Team Composition and Number

- A field team will have a minimum of two people
  - Pilot
  - Safety observer(s): keep eyes on UAV, scans for other aircraft and hazards; the safety observer cannot be looking a screen as human factors studies show this creates distractions. The safety observer should be familiar with that UAS and thus can detect anomalies; the safety observer is not an ad hoc extra person, more likely the back-up pilot.
- The field team may have additional members
  - Mission specialist/agency representative. This person may have no experience with UAS but they are experts. They know what to look for and what is urgent to report back. Usually this team member gets their own mirrored display of what the pilot is seeing so as not to crowd the pilot. Studies suggest that turning control over to the Mission Specialist does not actually speed up the mission or make the Mission Specialist any more comfortable.
  - Co-pilot. This is common for systems where there is a computer control of the flight path. The pilot focuses on situation awareness of the UAS in case of emergency, the co-pilot monitors the path and telemetry, changes waypoints and performs other functions. Human factors studies indicate that the pilot cannot successfully switch mental modes and frames of reference.
  - Bouncer. If the UAS is being deployed from an unprotected area, someone needs to keep bystanders
  - Data manager. This is person who makes sure the data was recorded and backs it up before the next flight or moving to the next area. The data manager is often the co-pilot or safety observer, working while the pilot readies the platform for the next flight.
- There may be team at the base of operations, if only to provide security for equipment while the field team is out and to answer questions. The team member(s) may serve in the following capacities:
  - Data Manager- collating and coordinating for all flights
  - Repairs, maintenance.
  - Team public information officer (this is usually the Team Leader, who serves as the single point of contact for the team and liaises with the agency PIO)

CRASAR Principles and Observations

- The small UAS team must meet the regulatory competencies specified by the relevant agency
- New models of platforms, software upgrades, or team members should NOT be deployed. Only proven technology and teams that have had prior interaction should befielded, otherwise the potential for surprises and mistakes are increased.
- Open source software is not necessarily bug-proof. Software engineering studies indicating that stringing together several software packages introduces bugs from unanticipated interactions. Rigorous system testing is needed.
- The number of people in the field and base of operations should be kept to the absolute minimum in order to reduce the demand on local resources and the personnel accountability for the requesting agency.
- Best human factors principles are essential because pilots will have only seconds to recover from an anomaly.

Human Factors Principles from Manned Aviation

- **Checklists.** Teams should have a complete pre-flight checklist and follow it. Different payloads and missions may require different checklists.
- **Sterile cockpit.** Conversation among team members distracts even when the flight is routine. Chatter should be kept to a minimum. No non-operations talking during the take-off and landing phases (the pilot should announce these to be clear).
- **Hot washes after each flight and at base.** Replay and learn.
- **Rest periods.** The CRASAR heuristic is that 20 minutes of operation is the equivalent of working for 2 hours. Pilots will need rest breaks.

See Chapter 6 Disaster Robotics (R. Murphy, MIT Press, 2014) for more details on team composition, roles, and response etiquette and Chapter 4 for UAS human factors

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