# APPENDIX G—VISUAL OBSERVER CERTIFICATION AND TRAINING CRITERIA

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

## EXECUTIVE SUMMARY

As stated in the *Unmanned Aircraft Systems (UAS) Operational Approval* policy notice, visual observers are expected to be responsible for helping pilots keep UAS within visual line of sight and for exercising see-and avoid responsibilities. In Phase 1 we conducted in-depth interviews with SMEs and surveyed UAS community members. Our participants stated that visual observers must be able to scan the airspace effectively, track aircraft, and make accurate and reliable estimates of (relative) aircraft position, assess the need for a potential avoidance maneuver, and communicate that need to the UAS pilot in a timely manner.

In Phase 2 we collected field recordings of visual observers and other UAS crewmembers during a UAS flight test conducted at non-towered airport in Las Cruces, NM. Visual observers tracked the UAS and monitored the airspace for incoming air traffic. Visual Observer's radio messages to the mission commander included the following information, when appropriate: 1) Nature of the communication (new air traffic present or update), 2) Location of the air traffic in relation to UAS, 3) Estimated flight path of air traffic (global or relative to UAS and/or local landmark), 4) Estimated altitude of air traffic, and 5) Relative closing speed and/or time estimate, 6) Assessment of the potential for NMAC or some other mishap, and, when needed, 7) Suggested avoidance maneuver. These findings confirmed what we heard from SMEs in Phase 1: visual observers rely on a combination of visual perception, communication, and team coordination skills to assist pilots in effectively accomplishing see-and-avoid duties during UAS operations.

In Phase 3, we conducted a broad NAS stakeholder survey that focused on two pivotal issues: Should visual observers receive formal training, and should visual observers be required to pass an exam? Participants were approximately evenly split on the need for formal classroom/online and hands-on training. Furthermore, participants favored having to pass a formal classroom/online exam (although the trend was not quite statistically significant), whereas, participants were generally against a formal practical exam.

Due to the complexity and human factors involved in UAS operations, it is recommended that future rulemaking take into account persons' existing certificates. **It is thus recommended that licensed manned/unmanned aircraft pilots should not require any additional training or certification to act as visual observers in UAS operations, regardless of platform weight. On the other hand, previously unlicensed persons who would like to serve as visual observers can rely on existing print/online materials for training and should be certified with a process similar to what the FAA is currently using for Part 107 licensure.**

## 1. BACKGROUND

As stated in the *Unmanned Aircraft Systems (UAS) Operational Approval* policy notice[7], visual observers (VOs) are expected to be responsible for: 1) helping UAS pilots keep the aircraft within visual line of sight (VLOS), and 2) exercising see-and avoid responsibilities by preventing the unmanned aircraft from creating a collision hazard and maintaining compliance with 14 CFR § 91.111[10], 91.113[11], and 91.115[12]. To ensure that these functions can be performed adequately, VOs must be able to scan the airspace effectively, track aircraft, and make accurate and reliable estimates of (relative) aircraft position, assess the need for a potential avoidance maneuver, and communicate that need to the UAS pilot in a timely manner[4].

These guidelines, along with a number of others were reiterated in the FAA's recent Small UAS Rule (14 CFR § 107[13]) for civil UAS operations in the National Airspace System. The proposed language states that flights are limited to small UAS (sUAS; 55 lbs. or less) operated within visual line-of-sight (VLOS) in visual meteorological conditions. In addition, a VO is required in scenarios where the pilot cannot consistently maintain VLOS and carry out see-and-avoid duties, such as when the pilot in command (PIC) expects to be in a heads down position or their view of the airspace is otherwise obstructed. Furthermore, a VO is needed for any operations above 400ft above ground level or beyond 1500ft laterally from the PIC; two VOs are needed when the PIC is in an enclosure. While the regulations provide medical standards for VOs, training and certification criteria have yet to be pinned down.

While regulations have been established for sUAS, operating larger platforms inherently carries more risk due to the increased momentum of the aircraft while in flight. Compared to sUAS, UAS platforms larger than 55lbs are flown with the PIC inside an enclosure more frequently. Thus, it follows that flying such aircraft in the NAS will require VOs to be present in a variety of operational scenarios and settings. Furthermore, the added risk in such operations provides a clear impetus to standardize VO training and establish performance benchmarks such that VOs can become certified.

