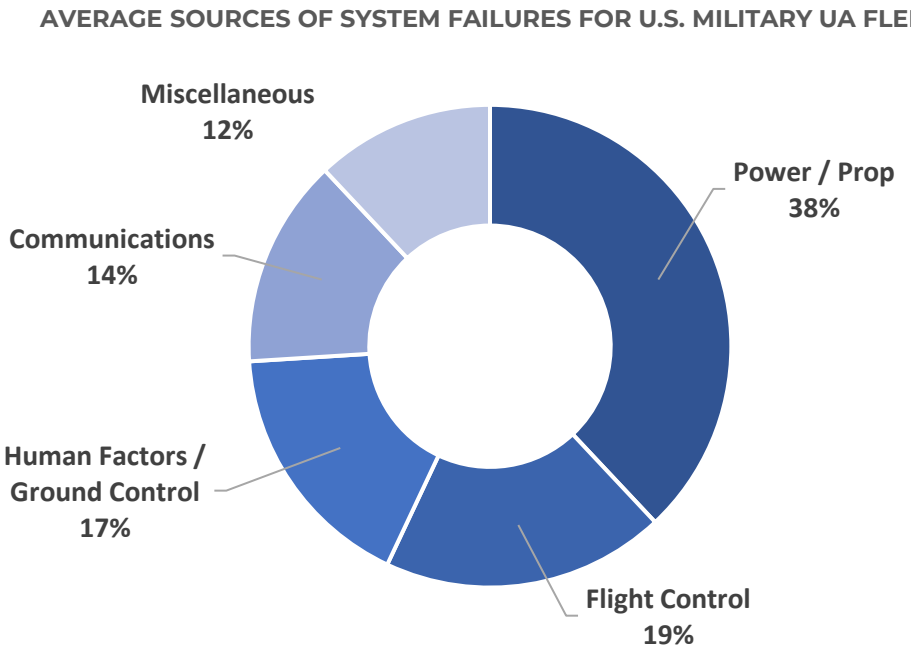
RELIABILITY SERIES 5 OF 5
DRONE CRASH CAUSES
#5 MISCELLANEOUS

In our last blog entry “Causes of UAV Loss” we explained what are the main causes of UAV losses and when they happen.

Let us start with a quick reminder. The US Department of Defense document “Unmanned Aircraft Systems Roadmap 2005-2030” uses the following definitions to categorize areas of a system failure leading to mission aborts or cancellations.



- **Power/Propulsion (P&P)**.
- **Flight Control**.
- **Communication**.
- **Human Factors/Ground Control**.
- **Miscellaneous**. Any mission failures that are not attributable to those previously noted, including airspace issues, operating problems, and other non-technical factors. Because operating environments are not uniform as a variable affecting the data, the weather was excluded as a causal factor in this study.

Now, let’s talk about cause #5, Miscellaneous

Cause #5: Miscellaneous

Looking at the other four causes, it is hard to find what could be included in this category, since the weather is out of the study.

We have found some that could be considered "Miscellaneous":

- **BIRD STRIKE.** For example:

Jul 19 2011 Pakistan Navy GIDS Uqab Mid-flight (bird strike) Pakistan

KARACHI:

A day after a 'collision with a bird' crashed a Pakistan Navy unmanned aerial vehicle (UAV), the navy inducted the reconnaissance drones into its fleet.

The formal induction of the Uqab series drones was announced on Wednesday at the PNS Mehran base here, marking the "first squadron of UAVs" in the armed force.

On Tuesday, a drone from the Uqab series crashed when it "hit an eagle" during mid-flight between 9:30 and 10 am. The UAV crashed at the National Oil Refinery in Korangi after it flew from the PNS Mehran base.

https://tribune.com.pk/story/213634/pakistan-navy-inducts-drones-into-its-fleet

- **EMBEDDED SOFTWARE MALFUNCTION.** For example:

Nov 2 2015 UK Army Watchkeeper Landing (software failure) Salisbury, UK

SERVICE INQUIRY INTO AN ACCIDENT INVOLVING A WATCHKEEPER UNMANNED AIRCRAFT {UA) WK006 AT MoD BOSCOMBE DOWN {BON), WILTSHIRE ON 2 NOV 15

