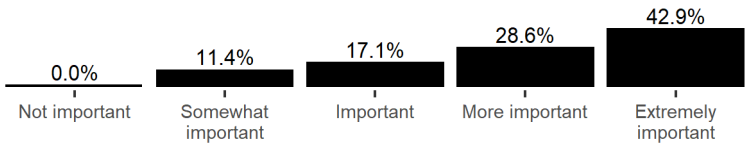


C53a. Do your trainees receive training in weather identification?

n
39

C53b. How important is weather identification for your trainees?

n	mean	sd
35	4.03	1.04

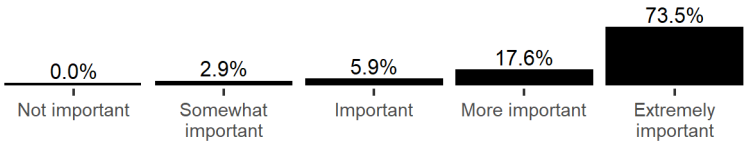


C54a. Do your trainees receive training in planning?

n
38

C54b. How important is planning for your trainees?

n	mean	sd
34	4.62	0.74

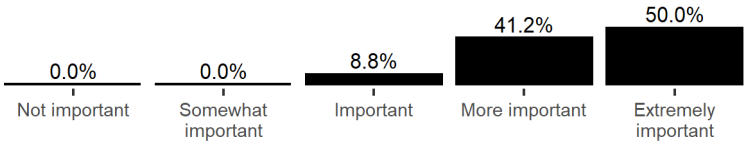


C55a. Do your trainees receive training in teamwork?

n
39

C55b. How important is teamwork for your trainees?

n	mean	sd
34	4.41	0.66

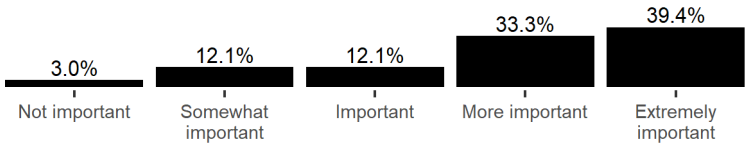


C56a. Do your trainees receive training in leadership?

n
39

C56b. How important is leadership for your trainees?

n	mean	sd
33	3.94	1.14

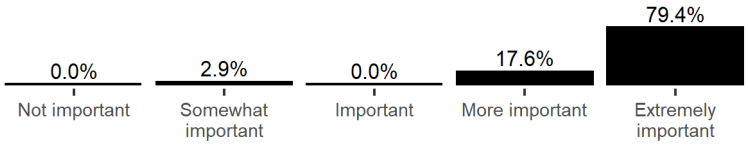


C57a. Do your trainees receive training in takeoff and landing?

n
39

C57b. How important is takeoff and landing for your trainees?

n	mean	sd
34	4.74	0.62

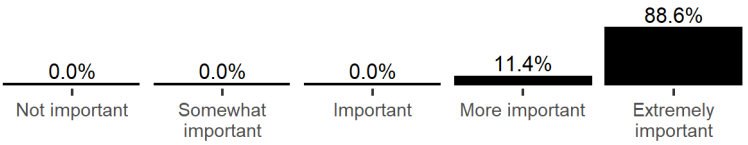


C58a. Do your trainees receive training in situation awareness?

n
39

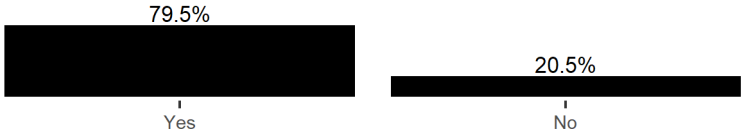
C58b. How important is situation awareness for your trainees?

n	mean	sd
35	4.89	0.32



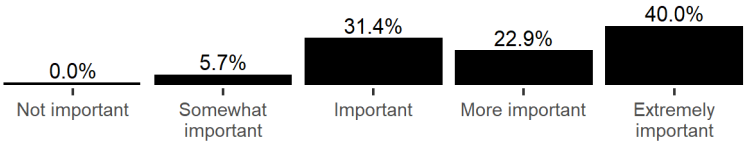
C59a. Do your trainees receive training in time management?

n
39



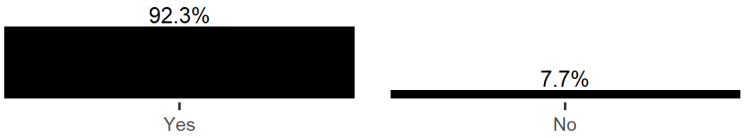
C59b. How important is time management for your trainees?