## 2. GENERAL METHODOLOGY

To address this timely and complex issue, we have established a three-phase approach based on Activity Theory (AT). Activity Theory is a meta-analytic research framework that considers an entire work/activity system (including teams, organizations, etc.) beyond just one actor or user[8]. It accounts for environment, history of the people, culture, role of the artifact(s), motivations, and complexity of real life activity[8]. One of the strengths of AT is that it bridges the gap between the individual subject (in our case: a VO or pilot) and the social reality—it studies both through the mediating activity (in our case: UAS operations). The unit of analysis in AT is the concept of object-oriented, collective and culturally mediated human activity, or *activity system*[8]. This system includes the object (or objective, in our case: Safe UAS Operations in the NAS), subjects (in our case: UAS crew), mediating artifacts (signs and tools, in our case: UAS Control Stations and other technologies), rules (14 CFR § 91.111[10], 91.113[11], 91.115[12] and 107[13]), community (in our case: all other aircraft and other stakeholders), and division of labor (in our case: function allocation). According to Bonnie Nardi, a leading theorist, activity theory "focuses on practice, which obviates the need to distinguish 'applied' from 'pure' science—understanding everyday practice in the real world is the very objective of scientific practice."[9]

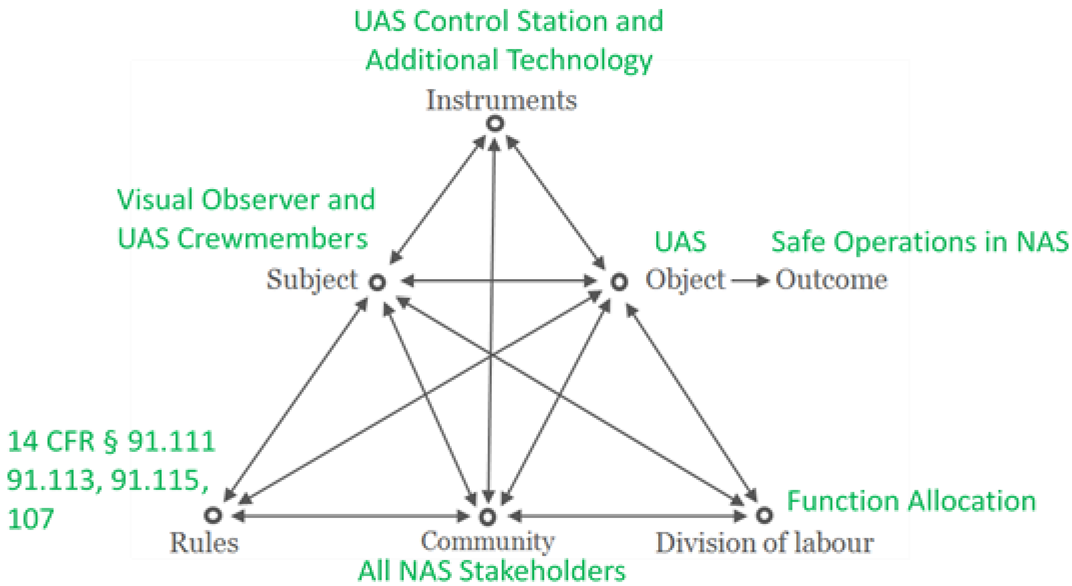


Figure 1. AT diagram of UAS operations in the NAS; typical components of the AT diagram are depicted in black and specific components of the current research are labeled in green. Other members of the A7 team are tasked with investigating the training requirements for UAS pilots, as well as the top (control station design) and bottom right (function allocation) corners of the diagram.

Systemic-structural activity theory (SSAT), which we are using in this research, represents a modern synthesis within activity theory that brings together the cultural-historical and systems-structural strands of the tradition with findings and methods from human factors/ergonomics and cognitive psychology[1,2,3]. The development of SSAT has been specifically oriented toward the analysis and design of the basic elements of human work activity: tasks, tools, methods, objects and results, and the skills, experience and abilities of the involved team/crew members[1,2,3]. SSAT has developed techniques for qualitative and quantitative description of work activity. Its design-oriented analyses specifically focus on the interrelationship between the structure and self-regulation of work activity (in our case: pilot and VO tasks), as well as the configuration of its material (in our case: control station design) and social (in our case: function allocation) components.

# 3. PHASE 1

## 3.1 METHODS

In the initial phase of this research (New Mexico State University Institutional Review Board [NMSU IRB] #12314), we set out to better understand the heart of the AT diagram (