Recommendation. The Panel recommends that Head Unmanned Air Systems Team ensures that the Vehicle Management Systems Computer landing mode software logic is modified to prevent a Ground Touch declaration and post landing actions are being commanded whilst the aircraft is still airborne.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/577237/20161212-WK006-Part1.1-1-4-Page24-RT.pdf

- **SHOT DOWN.** For example:

Feb 12, 2018, Turkey Bayraktar Mid-flight (Shot down?) Efrin, Syria

SDF claims it shot down a Turkish Bayraktar drone that crashed in Efrin

The Syrian Democratic Forces said its fighters shot down a Turkish Bayraktar Tactical UAS that crashed near Quda, a small town in the Rajo district of Efrin near the Syria-Turkey border.

"On February 12, 2018, the air defense of our forces managed to shoot down an unmanned Biraqdar reconnaissance aircraft in Qodeh village of Afrin," the SDF said in a statement.

https://www.thedefensepost.com/2018/02/12/turkey-drone-crash-afrin-bayraktar-sdf/

And that is it. If you can think of any other miscellaneous cause, let us know.

When the weather is considered among the causes, lightning strikes, ice accumulation, and strong winds are among the most common

Example:

Oct 17, 2015, US Air Force MQ-1 Predator Mid-flight (Weather) Kut, Iraq

MQ-1B Predator, T/N 05-3136
CENTCOM AOR
17 October 2015

On 17 October 2015, at approximately 0300 hours Zulu (Z), while conducting a combat support mission in the United States Central Command (CENTCOM) area of responsibility (AOR), the mishap remotely piloted aircraft (MRPA), an MQ-1B Predator aircraft, tail number 05-3136, forward deployed from the 432d Wing, Creech Air Force Base (AFB), Nevada, experienced electronic flight control component failure resulting in loss of aircraft control. The MRPA impacted the ground and was destroyed. At the time of the mishap, the MRPA was operated by a mission control element (MCE) from the 20th Attack Squadron (ATKS), Whiteman AFB, Missouri. The estimated cost of aircraft and munition damage is $5.2 million. There were no injuries or damage to other government or private property.

While transiting to the operations area, the MP identified a layer of clouds directly ahead and above the MRPA's altitude as haze and flew the MRPA into an area of rapidly changing weather undergoing the beginning stages of thunderstorm development. Lightning was present in the vicinity of the MRPA. The MQ-1B is not equipped with lightning protection, thus the effects of lightning-induced high voltage throughout the wiring in the MRPA's wings damaging the left and right-wing control modules. With these components inoperative, and still flying under the base of the developing thunderstorm, the MRPA was unable to maintain controlled flight and impacted the ground.

https://www.airforcemag.com/PDF/AircraftAccidentReports/Documents/2016/101715_MQ1B_CENTCOM.pdf

Library:

We have found very illustrative the following documents or web pages:

US Department of Defense: Unmanned Aircraft Systems Roadmap 2005-2030.
Although old, this document shows an in-depth understanding of how drones started to become a core element in military operations, the implications of UAV reliability, the regulatory framework, and the future of UAV development. The full document can be found at:
https://irp.fas.org/program/collect/uav_roadmap2005.pdf

Drone Wars UK: Accidents Will Happen
Drone Wars published a dataset of just over 250 large military drone crashes that have taken place over the past decade (2009-2018). You can find the links and document here:
https://dronewars.net/2019/06/09/accidents-will-happen-a-dataset-of-military-drone-crashes/

Dedrone: Worldwide Drone Incidents
This page keeps a log of all reported drone-related incidents worldwide, from a small drone invading airport airspace to a drone trying to deliver drugs and phones into a prison yard. Here is the info:
https://www.dedrone.com/resources/incidents/all

George Slensky: Analysis of UAV Military Aircraft Mishaps
Mr. Slensky analyses the main causes of US military aircraft both, manned and unmanned.
https://www.researchgate.net/publication/327135551_Analysis_of_UAV_Military_Aircraft_Mishaps