n	mean	sd
35	3.97	0.98



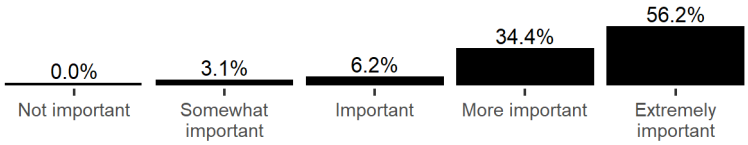
C60a. Do your trainees receive training in instrument monitoring?

n
39



C60b. How important is instrument monitoring for your trainees?

n	mean	sd
32	4.44	0.76

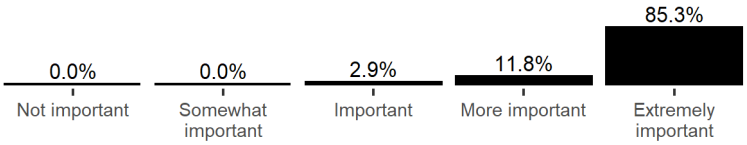


C61a. Do your trainees receive training in risk assessment?

n
39

C61b. How important is risk assessment for your trainees?

n	mean	sd
34	4.82	0.46

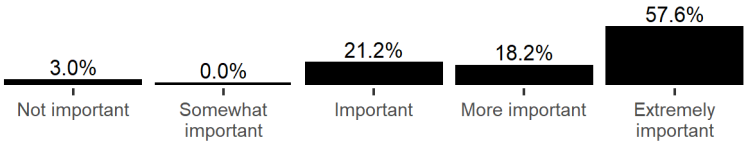


C62a. Do your trainees receive training in navigation?

n
39

C62b. How important is navigation for your trainees?

n	mean	sd
33	4.27	1.01



Results for *Item C63* include respondents who indicated 'Pilot/Operator with systems less than 55 pounds,' 'Pilot/Operator of systems equal to/greater than 55 pounds,' 'Engineer,' 'Cargo Operator,' 'Sensor Operator,' 'Manager or Supervisor,' or 'Other' on *Item A1*.

C63. Are there any other drone training topic areas (i.e., knowledge or skills) that you have received training on for your current UAS job role?

n
116

Results for *Item C63a* include only respondents who indicated 'Yes' on *Item C63* and provided a written response.

C63a. Other drone training topic areas, please describe: (See Appendix B. section C. Knowledge, Skills, and Tests for a list of responses)

n
17

Results for *Item C64* include only respondents who indicated 'Instructor (teaches about drones, regulations, best practices, etc.)' on *Item A1*.

C64. Are there any other drone training topic areas (i.e., knowledge or skills) that your students have received training on for their UAS job role?

n
39

Results for *Item C64a* include only respondents who indicated 'Yes' on *Item C64* and provided a written response.

C64a. Other drone training topic areas, please describe: (See Appendix B. section C. Knowledge, Skills, and Tests for a list of responses)

n
16

Results for *Item C65* include only respondents who provided a written response.

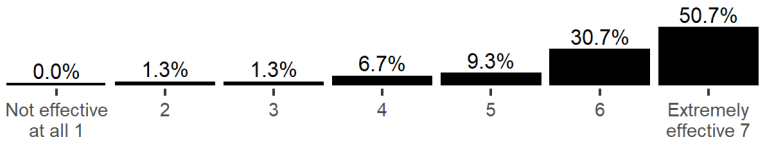
C65. Can you think of anything that would help make drone training better as an instructor or as a trainee? (See Appendix A for a list of responses)

n
107

Results for *Item C66* include respondents who indicated 'Pilot/Operator with systems less than 55 pounds,' 'Pilot/Operator of systems equal to/greater than 55 pounds,' 'Engineer,' 'Cargo Operator,' 'Sensor Operator,' or 'Other' on *Item A1*.

C66. Overall, how effectively has your training prepared you to complete the duties required of your position?

n	mean	sd
75	6.19	1.09



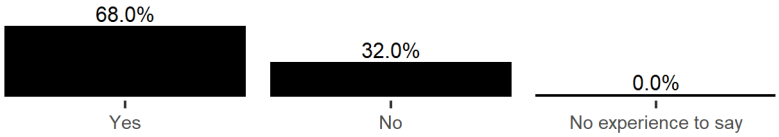
Results for *Item C67* include respondents who indicated 'Pilot/Operator with systems less than 55 pounds,' 'Pilot/Operator of systems equal to/greater than 55 pounds,' 'Cargo Operator,' 'Sensor Operator,' 'Manager or Supervisor,' or 'Other' on *Item A1* and provided a written response.