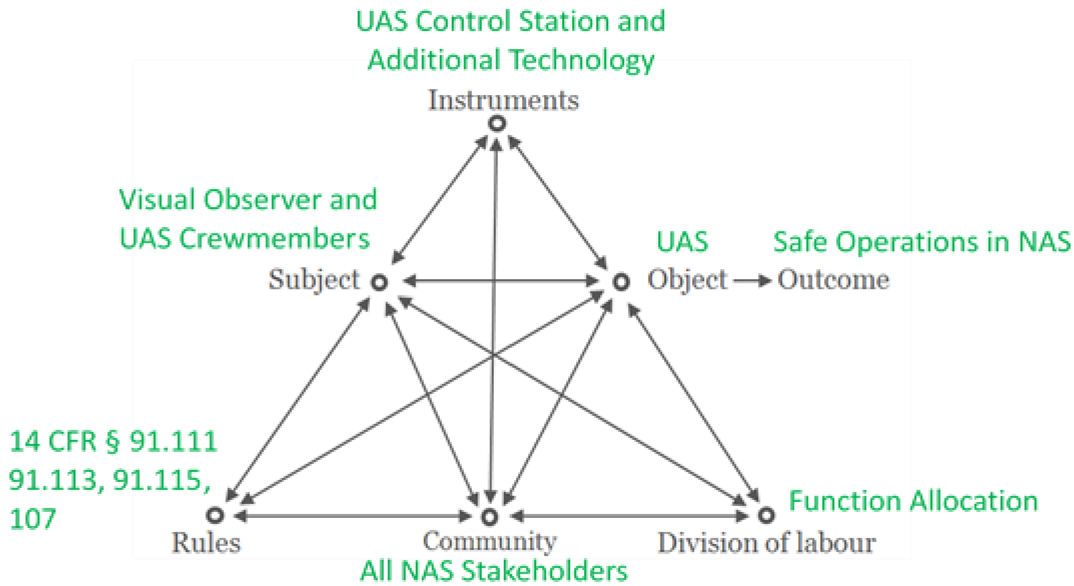


Figure 1), namely the relationships between UAS platforms, crewmembers, and the aviation community. We began by interviewing three subject matter experts (SMEs) who were licensed manned aircraft pilots and also performed the roles of UAS pilot, VO, and mission commander. We selected these individuals due to their deep understanding of all parts of manned and unmanned aircraft operations in the NAS. These interviews were transcribed and coded to examine SME's background, training, assessment of vital skills and technologies needed to perform VO duties, assessment of UAS operation risks in various conditions, and assessment of various current and potential UAS regulations. The findings from the SME interviews were used to construct an open-ended survey that was distributed to various stakeholders in the UAS community via social networking groups, online forums, and mailing lists (NMSU IRB #14021, see Appendix G2).

## 3.2 FINDINGS

Our SMEs reported that proficiency with the following VO skills is critical for safe UAS operations in the NAS:

- Tracking unmanned and manned aircraft in various lighting and meteorological conditions
  - Must be able to maintain VLOS
  - Must be able to re-engage visual contact after loss and/or distraction
- Scanning airspace for approaching air traffic
  - Must be able to shift visual depth of field
- Informing pilot of impending near mid-air collision (NMAC) (or some other danger) with enough time for the pilot to take appropriate action
  - Must maintain cockpit discipline

- o Must use appropriate verbiage when communicating with the pilot
- o Must be able to use global bearings and local landmarks to identify positions of UAS and other air traffic
- o Must be able to estimate aircraft flight paths, altitudes, and closure rates in order to determine the likelihood of an NMAC
- o Must be able to determine and communicate correct course of action and a safe deviation from the flight path to avoid a potential NMAC

Thirty participants responded to the survey call. All were male, with a mean age of 47 years. Of the participants, 63% were (or had been) licensed manned aircraft pilots, 60% were (or had been) UAS pilots, and 43% had performed UAS VO duties. Several participants skipped answering parts of the survey, as was their option.

Participants generally agreed that VOs should pass a practical exam and be somehow certified before operating in the NAS. Similarly, participants stated that platform size impacts the risk of UAS operations in the NAS, with larger and faster platforms being riskier. In addition, participants typically stated that BVLOS operations in the NAS were riskier than those where VLOS is maintained; several participants noted that such risks can be mitigated. Furthermore, nearly all participants thought that regulations regarding VO qualifications and certification that were provided in the small UAS rule (14 CFR § 10713) are "about right," for UAS operations, in general. A notable exception was the need for a second-class medical certificate, where the participants often noted their disagreement. There findings informed Phase 2, where UAS operations were assessed in the field.

## 4. PHASE 2

### 4.1 METHODS

To verify and elaborate on the findings of Phase 1, we collected field recordings of VOs and other UAS crewmembers during three phases of UAS flight test conducted at the NMSU UAS Flight Test Center. A visual observer was fitted with a GoPro camera to monitor their activity and a digital video camera recorded activity in an enclosed, mobile ground control station (GCS) during three phases of operations, takeoff, mid-flight, and landing. A researcher was positioned near the VO and took notes on their behaviors and communications. Field notes and digital recordings were examined with attention to function allocation, VO responsibilities and communications between the VO and other crewmembers.

The flight test occurred at the NMSU UAS flight test center (FTC), which is located at Las Cruces International Airport (LRU) in New Mexico. The airport is non-towered and has 3 runways including a precision instrument approach. The platform that we studied was Vanilla's VA001, a large (36-foot wingspan) long-endurance UAS.

### 4.2 FINDINGS

#### 4.2.1 Crew Composition

The flight crew consisted of mission commander, an internal pilot, an external pilot (for takeoff and landing), payload operator, 1-2 visual observers, and the tow vehicle driver (see Appendix G1 for personnel qualifications). Due to the duration of the flight, multiple people rotated in each role. In accordance with the NMSU FTC flight test plan, 2 visual observers were utilized at time of takeoff and landing for better visual coverage of the airspace. In addition, the aircraft's primary designer, who also played the part of systems engineer, was part of the flight test team.

