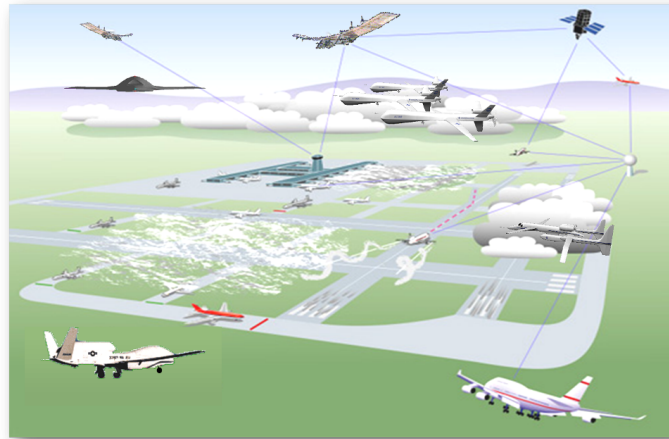# Pilot critical incident reports as a means to identify human factors of remotely piloted aircraft

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Human challenges of remote piloting

- Loss of natural sensing
- Control and communication via radio link
- Physical characteristics of control station
- In-flight transfer of control
- Unique flight characteristics
- Flight termination
- Reliance on automation
- Interfaces based on consumer products

The problem

- Lack of data on Remotely Piloted Aircraft Systems (RPAS) incidents
- Relatively few RPAS reports have been submitted to ASRS by RPAS pilots

Critical incident technique

- In 1940's, researchers asked pilots to recall pilot error incidents
  - Many "errors" reflected poor cockpit design
  - Results led to standardized cockpit design in modern aircraft

Major accident 1

Minor accidents 10

Reportable incidents 30

Minor events 600
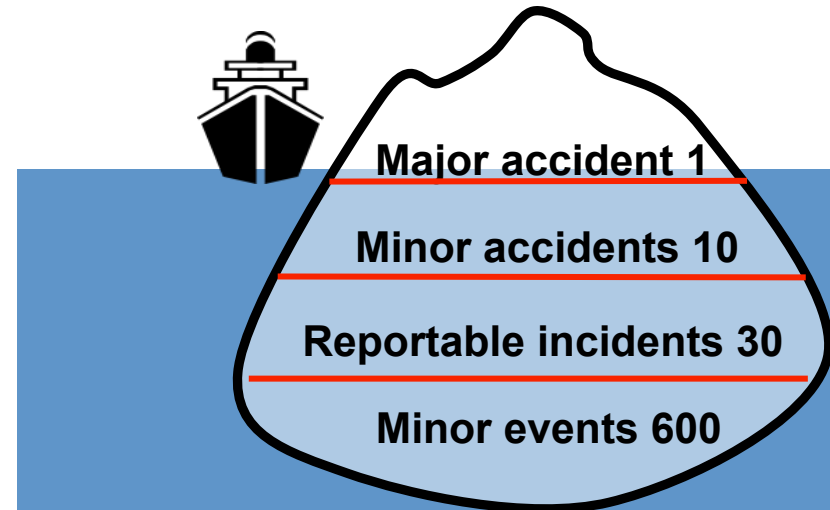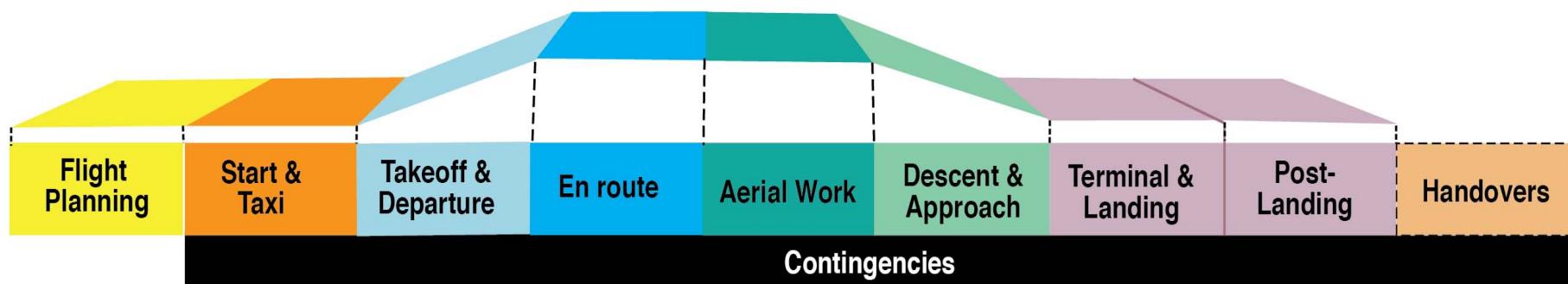
The current study