C67. What kind of additional job aids might be useful for your position? (See Appendix B. section C. Knowledge, Skills, and Tests for a list of responses)

n
67

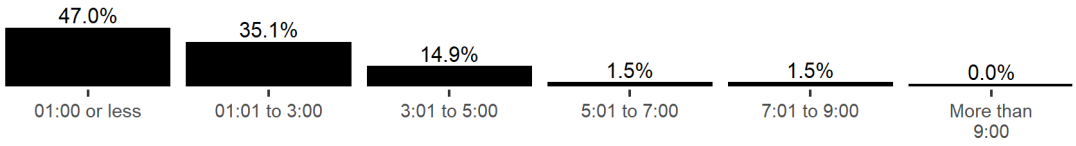
C68. Does your organization provide training on fatigue awareness and fatigue management?

n
147



C69. How long is a crew member required to stay on station before taking a break?

n	mean	sd	min	max	median
134	1.83	1.65	0	8	2



Appendix B. Text Response to Open Ended Questions for Air Carrier Operational Considerations for UAS: Knowledge, Skills, Abilities, and Other Characteristics

The FAA 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 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 operator knowledge, skills, and tests included 17 open response items formatted for text entry. These items typically asked respondents to explain the job roles and knowledge, skills, and tests for UAS operators within their organization. Item B2 assessed other automation functions not listed in item B1 that were available (B2a; Table B8) or required (B2b; Table B9) on the respondent's aircraft.

The responses shown in this appendix 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 responsibilities of the job (A1b), Table B1 and Table B2 respectively.

Table B1; *Item A1b*, Table B2; *Item A4*,

Table B3; *Item A5a*, Table B4; *Item A7a*,

Table B5; *Item A8a*,

Table B6; *Item A9a*, Table B7

B. Air Carrier Operational Considerations for Unmanned Aircraft Systems

Item B2a, Table B8; *Item B2b,* Item B1 assessed whether automated functions were required, and if they were available. These functions included Takeoff, Flight Path, Hover or Holding Pattern, Obstruction Avoidance, Traffic Collision, Lost Link, Return Home, and Landing. Item B2 asked if the respondent's aircraft had other automated functions (not listed in item B1) that were available or required. Those respondents who indicated 'Yes' were asked to describe the available (B2a) or required (B2b) automation, Table B8 and Table B9, respectively.

C. Knowledge, Skills, and Tests

Item C3a, Respondents saw several items based on the job role they selected in Item A1. Only those who indicated that they were a 'Manager or Supervisor' saw item C1. The item asked if the respondent's organization had established selection criteria for hiring drone crewmembers. Similarly, only respondents who selected any job role other than

manager/supervisor or instructor on item A1 saw Item C2, which asked if the respondent was required to complete any organization-specific testing before being hired. Only those who responded 'Yes' to items C1 or C2 are included in reporting for item C3 (Table B10).

Table B10; *Item C4a*, Table B11; *Item C5a*,
Table B11; *Item C8a*,
Table B13; *Item C63a*,
Table B14; *Item C64a*,
Table B15; *Item C65*, Table B6; *Item C67,* Table B17

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

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

A1. Currently, what is your primary job role? **(required)** *Other (please describe)*	
a. In brief, please describe your job role:	
*	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

A1b. In brief, please describe the main responsibilities of your job:	
*	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.
*	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.

	A1b. In brief, please describe the main responsibilities of your job:
*	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
*	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.

	A1b. In brief, please describe the main responsibilities of your job:
*	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.
*	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.

A1b. In brief, please describe the main responsibilities of your job:	
*	I am the UAS Program Manager and lead FAA Part 107 Pilot in our organization.
*	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.

A1b. In brief, please describe the main responsibilities of your job:	
*	I work as a City emergency manager as well as a communications specialist.
*	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
*	Research scientist/professor

A1b. In brief, please describe the main responsibilities of your job:	
*	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
*	UAS Detail Coordinator for the [Company] State Police

A1b. In brief, please describe the main responsibilities of your job:	
*	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.
*	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

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?	
*	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
*	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
*	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

B. Air Carrier Operational Considerations for Unmanned Aircraft Systems

Item B1 assessed whether automated functions were required, and if they were available. These functions included Takeoff, Flight Path, Hover or Holding Pattern, Obstruction Avoidance, Traffic Collision, Lost Link, Return Home, and Landing. Item B2 asked if the respondent's aircraft had other automated functions (not listed in item B1) that were available or required. Those respondents who indicated 'Yes' were asked to describe the available (B2a) or required (B2b) automation, Table B8 and Table B9, respectively.