#### 4.2.2 Communication Networks

As illustrated in Figure 2, the mission commander, internal pilot (also serving as the Pilot-in-Command), and payload operator were all co-located in the mobile control station. The external pilot, tow vehicle driver and visual observer(s) were located outside. The external pilot and VOs were located outside, positioned strategically along a runway and near the (enclosed) mobile GCS. The internal pilot, payload operator, and mission commander were co-located inside the mobile GCS.

Figure 2 also depicts four radio communication networks that were utilized during the flight test: 1) The internal pilot and payload operator communicated with the UAS (shown in red); 2) The external pilot, internal pilot, and tow-vehicle driver communicated with each other on an isolated radio network during takeoff and landing (shown in orange); 3) The mission commander and VOs communicated with each other on another radio network (shown in blue); these communications were audible to the internal pilot, who never communicated directly with the VOs, and 4) The mission commander monitored and advised cooperative air traffic over a public communications frequency (shown in green). Proper cockpit atmosphere was maintained with allowances for flight-test necessary communications.

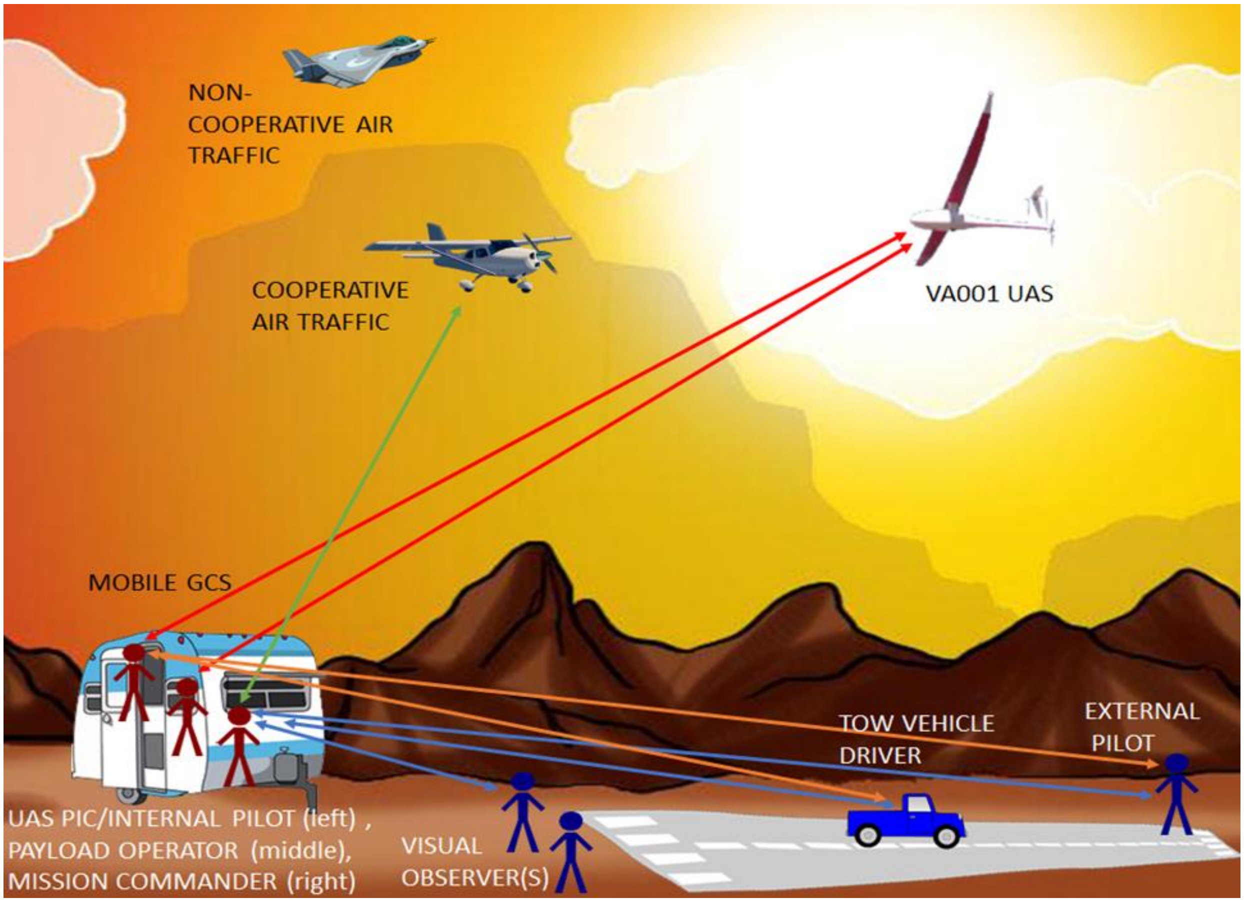


Figure 2. Diagram of the crew and communications networks used during the flight test.

