Flightfax
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Shadow Update 2019

The human error mishap rate for Shadow aerial vehicles (AV) sharply increased in 2019, prompting a need for improvement. Efforts to redesign the system around common errors are constantly ongoing, but new and repeated errors continue in the field. Human error mishaps remain one of the top mishap categories every year, accounting for approximately 32 percent of all mishaps in 2019.

The chart below shows the sharp increase from the previous five-year human error rate.

Overview

During 2019, the error rate increased, with many of the mishaps being repeated errors over the course of the year. If we fail to learn the lessons these mishaps teach us, we are doomed to continue to have higher rates of human error mishaps.

Let's look at some highlighted "repeat" errors we are seeing in the field and the countermeasures units can take to prevent them.

Tactical Automatic Landing System (TALS)

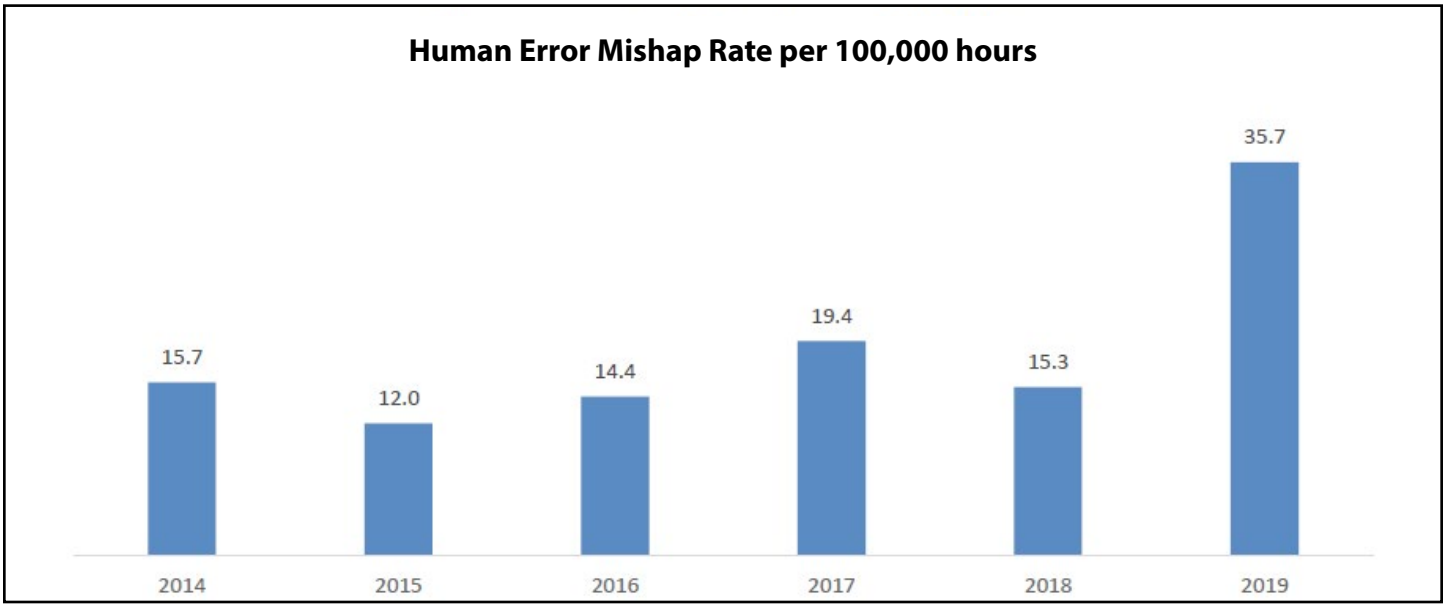
Setup. There have been two mishaps and two near misses due to improper emplacement of the TALS.

Errors:

- Canted TALS pedestal.
- Incorrect value for TALS entered.
- TALS values entered on wrong TALS due to the wrong cable connected.
- TALS Track Subsystem (TSS) staggered array obstructing the transmission path.