Table B8.
Responses Provided by Respondents Who Indicated 'Yes' on Item B2 and Who Listed Other Available Automation (n=14)

B2. Are there other functions not listed in the previous question that are available or required for your aircraft? *Yes (please describe)*	
a. Other available automation:	
*	ADS-B receiver Redundant Flight Systems
*	Auto-Divert to closest practical field.
*	Autopilot altitude hold, airspeed hold, and heading hold
*	DJI Intelligent Flight Modes Skydio flight modes
*	Geo-Fencing, SATCOM, Cellular, Lost Comm,
*	hover, Return to Landing
*	Parachute emergency landing
*	position hold from visual inertial odometry (VIO)
*	Remote ID
*	sensor operation
*	Swarm Mapping
*	Various pre-defined photographic and video flight regiments
*	Visible markers or lighting for waivered missions beyond the agency's max distance from ground control station
*	Your question only assumes one UA is flown at the organization. For training, we use UA that have no automation. Later, we use UA that have autonomous capabilities.

Table B9.
Responses Provided by Respondents Who Indicated 'Yes' on Item B2, and Who Listed Other Required Automation (n=4)

B2. Are there other functions not listed in the previous question that are available or required for your aircraft? *Yes (please describe)*	
b. Other required automation:	
*	Ai Software packages
*	Auto-Divert to closest practical field.
*	Geo-Fencing, SATCOM, Cellular, Lost Comm,
*	sensor operation

C. Knowledge, Skills, and Tests

Respondents saw several items based on the job role they selected in Item A1. Only those who indicated that they were a 'Manager or Supervisor' saw item C1. The item asked if the respondent's organization had established selection criteria for hiring drone crewmembers. Similarly, only respondents who selected any job role other than manager/supervisor or instructor on item A1 saw Item C2, which asked if the respondent was required to complete any organization-specific testing before being hired. Only those who responded 'Yes' to items C1 or C2 are included in reporting for item C3 (Table B10).

Table B10.
Responses Provided by Respondents Who Indicated 'Yes' on Item C1 or 'Yes' on Item C2, and Who Described What Kind of Testing was Required Before Hire (n=8)

C3. For your current position, were you required to complete any organization-specific testing before you were hired? If yes, what kind of testing is required? *Other (please describe)*	
a. Other testing required, please describe:	
*	Background check & minimum UAS flight hours
*	Current military form 8 (checkride)
*	Drug and background screen
*	I own my own aerial production company so all of this.
*	Knowledge interview, previous qualifications and security clearance.

C3. For your current position, were you required to complete any organization-specific testing before you were hired? If yes, what kind of testing is required? *Other (please describe)*	
a. Other testing required, please describe:	
*	ODA Aerial Applicator
*	Part 107 Certification
*	We always perform an FAA document check for each pilot. Often times it's multiple interviews (tech screens) with our senior staff to ensure the pilot is competent with the scope of work required.

Table B11.

Responses Provided by Respondents Who Indicated 'Other training or experience' on Item C4, and Who Listed Their Training or Experience Requirements (n=19)

C4. 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.

C4. 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:	
*	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.
*	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.

Table B12.

Responses Provided by Respondents Who Indicated 'Other training' on Item C5, and Who Listed the Minimum Organizational Requirements for Instructors to Operate Drones (n=14)

C5. What are the minimum requirements necessary for instructors to operate drones at your organization? *[mark all that apply]* *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.

C5. What are the minimum requirements necessary for instructors to operate drones at your organization? ***[mark all that apply]*** *Other training (please describe)*	
a. Other, please describe:	
*	NIST UAS
*	Sworn Law Enforcement experience.
*	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 B13.
Responses Provided by Respondents Who Indicated 'Other training' on Item C8, and Listed Training Required by Their Organization (n=11)

C8. 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

C8. What type of training does your organization require? ***[mark all that apply]*** *Other training (please describe)*	
a. Other required training, please describe:	
*	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 B14.

