JAN 2023

UK Civil Aviation Authority

YOU HAVE CONTROL

DRONE EDUCATIONAL & SAFETY ARTICLES

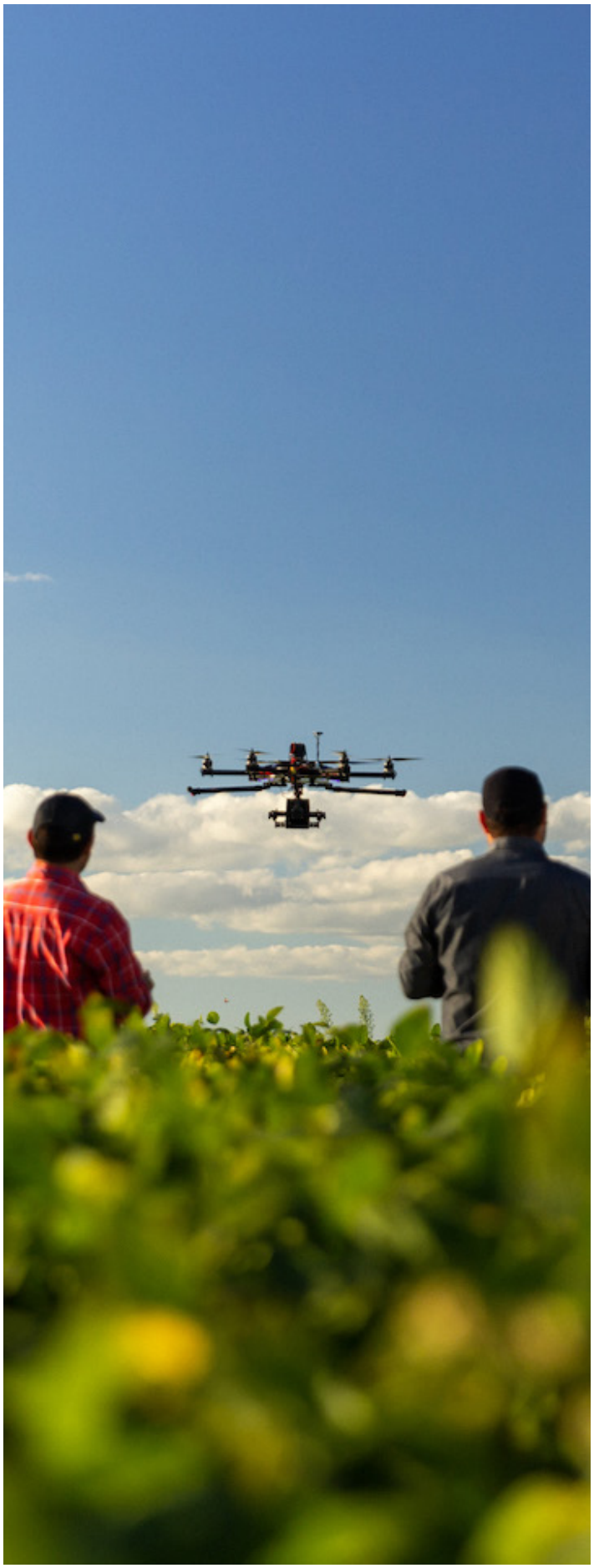
01.

INTRODUCTION

The role of Human Factors (HF) in aviation safety has been recognised and studied since the 1970s. How people behave under stress, when fatigued or impaired; the ease with which we can become distracted by - and sometimes fixated on - non-mission-critical events; the psychology of crew and team interactions; the risks of complacency that comes with familiarity. These are all now well understood by the commercial and military aviation sectors.

As the RPAS industry in the UK continues to grow and develop, understanding our potential behaviours and reactions as remote pilots and observers is vital. Drones have advanced safety technology, including highly autonomous flight capabilities, object detection and avoidance, and emergency return features. Yet Mandatory Occurrence Reports (MOR) and Air Accident Investigation Branch (AAIB) findings highlight HF's increasing role in drone incidents reported by approved operators. For example, 2021 data shows that over 30% of reported loss of control (LOC) events were caused by human error - the most reported factor.

It's tempting to think that pushing the wrong button or failing to attach a prop correctly couldn't happen to you. After all, you know your equipment inside out and have tens, perhaps even hundreds, of incident free flying hours behind you. But as a remote pilot, you should be keenly aware of other factors that could indirectly or directly affect your performance and decrease the safety of your operations.



EQUIPMENT AND SYSTEMS KNOWLEDGE

Experience can sometimes encourage complacency. Checklists and methodical pre-flight inspections only work to ensure safety if they are followed in full every time. Just because an aircraft part or accessory was OK for the last flight doesn't mean it will be for the next one.