- Goal: Examine the feasibility of a method to collect the operational experiences of RPAS pilots

  - Information will be used to identify needed improvements in control station design, procedures, training, etc

- Will provide independent and complementary data to supplement NASA simulations and flight tests

Approach

- Focus groups with 2-3 pilots at a time
- Participants asked to recall events that they have experienced while operating a remotely piloted aircraft
  1. A hazardous situation or error

     - Could be about the design of the system, procedures, communication, or other issue
  2. A situation where a hazardous situation or error was identified and rectified
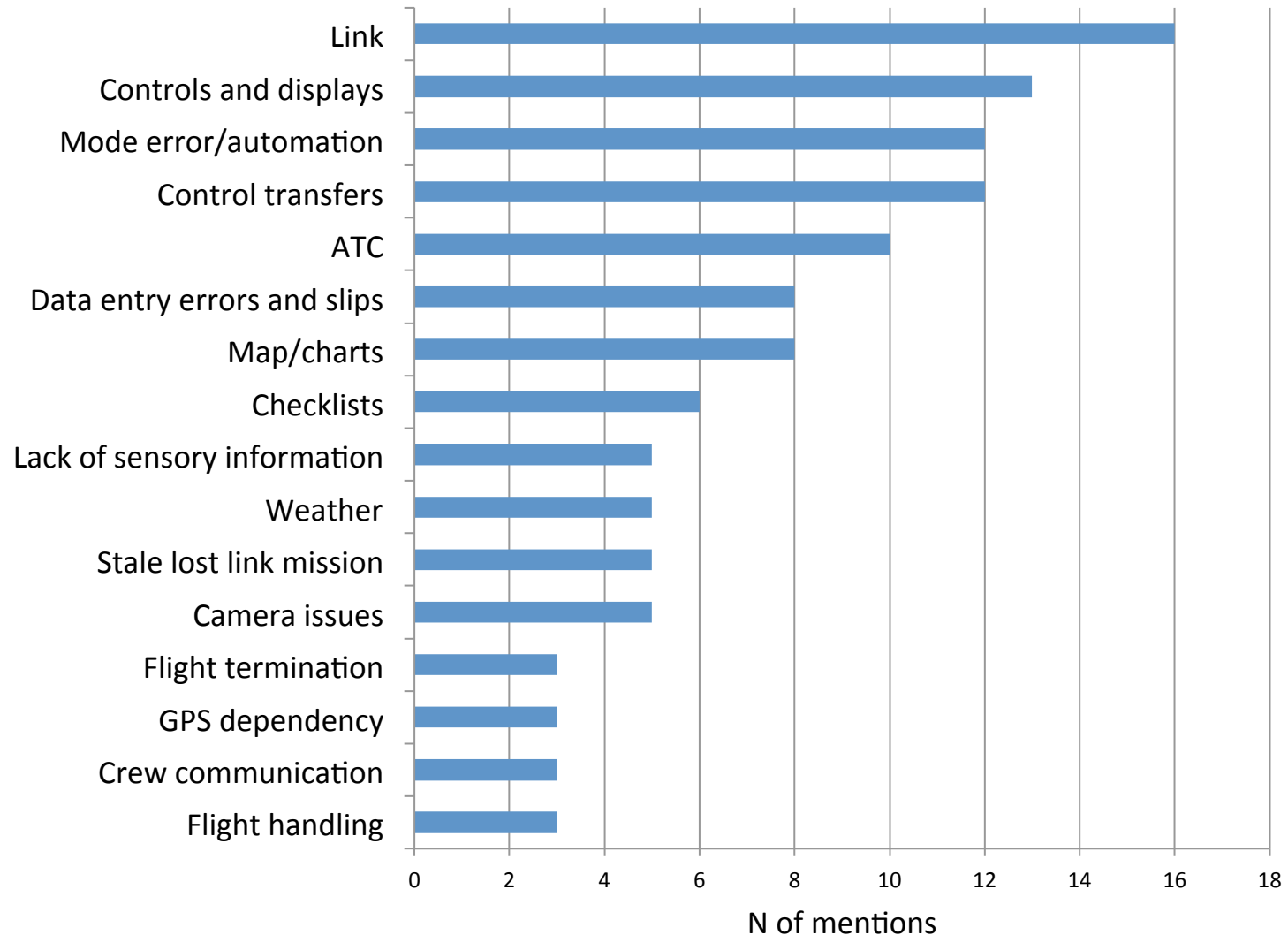
Approach