4.2.3 Visual Observer Activities

As specified in 14 CFR § 107[13] visual observers' primary duties entail helping the pilots accomplish effective see-and-avoid. Appropriately, the VO spent the overwhelming majority of the time tracking the UAS and occasionally breaking off to scan the sky and/or to acquire other traffic in the airspace. In instances where incoming aircraft were in the vicinity of the UAS or on a trajectory that may bring them within the UAS's operational area, the VOs communicated this observation to the mission commander via radio. In some instances the mission commander was already aware of the incoming traffic, in which case they informed the VO that the traffic was cooperative. In other instances, the mission commander acknowledged the new traffic and awaited updates from the VO. In addition, the mission commander forewarned the VOs of scheduled traffic in the airspace.

Visual observers radio messages to the mission commander included the following information, when appropriate: 1) Nature of the communication (new air traffic present or update), 2) Location of the air traffic in relation to UAS, 3) Estimated flight path of air traffic (global or relative to UAS and/or local landmark), 4) Estimated altitude of air traffic (relative to UAS), 5) Relative closing speed and/or time estimate, 6) Assessment of the potential for NMAC or some other mishap, and, when needed, 7) Suggested avoidance maneuver.

Field notes and recordings obviated that tracking the UAS was not difficult, regardless of the time of day. However, when the VO needed to divert their attention to other air traffic, visually re-acquiring the UAS was not always instantaneous. In such instances auditory cues became even more important and the VO was observed responding to the sound of the UAS engine before locating it visually.

The findings of Phase 2 confirmed our findings from Phase 1, namely that VOs rely on a combination of visual perception, communication, and team coordination skills to assist pilots in effectively accomplishing see-and-avoid duties during UAS operations. In the current scenario, the pilots' workload was offloaded in three ways: takeoff and landing flight dynamics were offloaded to the external pilot (and tow vehicle driver), see-and-avoid duties were offloaded to VOs and some communications were offloaded to the mission commander. The mission commander monitored cooperative air traffic communications and only relayed mission critical information to the pilot. In a crew configuration where any of the noted personnel are not present, the task of the UAS pilot becomes that much more difficult.

## 5. PHASE 3

### 5.1 METHODS

To verify and elaborate on the findings of Phases 1 and 2, we conducted a broad survey of NAS stakeholders focusing on two pivotal issues: Should VOs received formal training, and should VOs be required to pass an exam? (NMSU IRB #15418, see Appendix G4).

### 5.2 FINDINGS

Two-hundred and three persons responded to the survey call; of those 91 did not provide enough information to conduct an analysis. Thus, we trimmed the dataset to 112 participants (96 male, 13 female, 1 other, 2 not reported); the mean reported age was 43 years. Participants' roles in aviation varied and are illustrated in Figure 3.

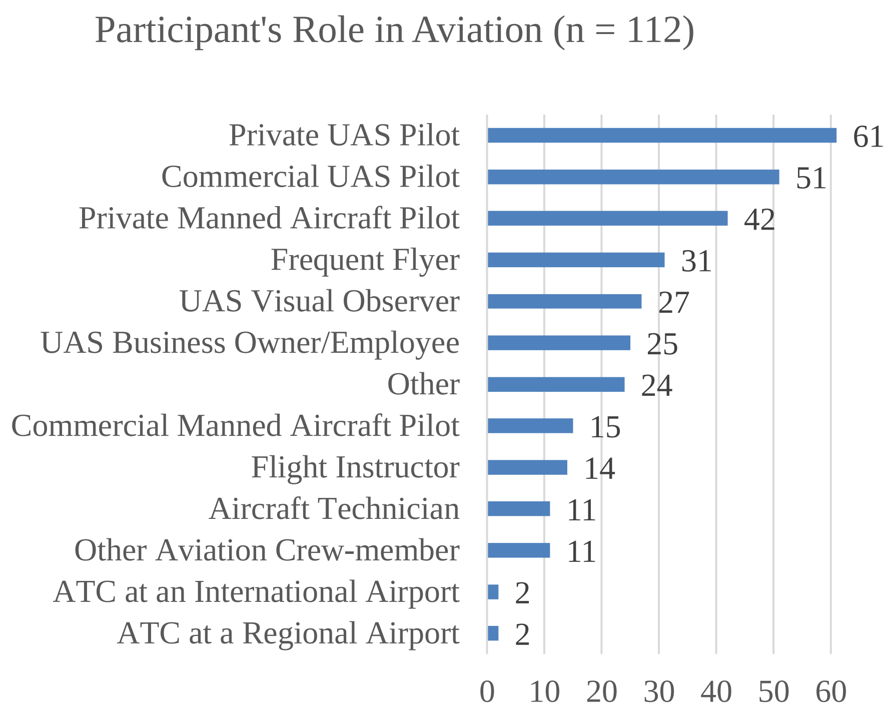


Figure 3. Graph depicting participants' reported roles in aviation; the total number of included participants is 112. Participants could select multiple categories.