Responses Provided by Respondents Who Indicated 'Yes' on Item C63, and Listed Other Drone Training Topic Areas They Received Training on for Their Current UAS Job Role (n=17)

C63. Are there any other drone training topic areas (i.e., knowledge or skills) that you have received training on for your current UAS job role? *Yes*	
a. Other drone training topic areas, please describe:	
*	~6 years of Aerospace Engineering, ground school
*	BVLOS operations. Sensor operations.
*	Certified by APSA for basic proficiency training
*	Cinematography & Photography skills.
*	Confined space operations. Safety, special recognition, and skills training
*	Human Factors
*	Knowledge of and application of ICS procedures. Integration of multi-agency Drone operations.
*	Maritime Operations
*	Night operations and autonomous training. Also field scenarios including use of thermal imagery.
*	NIST UAS
*	Operational Risk Management, Crew Resource Management, International Aviation Standards, Regulatory Guidance, Instructional techniques, Airspace Design and Management, Communications Standards, Engineering Principals, others.
*	recognition of enemy air defense systems

C63. Are there any other drone training topic areas (i.e., knowledge or skills) that you have received training on for your current UAS job role? *Yes*	
a. Other drone training topic areas, please describe:	
*	SMS (Policy, Risk Management, Assurance, Promotion)
*	swarm control
*	Thermal camera use
*	Videography
*	weapons (bombs and missiles) employment

Table B15.

Responses Provided by Respondents Who Indicated 'Yes' on Item C64, and Listed Other Drone Training Topic Areas That Their Students Received Training on for Their UAS Job Role (n=16)

C64. Are there any other drone training topic areas (i.e., knowledge or skills) that your students have received training on for their UAS job role? *Yes*	
a. Other drone training topic areas, please describe:	
*	Automation
*	Autopilot integration and configuration, parameter configuration, SUAS maintenance.
*	camera operation
*	Common sense when talking with the public, inform and educate when possible.
*	Detailed student and property safety, as well as liability.
*	Each situation is different and must be approached as such, no 2 are the same and ADM principles must be employed every time
*	First person view
*	Flying in the Wire Environment
*	How drones are being used in industry.
*	Human factors performance and UAS.
*	Launch and recovery missions
*	Payload management, crowd control for operations in public areas
*	Site assessments, systems knowledge, maintenance, autopilot integration and flight tuning, application training, software proficiency

C64. Are there any other drone training topic areas (i.e., knowledge or skills) that your students have received training on for their UAS job role? *Yes*	
a. Other drone training topic areas, please describe:	
*	Supremacy Clause, state and local laws, personal safety, ITAR/EAR, photogrammetry, photography/sensor systems, privacy
*	Tactics specific to public safety
*	Use of image processing software.

Table B16.

Responses Provided by Respondents Who Indicated What Would Help Make Drone Training Better as an Instructor or as a Trainee on Item C65 (n=107)

C65. Can you think of anything that would help make drone training better as an instructor or as a trainee?	
*	Quick References outlining "need to know," topic areas for periodic refresh - Periodic short refresher modules, which can be accessed via mobile phone Apps
*	Actual application training
*	All of these aspects are covered in our agency protocols and FAA exam/recurrent materials. The UAS flights I'm referring to in my answers are small UAS within LOS and lower altitude.
*	An instructor, having an FAA flight practical exam that is to be signed off and required before commercial operations. This is currently a company maintained standard.
*	An FAA recognized path to Remote Pilot Instructor. An FAA required practical exam for remote pilots (administered by DPEs similar to Canada's scheme. Suggest using NIST BPERP.
*	As a trainee, I found that the majority of training material seems to be derived from training material, experience and principles required for manned aircraft operations rather than unmanned aircraft. I think it would help to have training material that is focused on the real world requirements that drone (UAS) pilots will face from their perspective rather than from the perspective of manned aircraft. I realize that drone technology and drone laws are just coming out of infancy and it will take time but hopefully this survey will help...
*	As a trainee, information on the maintenance of the drone would be extremely useful.