- Participant identities remain confidential
- De-identified incident reports will be made public

Preliminary results

- 23 participants
- 90 incidents

Preliminary results

Horizontal bar chart titled "N of mentions" showing the following values:

- Link: 16
- Controls and displays: 13
- Mode error/automation: 12
- Control transfers: 12
- ATC: 10
- Data entry errors and slips: 8
- Map/charts: 8
- Checklists: 6
- Lack of sensory information: 5
- Weather: 5
- Stale lost link mission: 5
- Camera issues: 5
- Flight termination: 3
- GPS dependency: 3
- Crew communication: 3
- Flight handling: 3

Link

- Intentional uses of lost link mission
  - During control transfers,
  - Exit from problem situations.
- Use of lost link timer
  - Entering areas with uncertain coverage,
  - ATC certainty.
- Multiple lost links

Lost link

A pilot programmed "lost link okay" for a 3-hour period of time while the aircraft was loitering and on satellite control. While he had the aircraft it actually went into lost link and it was still lost link when I came in to take over. I didn't want to take an aircraft that I have no idea where it's at or what it is doing. I did eventually take over the aircraft and another GCS, who had line-of-sight control, finally took over the aircraft.

Controls and displays

- Keyboard and consumer interfaces
- May be particularly productive of errors
- Shared payload and flight controls

Control transfers

- Inter-control station mode errors
- Unintended transfers

Data entry errors and slips

"I turned the SAS [Stability Augmentation System] off by accident. We use the emergency red button to turn the SAS off, and we do this during normal operations when the ground crew remove the chocks. ... to make sure the ground crew do not get hit if the SAS moves a flight control surface. I had developed muscle memory with the activation of the SAS disengagement button. ... I went to put the gear down, but instead I turned the SAS off using the red emergency button. The aircraft went into a 20-degree bank and 5-degrees nose down. I was able to recover the airplane. Now, the procedure is to turn off the SAS using the ..[keyboard].. instead of using the red button".
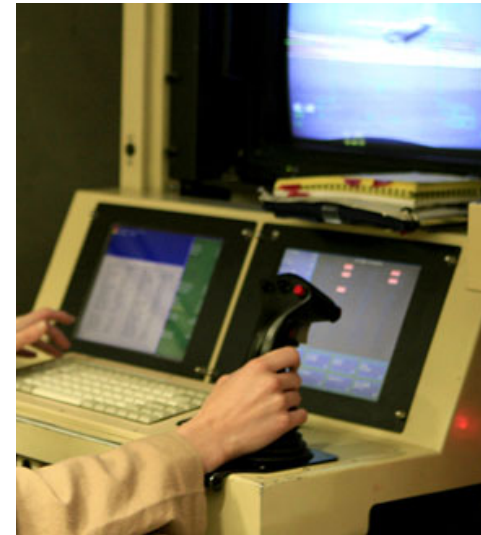
Stale lost link

- Pilot awareness of lost link mission
- Lost link mission needs regular updating
- Lost link mission can be a form of "automation surprise"

Camera view illusions

"Depending on how I do the landing …. (the moveable sensor camera) …will be used to make sure that we clear the turns. But sometimes, the sensor operator will move the camera, which will make it look like that I'm turning but I'm actually not turning. So I have to concentrate and make sure I don't respond to that erroneous camera view".

Conclusions and next steps

- RPAS pilots are willing to share their experience

- Incident reports can help to identify topics for future research

- Results will be used to inform
  - Design guidelines for RPAS control stations
  - Input to FAA & ICAO
  - Incident reporting systems