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ASSURE

Alliance for System Safety of UAS through Research Excellence

UAS Center of Excellence
Human Factors Research

Ellen J. Bass,
Drexel University

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Unmanned Aircraft Systems (UAS) Human Factors Considerations

Ellen Bass
Drexel University

Igor Dolgov
New Mexico State University

Phil Smith
The Ohio State University

John Bridewell
University of North Dakota

Unmanned Aircraft Systems (UAS) Human Factors Considerations - Overview

Need – This research addresses human factors safety concerns that are unique to UAS to support development of standards, regulations, and guidance for civil UAS. This research addresses four synergistic areas:

1. Function Allocation (FA) between UAS Pilot and System Automation;
2. Control Station Standards and Guidelines;
3. Crewmember Training and Certification; and
4. Visual Observer (VO) Requirements.

Approach – The function allocation research will inform the control station recommendations which will in turn inform crew member training and certification recommendations. Empirical studies will inform the VO requirements

Unmanned Aircraft Systems (UAS) Human Factors Considerations - Research Questions

What are the recommended function allocation strategies for UAS human-machine functions?

What measures should be used for making strategy tradeoffs?

What are alternative conceptual approaches for allocation of pre-flight and en route contingency planning and management tasks to different people?

What are the recommended minimum standards and design guidelines for UAS control stations?

What are the function allocation strategies that support those standards and guidelines?

What are the recommended crewmember training and certification requirements, to include pilots and other crewmembers?

What are the recommended visual observer training and certification requirements?

Unmanned Aircraft Systems (UAS) Human Factors Considerations - Research Approach

Function allocation literature review
Planning literature review
Function allocation and controller station initial draft
Function allocation strategy and future research recommendations

Control Station literature review
Control Station Standards and Guidelines and recommendations for future research

Crewmember Training and Certification literature review
UAS Training and Certification Recommendations
Gather data for visual observer study in form of interviews of UAS operators/crewmembers and trainers/instructors.

Refine visual observer study research instruments
Conduct second data collection and Activity Theory analysis for visual observer study

Function Allocation Literature Review

Define literature inclusion and exclusion criteria

- Exclude literature on unmanned ground vehicles, multi-UAV control

Develop a taxonomy for characterization of literature

- UAV Type; Ground Control Station Type; Function Allocation Strategy; Participants Task(s) Performed; External Context; Measures of Effectiveness; Experiment Design; …

Search for relevant literature using the outcomes

- Characterize literature in accordance with taxonomy

Subject Matter Expert (SME) interview structure

Produce UAS Function Allocation recommendations

- Identify UAS performance trends as a function of task automation
- Inform recommendations for UAS Function Allocation strategies based on identification of UAS performance trends
- Identify gaps in the existing literature as areas for future research based on taxonomy categorizations containing insufficient work

Identified a Need for Scenarios

Different use cases that have implications for function allocation, adaptive planning (preflight and airborne) and control station design. Samples of defining dimensions:

- Mission type such as routine freight transport vs. ad hoc operations for security, agriculture and firefighting, etc.
- Fixed wing vs. rotorcraft vs. hybrid operations
- Sterilized vs mixed equipage airspace
- Workstation equipage – desktop vs. laptop
- Remote pilot landing UAS at non-towered site

Contrast tasks and associated human factors requirements for planning and function allocation (people and technologies) for manned operations vs. UASs for different use cases

- Preflight planning
- Out to In: Departure vs. airborne vs. arrival vs. surface ops (including adaptive planning)

(Pilots as sensors, team members, decision makers, planners and actors)

Scenarios

Scenario 1:

- Fixed wing aircraft used for cargo (Cessna Caravan sized)
- Towered vs non-towered airports
- UAS-only (company owned) vs public airports
- Heavy vs light traffic (airport and airspace)
- Long vs. short stage lengths
- 4 city pairs: San Bernadino CA; Wilmington OH (towered airport with mixture of UAS and manned aircraft); company owned landing strip in Detroit area; Springfield OH (non-towered airport)

Scenario 2:

- Replacement for helicopter cargo ops with rotorcraft UASs
- EWR to downtown NY deliveries by a company like FedEx

Scenario Development

SMEs with expertise in Global Hawk/Predator operations, small UAS operations, Civil Air Patrol visual observer, general aviation, pre-flight planning, enroute monitoring and adaptive planning; training of UAS pilots