C65. Can you think of anything that would help make drone training better as an instructor or as a trainee?	
*	Based upon my experience as a military trained sensor operator and subsequent transition to military contractor it is evident that military FTU are over taxed and many times the training is rushed. Training I have received through third party organizations that help to oversee my military contractor training were more thorough, more focused and provided more real world scenario training.
*	Being knowledgeable and up to date on any recent changes to regs or tech.
*	Better delineation of different drone career pathways (e.g. drone maintenance technician, drone operator, drone tester/designer), and established standards and qualifications for each pathway.
*	Better quality flight simulator software that would potentially be available directly from the FAA.
*	Better sims to create realistic emergency situations
*	Better simulators.
*	Both Classroom and Hands on are critical.
*	Both scenario based training and hands on/OJT training are very important for giving the student a chance to actually experience different scenarios so that they will be able to properly react in a real situation.
*	Clear instruction on avoiding bird strikes and wildlife disturbance. Clear instruction on appropriate procedures for maximizing imaging quality.
*	Clearer regulations from FAA, less complicated, and restrictive
*	Consistent standards of training
*	continued experience and flight time
*	Continuing to bolster the training requirements. We are going from flying toys to complex heavy equipment and the training environment hasn't kept up.
*	Data management and security
*	Discussions about what to do when your doing a drone flight and you see a plane of in the distance. Sometimes they change course and head right for your site. I took a 3rd party course and I don't recall learning what to do in these situations. Should you land the drone immediately to error on the side of precaution or just monitor the situation and be ready to react?

C65. Can you think of anything that would help make drone training better as an instructor or as a trainee?	
*	Dwell on the knowledge of the manual and how it correlates to the checklist. Written tests of emergency procedures. Student handbook is also useful
*	Experience and patience
*	Flight skill exams.
*	Focus on "hands on" training vs. simulations. You cannot understand the need for depth perception on a simulator. Flying safely in a conjected area with trees, towers, etc. requires visual 3D capability. This is why I require a student to land on a 8 foot diameter table that is 5 feet above the ground and 50 feet away from the pilot.
*	For better instructors they need instructor training - just like in manned aviation a person needs experience acting as an instructor through train the trainer programs and gaining instructional knowledge
*	Greater emphasis on aerodynamics, preflight inspection for airworthiness prior to launch, and risk management.
*	Have a practical skills evaluation in place of or in addition to the written exam. More emphasis on drones, less on airspace maps.
*	Have fun with it and on location training is a lot more exciting than classroom.
*	Have practical flight training as a requirement for Part 107 certification. Simple NIST (or NIST-like) course.
*	Having some manned aircraft experience makes a big difference in the trainee's ability to understand how aircraft are expected to operate in controlled airspace. Manned aircraft experience also helps build the situation awareness of the trainee. Having trained students with and without manned aircraft experience I have found that those with manned experience have a much better understanding of aircraft operations in a controlled environment and have more awareness of other aircraft and their positions in relation to the UAV.
*	Honestly, you just have to learn by doing it both in the classroom and out in the field; you have to take and pass the FAA part 107 exam and then learn how to manually fly before moving on to completely automated missions.
*	I self-studied and passed my Part 107 remote-pilot exam. All of my flight experience has been on the job/hobby flying. My training has been all computer-based.
*	I think having an instructor that is up to date with current regulations/technology is key. Far too often the wrong information is given at trainings and that is detrimental to the students.
*	I think including manned airport procedures could help with situation awareness.

	C65. Can you think of anything that would help make drone training better as an instructor or as a trainee?
*	I would like to see more emphasis on airspace awareness and what other ops are in the area. It seems natural from a manned aviation standpoint but I have seen it breezed over a few times with folks that may not have that background.
*	I would like to start to see the adoption of standardized practical flight training. I feel that drones have matured in operation enough that there can begin to be a process by which we measure students with their hands-on drone proficiency. I also feel more practical training with flight planning is helping our students (i.e. how do I cover a 100-acre field with mapping - how do I find proper places to set up and break down while avoiding obstructions and maintaining VLOS?) Good UAS planning seems to be as much about ground control station setup + location as it is actually operating the drone - the telecom industry is a good group to look at who is standardizing this kind of work.
*	I'd like to know what it means for a drone to stall, what situations would cause it, and how to avoid and recover if a stall occurs.
*	If training is specific to under 55lbs with no payload modifications to UAS then many of of the Maned flight concepts an be reduced.
*	Improved aircraft and mission simulation, particularly with the ability to conduct real world scenario training. Examples include mix of manned and unmanned traffic, high density operations, operations in various airspaces.
*	In general, no. If we needed to improve our internal training we would implement changes as necessary.
*	In-depth review of actual drone accident and incidents.
*	Invest HEAVILY in training. And I truly mean heavily. If your crew is not trained, you will lose money faster than you can count it
*	Knowledge of the limitations of their equipment. I.E. a lot of drones require a tablet (such as an ipad) to fly and visually comprehend what the drone is seeing. We have found that they can overheat in the sun or freeze in the winter. This causes lockup in their visual reference and can cause panic amongst our most experienced pilots. Think ahead of the limitations of the equipment.
*	Mainly just having pilots practice in open fields away from infrastructure or restricted airspace. Getting comfortable as possible with flying their drone.
*	Make it memorable
*	Mandatory Flight Training as part of the 107