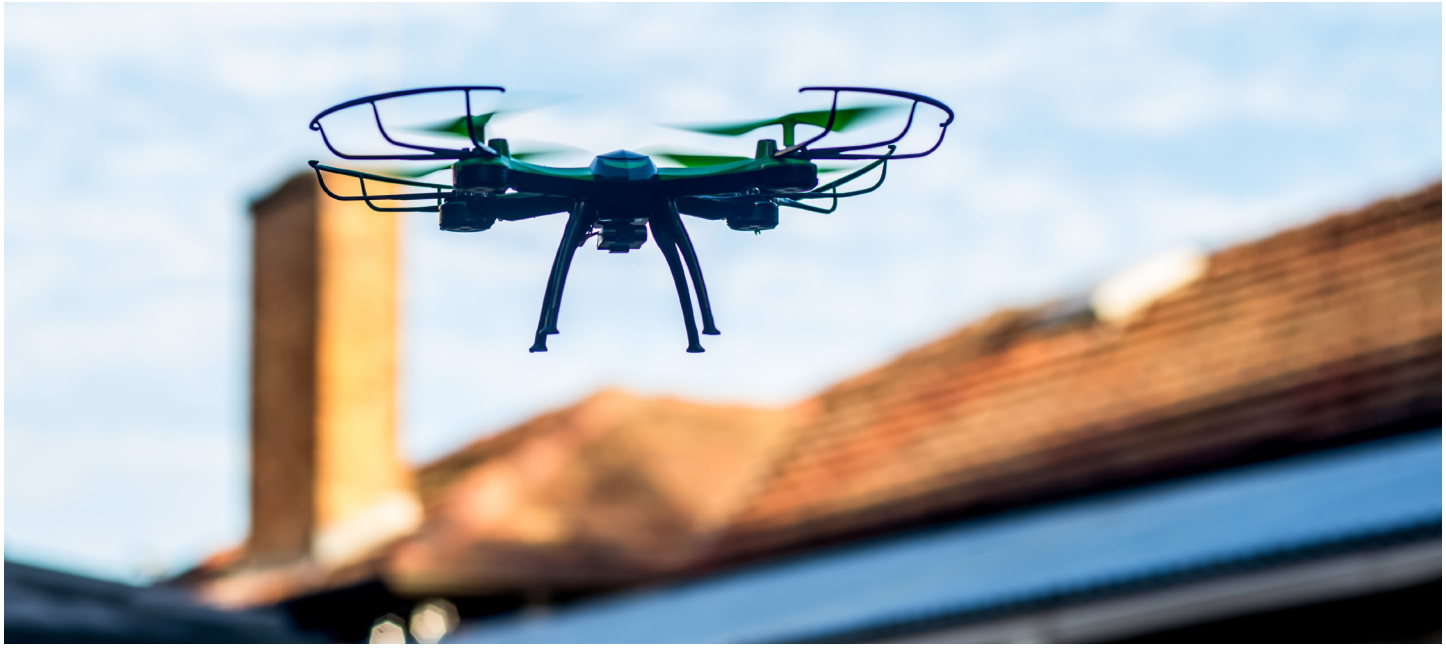
- Keep up to date with software and firmware updates, and ensure you thoroughly understand any new or changed features before you use them. Know and practice how to engage emergency systems such as automatic return to home and, crucially, understand their limitations.

- Know your system and limits. Understand how emergency motor shutdown systems operate and are triggered. Could this be done inadvertently? Keep alert for your controller's visual or audible cautions and warnings, and double-check their status and meaning. Never push battery limits, no matter how well you think you know your equipment. Always allow a large safety margin to give you time to land safely.

- Understand your drone's wind performance limits. Be aware that forecast wind speeds can be inaccurate, especially given the specifics of local terrain and ground objects in hilly or built-up areas. Reported incidents of LOC have shown aircraft unable to counter winds to return to the launch point even with "sport mode" activated. If in doubt, consider ascending to your planned mission height while upwind of the take-off position to assess conditions before moving downwind.

- Regularly practice manually recovering your aircraft to the launch point, mimicking a loss of assisted control. This could be particularly beneficial for operators who often use highly automated flight modes (e.g. inspection, survey or photogrammetry work) or those whose drone is primarily used as a stationary observation or photography platform.

In its May Drone feedback report, CHIRP discussed incidents where several Matrice 300 aircraft suffered rotor arm folds in flight. Conclusions drawn were that it was highly likely the incidents were due to locking collars not being secured correctly or fully before a flight. Correct use of a checklist, pre-flight inspections and a "challenge and response" approach if operating multi-crew will reduce the risk of missing critical preparation.



CREW STRESSORS AND DISTRACTIONS

Several reported incidents can be directly related to RPAS crew operating under additional, sometimes unanticipated, pressures. These stressors can be external or internal. Another factor reported is the potential danger of distraction at critical times during pre-flight or in-flight actions.