As shown in Table 1, participants were approximately evenly split when answering the questions of whether VOs should receive formal classroom/online and hands-on training. While participants favored having to pass a formal classroom/online exam, the difference in Yes/No response counts was not significant. Furthermore, participants were generally against a formal practical exam; this was the only significant difference identified by $\chi^2$ (chi-squared) tests.

Table 1. Yes/No counts for survey responses and results of statistical ($\chi^2$) tests. Probabilities less than 0.05 are considered statistically significant and are indicated with a *.

| **Should VOs:** | **Yes** | **No** | **$\chi^2$ Value** | ***p* (probability)** |
|---|---|---|---|---|
| Receive formal classroom/online training? | 58 | 54 | 0.07 | 0.71 |
| Receive formal practical (hands-on) training? | 55 | 57 | 0.16 | 0.57 |
| Take a formal classroom/online exam? | 61 | 51 | 0.64 | 0.26 |
| Take a formal practical (hands-on) exam? | 43 | 69 | 5.79 | 0.00006* |

Multinomial logistic regression and maximum likelihood ratio tests were then conducted to determine whether participants' roles in aviation and age predicted their responses to the questions in Table 1. The models could not significantly predict Yes/No responses to the first three questions in Table 1. However, participants roles did significantly predict responses to the final question [$\chi^2(12)=25.4$, $p=0.013$, Nagelkerke pseudo-$R^2=0.28$]. More specifically, commercial UAS pilots [$\chi^2(1)=3.6$, $p=0.058$] were marginally more likely to respond 'No,' whereas ATCs [$\chi^2(1)=3.2$,

$p$=0.073] and aircraft technicians [$\chi^2(1)$=8.1, $p$=0.004] were significantly more likely to say 'Yes.' Furthermore, older participants were marginally more likely to respond 'Yes' [$\chi^2(1)$=3.55, $p$=0.06].

Fewer than half of the participants provided reasons for their Yes/No answers. When examining the reasons for why participants felt that training and examination were necessary, participants noted the usefulness of classroom training in understanding NAS regulations and manned/unmanned aircraft operations, as well as increased risk due to platform size. For example, one participant stated, "Visual observers must be familiar with aeronautical information and performance standards in order to judge performance and assess hazards properly." Another stated, "Knowledge of airspace, meteorology, and human factors and crew resource management will help make for a more competent and safe crew." Those participants that felt that practical training was needed stated that hands-on knowledge is irreplaceable. For example, one participant noted that, "[VOs need] practice acquiring and re-acquiring UA at different distances and altitude, [and to] understand how to determine the attitude and distance from the GCS of the UA.stated," and another said, "[Hands-on training is needed] because practical lessons provide a more realistic perspective to real world situations." When examining the reasoning for 'No' responses across the questions, most participants simply did not answer this question or stated that formal training and/or testing was not needed.

When recommending training regimens, participants mainly suggested online/print materials, such as the *sUAS Airmen Certification Standards* manual, the *small Unmanned Aircraft Systems (sUAS) ALC-451* online course, the *Federal Aviation Regulations Aeronautical Information Manual* [FAR AIM], and commercially-available VO self-study guides. One participant that thought practical training was necessary mentioned simulator training as an option. Furthermore, another participant stated, "[Hand-on testing should be a] continuation of the formal practical training, another day would be the test day, where a spotter would be paired up with an operator who will then ensure the spotter goes through the list of operations correctly, and may even test them by trying something not allowed."

In sum, while NAS stakeholders acknowledge the added risk of operating a UAS larger than 55 lbs., there is currently a lack of consensus regarding whether training and/or certification needs to be mandated. Significantly more participants thought that practical (hands-on) testing was not necessary than those that did. In addition, although participants somewhat favored classroom/online certification, the difference in Yes/No counts was not statistically significant. However, this trend is likely to become statistically significant with a larger sample size and is indicative of numerous factors that make operations of such aircraft more dangerous than their lighter counterparts.