C65. Can you think of anything that would help make drone training better as an instructor or as a trainee?	
*	Manned flight experience, esp. airspace, stall awareness, unusual attitude recovery, see and avoid, TCAS/sense and avoid
*	Manufacturer & model-specific training
*	More class room training i.e., Flight simulator training More in field flight Training per Aircraft to be certified on.
*	More comprehensive reading materials. Some books are very hard to digest and makes it difficult to understand.
*	More FAA input
*	More female instructors based on the fact that women tend to be more patient, pay more attention to detail and aren't afraid to ask for help when necessary.
*	more focus on safe drone operation and less on airports, sectional charts, weather reports, etc.
*	more hands on flight time
*	More hands on training
*	More hands on training, more conceptual connections to UAS operations, not simply crewed flight principles that are assumed to carryover to UAS ops.
*	More insight from the OEM on the UA's limitations, systems, checklists, etc.
*	more live flight training.
*	More night time training.
*	More places to operate a drone and not worry about being afraid of crashing the drone or having to replace anything damaged. I think it would reduce the overall experience if the pilot in training wasn't responsible for replacing damaged drones or whatnot.
*	More Practical Training
*	More time set aside for drone training
*	More training
*	NIST Standard Test Methods
*	no
*	no
*	no
*	No

	C65. Can you think of anything that would help make drone training better as an instructor or as a trainee?
*	No
*	No
*	No
*	No
*	No
*	NO
*	NOT AT THIS TIME
*	Not right now
*	Not within my organization, no.
*	one on one personal instruction
*	Periodic review of training and topics to ascertain/determine relevance.
*	Ppl ground school should be required for all military and civilian operators.
*	Preliminary needs assessment
*	Prior CFI experience is definitely a bonus, especially a good understanding of the fundamentals of instruction (FOIs)
*	Realize that the part 107 requirements are the bare minimum. It takes much more knowledge and experience to be a safe and ethical UAS operator.
*	requiring a national skillset check by a DPE before issuing part 107. We need a drone checkride. Additionally we need to have endorsements for fixed wing/multi-rotor/helicopter etc.
*	Scenario and reality based training proves to be of significant value. When we have simulated missions in our city that includes periods of time when they are not allowed to fly (e.g., in a "0 Square" or too close to a heliport, etc.) and they are directed to prepare for a mission but wait to launch for any approval, it has revealed holes in their checklist discipline we could address.
*	Simplify and educate
*	Simulations & simulators
*	Specific training on mapping end user
*	Standardization.

	C65. Can you think of anything that would help make drone training better as an instructor or as a trainee?
*	Stress the importance of maintaining flight proficiency by recent flight experience, i.e., maintain flight proficiency by actually flying frequently.
*	Systems must be engineered to be very intuitive in operations and maintenance. (Think the iPhone's training manual and required training.)
*	Tailored approach for level of experience.
*	Techniques for developing scenario-based training.
*	The best standards or Instruction I have worked with in my career have come from the Military training methodology I learned as a Military Instructor Pilot. Drone training needs to be tailored to the Aircraft and Airspace of intended use. As drones become more complex and integrate into the US NAS the level of required knowledge must mirror a manned aircraft model.
*	The FAA needs to be catch up with the UAS industry technology capabilities. Need to create regulations that are clear and concise so the everyone can understand them. Plus, current remote ID regulations are going to harm the recreational and Part 107 operators. Requiring K-12 schools to become part of a CBO and only fly in FRIA's will not encourage students to enter the profession. The FAA needs to equally support all levels of unmanned aircraft and stop catering to DoD and big business and encourage aviation STEM rather than making everyone a criminal if they fly a UA.
*	This topic is specific to the types of missions being flown and the locations of those missions. I live in rural area and there are no manned airports where I fly drones. I fly mainly in manual flights with very little automation. Others are completely opposite of me. I train first responders on flying with controls and developing those skills.
*	Training is done at a as-needed basis for a wide-range of activities. Otherwise its too much information at once.
*	Training material and exam considerations for students with dyslexia or on the spectrum, as well as visual demonstrations of information application.
*	Video based training. New generations absorb information best via visual learning and on-the-job training/practical experience. There are limited new media resources provided by FAA. Study exams should be up to date and match the testing criteria. Provide drone training facilities in each state.
*	Widely accepted standards for the entire drone pilot industry.
*	Widely available simulators that don't cost money to use and provide a reasonable degree of fidelity.