- Define and refine scenarios
- Identify human factors issues that arise at different points in these scenarios relevant to function allocation, planning and workstation design

Crewmember Training and Certification

Literature Review Activities

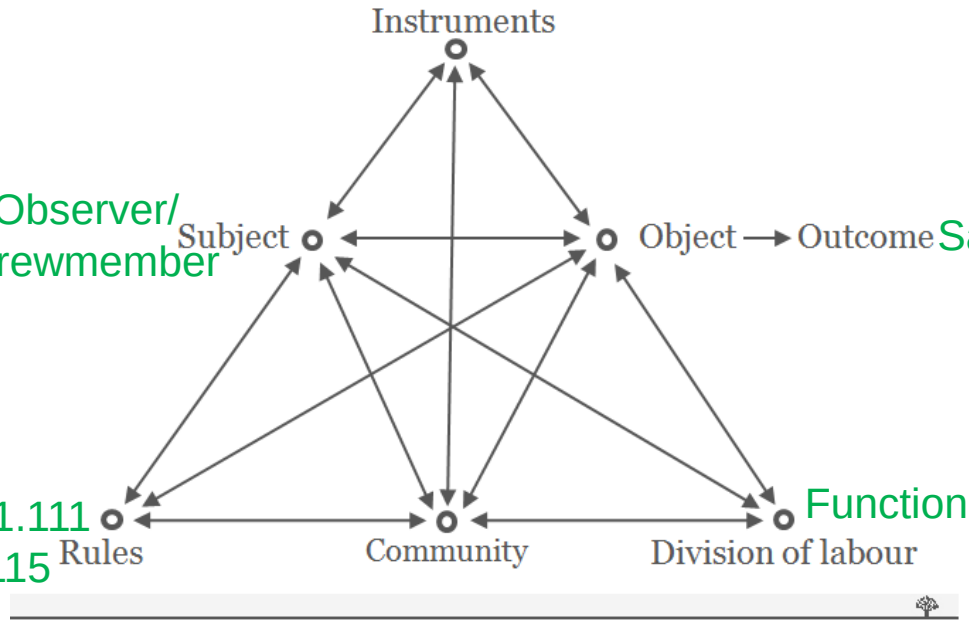
1. Identification of documents of interest
   a) review will apply to UA operators, system operators, visual observers, and mission commanders
   b) envisioned is Part 61-like training
   c) In addition to UAS training literature, look for literature directed towards certification standards for operators of large UAS
   d) UAS medical certification issues/standards, along the lines of Part 67 for manned flight

Visual Observer Certification & Training Req's

Step 1: Select correct descriptive methodology (Completed)

- Systemic-Structural Activity Theory: Quantitative and qualitative methodology
  - Unit of analysis: concept of object-oriented, collective and culturally mediated human activity, or activity system (crew of an UAS operating in the NAS)

UAS Control Station + Additional Tech



Visual Observer/ UAS Crewmember

Safe Operations in NAS

14 CFR § 91.111 91.113, 91.115

Function Allocation

ACTIVITY THEORY FRAMEWORK

Visual Observer Certification & Training Req's

Step 2: Develop first round of surveys/data collection instruments (Completed)

- What measures should be used to get a complete picture of how functions are allocated to the Visual Observer during operations?

Created array of initial experimental instruments for data collection and obtain human-subjects testing permission from IRB

Step 3: Conduct interviews/data collection and perform Activity Theory analysis (In Progress)

- Will determine which training and certification program are currently in place
- Will determine function allocation to visual observers during various types of operations
- Will determine whether VOs/Pilots typically maintain visual contact with the unmanned aircraft in real-world operations
- Deliverable: Mid-project report to A7/ASSURE partners

Visual Observer Certification & Training Req's

Step 4: Develop second round of surveys/data collection instruments based on results of first phase of data analysis and literature reviews from A7 partners (Scheduled to begin 3Q of 2016)

- Considering how functions will be allocated under the newly developed design recommendations for control stations, how will the role of the VO be defined?

Step 5: Conduct interviews/data collection and perform Activity Theory analysis (Scheduled to begin 4Q of 2016)

- Will build a more complete picture of the allocation of functions between visual observers, the pilot, and other crewmembers.
- Will assess feasibility of newly developed recommendations for function allocation (and control stations) from the perspective of VO's duties.
- Deliverable: Final report to A7/ASSURE partners.