## 6. FINAL RECOMMENDATIONS

Due to the complexity and human factors involved in UAS operations[4,5,6,14], it is recommended that future rulemaking take into account persons' existing certificates. Licensed pilots have already mastered all of the essential skills needed to carry out VO duties. Furthermore, licensed pilots have already been trained and certified in their knowledge of rules and regulations pertaining to operations in the NAS. Moreover, manned and unmanned aircraft pilots have a multitude of hours performing seek-and-avoid duties, are well versed in aviation verbiage, and are trained in maintaining a proper cockpit discipline. **Thus, it appears that licensed manned/unmanned aircraft pilots should not require any additional training or certification to act as VOs in UAS operations, regardless of platform weight. On the other hand, the added risk involved in operations of UAS greater than 55lbs suggest that previously unlicensed persons who would like to serve as VOs can rely on existing print/online materials for training and should be certified with a process similar to what the FAA is currently using for Part 107 licensure.**

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## 8. APPENDIX G1: SME QUALIFICATIONS (PHASE 1)

SME #1: This SME has been employed as a UAS test pilot since 2011; he has over 1,000 hours of UAS flight time including flying the Predator in combat for the United States Army and then training UAS pilots as an employee of General Atomics. In that time he has logged over 500 hours performing various duties including UAS mission commander and visual observer. He is a licensed private pilot with over 3,000 hours of flight time over a period of three decades; he is also IFR rated.

SME #2: This SME has been employed as senior UAS test pilot since 2008; he has over 1,000 hours of UAS flight time including fixed wing and rotor wing UAS. In that time he has logged over 500 hours performing various duties including UAS mission commander and visual observer. He is also a private pilot with over 2,000 hours of flight time over a period of two decades; he is also IFR rated.

SME #3: This SME is a UAS pilot and has conducted UAS-assisted agricultural research since 2009; she has over 300 hours of UAS flight time on fixed wing. In that time she has logged over 300 hours performing various duties including UAS mission commander and visual observer. She is also a private pilot with over 500 hours of flight time over a period of a decade; she is also IFR rated.

## 9. APPENDIX G2: UAS CREWMEMBER SURVEY (PHASE 1)

This survey contains several questions about your background and training for UAS Operations, as well as your opinion of various regulations for UAS operations in the National Airspace System. Please provide detailed responses. However, if you do not feel comfortable answering certain questions, you should always feel free to partially answer or skip them.

1) Demographics questions
    a. What is your age?
    b. What is your gender? (M/F/O)
    c. Are you/Have you been a licensed pilot (Y/N)?
2) Current and Prior Experience. In what capacities have you been involved in UAS operations? Please provide details regarding the type of entity for which you operated UAS (like a government agency/military/company/university flight test center/recreational/etc.), your role(s), the particular UAS platform(s) involved, and the duration of your involvement. You do not need to describe individual missions, just the overall experience performing UAS-related duties. If you've had several such experiences with multiple entities, please briefly describe the most noteworthy ones. Additional response boxes are provided if you have had multiple experiences performing UAS operations duties.
    a. Experience 1
    …..
    e. Experience 5
3) Training questions. Please include the role/position for which you were training in your responses, especially if you have been trained multiple times.
    a. What kind of training and/or certification did you complete before you participated in each of UAS-oriented experiences mentioned in your answer to the previous question? Please provide details regarding the training materials and procedures, duration, and any certification requirements.
    b. What were the most valuable and effective aspects of your training for performing your duties during UAS operations?
    c. What were the least valuable and effective aspects of your training for performing your duties during UAS operations?
    d. Were there scenarios that you faced in the field in which your training failed or was inadequate? If so, please describe those scenarios and how you compensated.
    e. What technologies (aside from UAS control station), if any, help you perform your duties better? How so? Were you trained in the use of these technologies? If yes, how?
    f. Drawing on your training and prior experience, what are the needed skills and technologies for UAS pilots/visual observers to effectively accomplish see-and-avoid during operations?
    g. If you are a trainer or instructor of UAS pilots or visual observers, or are somehow involved in a similar role, please describe the training program that is currently in place in detail, as well as any requirements for certification upon its completion. If you are neither, please respond "N/A."
4) The FAA's recent small UAS rule (14 CFR Part 107) for civil UAS operations in the National Airspace System states that flights are limited to small UAS (55lbs or less) operated within visual line of sight (VLOS) for the UAS pilot during daylight hours in visual meteorological conditions.

   a. If you have experience in UAS operations of more than one size (for example, micro, small, large), please contrast them, with special attention to the risk involved.
   b. If you have experience operating UAS at night, please contrast them with daytime operations please contrast them, with special attention to the risk involved.
   c. If you have experience operating UAS beyond visual line of sight, please contrast them with operations in which VLOS is maintained please contrast them, with special attention to the risk involved.

5) With special attention to the risks involved in UAS operations, do you think the following limitations on UAS operations are too lenient, too strict, or about right? Why?
   a. The pilot-in-command (PIC) must be able to see or ensure that a VO is able to see the aircraft throughout the entire flight well enough to: know its location, determine its altitude and direction to exercise effective control, and observe the airspace for other air traffic or hazards.
   b. Operations conducted above 400 feet AGL or beyond 1500 feet laterally from the PIC must have at least one dedicated visual observer, even if VLOS can be maintained by the PIC.
   c. When the PIC is (expected to be) in a “heads-down” or any situation that precludes the ability to perform see-and-avoid duties.
   d. When the PIC determines that one or more VOs are necessary flight crewmembers to maintain the safety of the operation.
   e. When the PIC is within an enclosure, at least two visual observers are required.
   f. Operations, sometimes referred to as “daisy-chain,” “relay,” or “leap-frogging,” would not be authorized.
   g. The VO will need to be in close proximity (within 10 feet) to the PIC and should be able to communicate directly, to exchange non-verbal signals, and to share the same relative visual references. When this is not possible, a backup communications system is required for operations where the PIC is in an enclosure and cannot directly see at least one visual observer.
   h. Because of the level of vigilance that would be required in tracking a UAS and scanning the surrounding airspace, a VO would be prohibited from supporting more than one aircraft operation at a time.