C65. Can you think of anything that would help make drone training better as an instructor or as a trainee?	
*	Work flow charts to help with conceptional visualization of procedures, circuitry, and signal paths
*	Would be great to have a CFI designation for sUAS. Other than the Airmen UAS Certification Standards and curriculum we use for our Part 107 test prep course, when it comes to hands-on flight training, we've had to establish our own standards and educational methodology. We are aware of the Trusted Operator Program but do not use it due to the unit economics not masking sense for the vast majority of our customers.
*	Yes, by having access to reliable drone simulators.
*	Yes, get a pt 61

Table B17.

Responses Provided by Respondents Who Listed Additional Job Aids That Might be Useful for Their Position on Item C67 (n=67)

C67. What kind of additional job aids might be useful for your position?	
*	2 person operation
*	A class on mechanics of the UAS to certified on.
*	Ability to get more projects using drones
*	Additional software pre-cautions like remote id and air sense always give a sense of comfort when flying.
*	Additional study exams, new media training, accessible FAA instructors or operators to clarify any questions or concerns.
*	Adherence to standards
*	Airport radio
*	An assistant to help with the paperwork end of mission flight requests.
*	Any FAA resources that would help to build an effective maintenance department to determine and maintain airworthiness
*	Approved UAS Training Device (i.e., FTD)
*	Automated logging for pilots and aircraft.

C67. What kind of additional job aids might be useful for your position?	
*	Better drone management/flight management applications/services.
*	better drones
*	Business classes
*	canned powerpoints
*	checklist for accessing airspace
*	Clear requirements for training
*	Computer automation
*	Confidence/obstacle course as a final test of pilot proficiency.
*	Depend on mission sets
*	Drone model specific training
*	FAA defined training standards for drone pilots.
*	First person point of view simulation
*	Flight course aid
*	For the MCE portion of my job a more in depth relationship with the customers (USCENTAF) intelligence assets would allow my company to provide a much better product to the US Government.
*	Full GCS simulator with loadable missions and injectable faults and scenarios
*	Handouts and maybe some fundamental flight tips on cards that fit into a wallet or small handbook
*	Hands on training
*	Hardware inspection carried out routinely every 6 months by qualified inspectors/engineers to reduce the risk of in-flight malfunctions.
*	I am not sure that I understand the question. Examples please?
*	I can't come up with any.
*	Laminated air space maps
*	More accurate/realistic simulators would aid in instructing trainees. Our current simulators have multiple limitations.
*	More education and flight training

C67. What kind of additional job aids might be useful for your position?	
*	More flight time, as well as more simulation time. I am a new and poor RC pilot of both helicopters and planes. I learned the importance of recent flight experience.
*	More hands on application
*	more online courses available for a reasonable cost
*	More online resources.
*	More practice tests for the FFA certification.
*	More robust ground control software.
*	More time mission planning.
*	More training and hands on experience. More exposure to industry practical scenarios.
*	more UAS for training
*	more visual observers
*	None that I can think of. A lot of my training came from being an aircrew member
*	None, we have it well covered. NOAA OMAO is there to support us and we fly with a 2 person team.
*	Not sure what your looking for on this question.
*	OEM published material
*	Operational standards for FAA certification instead of just a written test.
*	over the shoulder one on one training in all aspects
*	Photography & Cinematography knowledge and having a creative eye is what we look for, training to fly our UAS units is something we can start from the ground up.
*	Puncture, tear-resistant clothing. Satellite communications
*	Real life situation based training
*	Sample training materials peer reviewed and FAA recommended.
*	Simulators that are good enough to use on bad-weather training days.
*	TCAS or other deconfliction aids.
*	The LANCC system has been very helpful to get instant airspace approvals to know heights.
*	The standard job description so I know exactly what is expected of me in my role. To set ongoing goals or benchmarks for the position to be reviewed by another peer.

C67. What kind of additional job aids might be useful for your position?	
*	TRAFFIC MANAGEMENT
*	Training aids should also be intuitive and very supportive.
*	Training on how to safely modify drones for carrying custom scientific equipment.
*	Unsure
*	Video play back
*	We created job aids for NOAA for UAS operations in oil spill and hurricane response.
*	We have free access to simulators, regulations, and training materials.
*	wind forecast
*	Wish it was easier to find out information from the FAA on the part 107 exam. Whoever builds their websites makes them like a maze.