Corrective Action:

- Continuation training on TALS site selection.
- Use the checklist and interactive electronic technical manual (IETM).
- Visual centerline markings for crew chief (CE) verification of AV flight path during landing.
- Aircraft operator (AO) and CE crew coordination refresher training.
- AV recovery equipment positioning and marking added to standard operating procedures (SOP).
- TALS cabling marked and identifiable to system
- TSS setup in accordance with (IAW) the TM; no stagger allowed.



Systems

1. **Lithium ion battery.** Several mishaps and near misses were caused by a failure to follow TM limits with respect to the AV lithium ion battery.

Errors:
- Launched with state of charge (SOC) below 40 percent.
- Engine RPM spikes.
- Fluctuating bus voltage.
- Processor warm boots.

Corrective Action:
- Never launch the AV if bus voltage is fluctuating or the battery is not charging after engine start.
- Always ensure an SOC of not less than 40 percent prior to launch.
- Ensure prior to flight that the SOC is high enough to support launch; SOC of > 40 percent.
- Follow procedures: Q-7-20-ASAM-01 AV Power Checks and TM.

2. **Cylinder head temperature (CHT).** An AV was launched with the CHT outside the required operating limitations.

Errors:
- During preflight engine run the CHT was below 80 Celsius.
- The crew failed to acknowledge the red warnings, cautions, and advisories (WCA).
- The crew launched the AV with CHT below minimums.

Corrective Action:
- Never launch the AV if the CHT is not in operating limits for flight.

- Always use the TM.
- Record the CHT and ram air temperature (RAT) and compare prior to launch.
- If inflight CHT drops below 80 Celsius (not due to cold ambient temps), return to base.

3. **Arresting gear (AG) setup.** The AG was improperly inspected and set up.

Errors:
- The net to stanchion connection was too tight.
- The AG pendant was twisted inside the drum, not allowing payout of the strap.
- The unit left an AG on the approach end of runway.

Corrective Action:
- Incorporate pre-landing AG system checks: Net and pendant systems.
- Always use the TM and only one set of AG at the termination end of the runway.
- Units provide continuation training on AG system maintenance, inspection, and setup.

4. **AV Improper mounting.** Two near misses occurred due to improper mounting of the AV on the launcher.

Errors:
- Shortcuts, failed to remove ramps IAW the TM.
- The crew failed to verify the AV lugs were locked in place prior to launch.

Corrective Action:
- Use the TM and follow procedures. NO SHORTCUTS.
- Implement visual, eyes-on-lugs verification of lugs locked in place.
- Implement a secondary lug check by pulling up on the booms to verify they are locked.

5. **Fuel exhaustion.** Fuel exhaustion continues to be a recurring cause of mishaps. All have been due to failure to reset the Enhanced Fuel Transfer Pump (vEFTP) prior to fueling.

Errors:
- Shortcuts, failed to reset vEFTP prior to refueling IAW the TM.
- Failure to make required post-flight logbook entries for fueling.

Corrective Action:

- Use the TM and follow procedures. NO SHORTCUTS.
- Provide continuation maintenance training on proper fueling procedures and logbook entries.
- Prior to launch, verify fuel quantity.
- Fuel in a static AV cannot exceed 48 hours between flights; defuel as required.
- Establish SOP for fueling, defueling, and logbook entries.

6. System link. Near misses caused by primary link interference due to human error.

Errors:

- AVs on same frequency.
- Different control stations trying to control the same AV.
- Operational coordination failure.

Corrective Action:

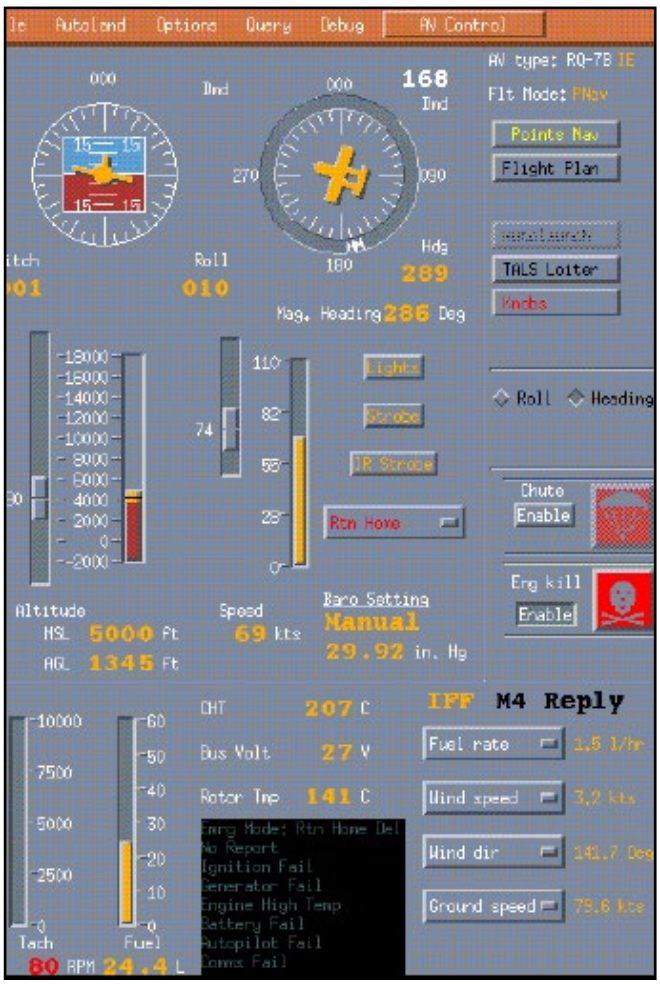
- Units coordinate frequency management.
- Use discrete uplink ground data terminal (GDT) addresses in operating area.
- Ensure one station is controlling one AV and other stations are in "receive-only mode."

7. Supervision. Lack of supervision on systems and inherent dangers associated with operating outside of flight limits has produced a great number of mishaps and near misses for Shadow AVs. We'll focus on the corrective action for the errors listed below:

- Landing with tailwind: Land into the wind if at all possible.
- Launch in wrong mode: Utilize the Launch Interlock Device (LID) for flight operations (prevents launcher fire if not in launch mode).
- Failure to deselect engine kill: Use and follow the TM and checklist (CL) for pre-transfer.
- Digital Terrain Elevation Data (DTED) - Failure to load required equipment: Use CL and load the DTED to all required equipment.
- Perform local disable: Only perform if the system is to be abandoned or seized in a hostile takeover.
- GPS failure - Failed to react to WCA warnings: Continuation training on GPS system and warnings, including simulator.
- Situational awareness: Mission brief and rehearsal, including local area terrain hazards and elevations.
- Improper return home altitude - Setting wrong altitude for the area of operation: Use the TM and verify Return Home Loaded information by the AO and one other crewmember.

8. Maintenance. Failure to use proper procedures and follow the work packets results in numerous errors and mishaps.

- Fuel pump FOD: Minimize foreign object debris (FOD) as much as possible, conduct work on fuel system components indoors if possible and follow the TM.



- Fuel tube kink: Pay particular attention to fuel lines when assembling the AV; do not overstretch them.
- FOD-Pitot: Follow the TM for installation and removal of the pitot system covers and FOD checks.
- Cooling fan utilization: Use fans as necessary to prevent equipment overheating and degraded electrical performance.

9. Ground transport. Transport errors result in an inoperable AV and associated equipment.
- Ground movement - Reduce speed as necessary for the situation.

Changing the Trend

This report was assembled as a contract deliverable to the Army from the Shadow original equipment manufacturer (OEM) and is provided by the Product Manager, Tactical Unmanned Aircraft Systems (TUAS). The Textron field service representatives, OEM and Army engineers, along with PM, TUAS, have laid out areas that require attention to detail with actionable fixes.
The TUAS team urges all Shadow team members and leaders to take action and get these observations lessons down to where the rubber meets the road, the Shadow tactical units. As in all aviation operations and maintenance, leader involvement ensures safe military UAS missions within the limits of acceptable risk.

Source:

Lessons Learned, Shadow V1 and V2 for 2019, UAS Engineering Investigation Group

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