6) With special attention to the risks involved in UAS operations, do you think the following requirements for visual observer certification are too lenient, too strict, or about right? Why?
   a. Medical standards and operational limitations in this proposed rule ensure that the pilot and VO are capable of scanning the airspace of intended operations. An FAA second-class medical certificate is required for commercial operations.
   b. In order to be certified, applicants for a Visual Observer Certificate would be required to pass a practical test with either a certified UAS pilot or instructor.
   c. The VO will be required to have the ability to always know where the UAS is and to discern the altitude and trajectory in relation to conflicting traffic, weather, or obstacles.
   d. The VO will need to be certified in the use of appropriate communications protocols/technologies during UAS operations.

# 10. APPENDIX G3: PERSONNEL QUALIFICATIONS (PHASE 2)

As noted in the main document, the flight lasted 56 hours and required multiple people to rotate in the mission commander, internal pilot, and visual observer roles. Qualifications are provided for those individuals that were on duty during times of data collection.

Mission Commander: The mission commander has been employed in this role with the NMSU UAS FTC since 2010. He has logged over 300 hours performing various duties during UAS FTC operations. He is a licensed private pilot with over 10,000 hours of flight time over a period of six decades.

Internal Pilot: The internal pilot has been employed in this role with the NMSU FTC since 2011; he has over 1,000 hours of UAS flight time including flying the Predator in combat for the United States Army and then training UAS pilots as an employee of General Atomics. He has logged over 500 hours performing various duties during UAS FTC operations. He is a licensed private pilot with over 3,000 hours of flight time over a period of three decades; he is also IFR rated.

External Pilot: The external pilot has employed in this role with the NMSU FTC since 2008; he has over 1,000 hours of UAS flight time including fixed wing and rotor wing UAS. He has logged over 500 hours performing various duties during UAS FTC operations. He is also a private pilot with over 2,000 hours of flight time over a period of two decades; he is also IFR rated.

Visual Observers: Each of VOs had performed such duties for the NMSU UAS FTC for 5 or more years and had logged at least 200 hours during UAS FTC operations.

## 11. APPENDIX G4: BROAD NAS STAKEHOLDER SURVEY (PHASE 3)

Please try to answer all questions to the best of your ability. If you do not feel comfortable answering any of the questions (or their parts), please feel free to skip them.

1) Demographics (uses Government-provided definitions for items C and D).
    a. Age ____ b. Gender _____ c. Race _____ d. Ethnicity _____
2) What is your (current or past) role in the field of aviation? (Please check all that apply)
    a. Private Manned Aircraft Pilot
    b. Commercial Manned Aircraft Pilot
    c. Private Unmanned Aircraft System Pilot
    d. Commercial Unmanned Aircraft System Pilot
    e. Unmanned Aircraft System Visual Observer
    f. Other Unmanned Aircraft System crewmember (mission commander, payload operator, etc.)
    g. Air Traffic Controller at a Regional Airport
    h. Air Traffic Controller at an International Airport
    i. Manned/Unmanned Aircraft Technician
    j. Frequent Flyer
    k. Other _______________
3) Currently, 14 Code of Federal Regulations Part 107 states that unmanned aircraft, 55lbs and under, may operate in Class G airspace (and classes B, C, D, and E with ATC approval), provided that they do so during visual meteorological conditions and within visual line of sight. In certain scenarios (pilot in heads-down position or in an enclosure), a visual observer is required during operations. Currently, no certification or training is required for visual observers involved in such operations? Do you think that visual observers involved in unmanned aircraft system operations greater than 55lbs should be required to:
    a. Receive formal classroom/online training? (Y/N)
    b. Receive formal practical (hands-on) training? (Y/N)
    c. Pass a formal classroom/online certification exam? (Y/N)
    d. Pass a formal practical (hands-on) certification exam? (Y/N)
4) If you answered 'Yes' to any of the items in question #3, please explain the reason why. (Please write N/A for corresponding items to which you answered 'No' in Question #3.)
    a. _____
    b. _____
    c. _____
    d. _____
5) If you answered 'Yes' to any of the items in question #3, please explain what kind of training/certification procedures would be ideal. (Please write N/A for corresponding items to which you answered 'No' in Question #3.)
    a. _____
    b. _____
    c. _____
    d. _____