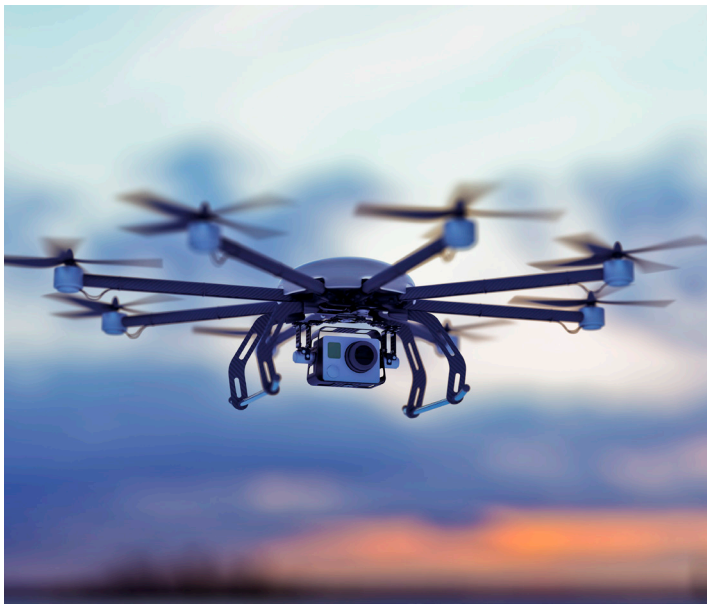
- Know yourself and your limits. Long operating days, particularly in challenging environments or against tight deadlines, can lead to fatigue. You're much more likely to make mistakes or miss vital checks if tired. You're also less likely to be able to quickly and accurately react to emergencies, so ensure you're adequately rested before flying. Of course, you should never fly under the influence of alcohol or illegal drugs, but also be aware of any prescription or over-the-counter medication you take that may impair your performance.

- Be personally prepared for expected and unexpected, weather conditions. Whether operating in a heatwave or freezing conditions, having the right personal gear can keep you more comfortable and potentially less distracted. Cold hands can be a particular problem for winter flying. For example, if you are going to be at a remote site for an extended period, make sure you take supplies with you to maintain your hydration and energy levels. Take regular rest breaks, and if you can, go somewhere warmer or cooler, as applicable, for a while as appropriate.

- Don't succumb to external pressures and compromise flight safety. The self-imposed need to not let the client down can lead to poor decision-making and compromise flight safety. Most of us will know the feeling of heightened stress as we start to run out of light, time, or a weather window. Recognising the potential for these pressures to arise in your pre-flight planning can help you to react appropriately should they happen.

- Beware of distractions at critical times. Clients, colleagues or members of the public can sometimes approach you at key moments, and interacting with them can become a distraction from safe operations. As well as being aware of potential distractions during the flight phase of operations, also recognise the risks of them occurring during the pre-flight check. At least one pilot-reported incident of rotor arm failure was directly linked to a distraction caused by a conversation during critical pre-flight safety checks on the ground.

In one recent MOR, an experienced pilot recounted an incident where their drone collided with a boat after a complete power failure and subsequent LOC. They neglected to check the battery voltage used for the incident flight. They outlined how challenging wind conditions, complex manual flying, multiple flights with frequent battery changes during long working days, and a desire to [keep] the client happy led them to focus only on completing the task.



MULTI-CREW OPERATIONS

The concept of crew/cockpit resource management (CRM) awareness and training is now well-established in civilian and military crewed aviation. Working as a team should bring greater safety benefits, but it can also introduce additional risk factors in some circumstances. Crew issues identified by civil incident reports as contributory factors may also apply to some drone operations.

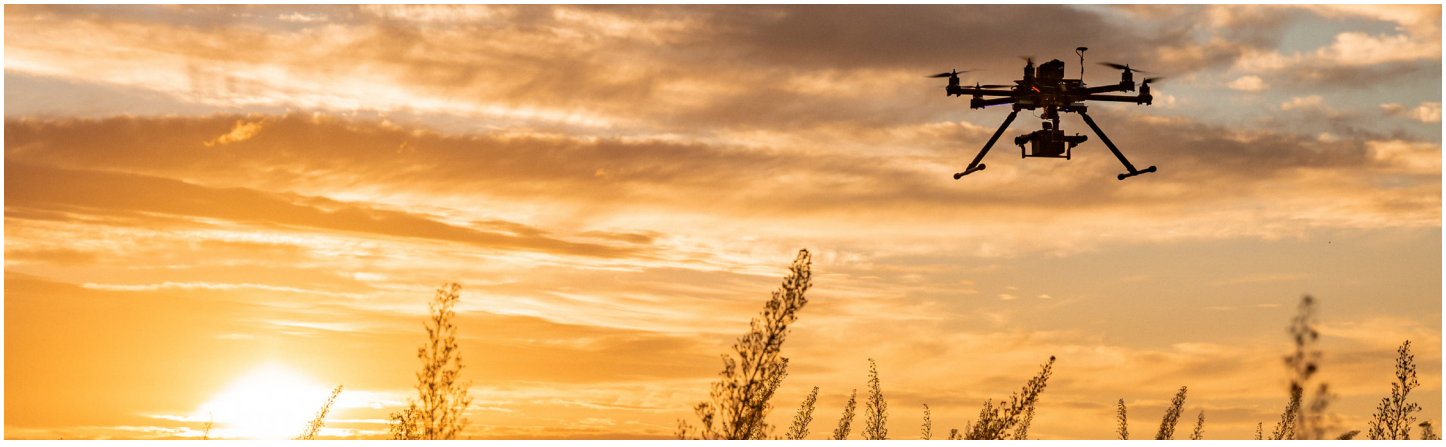
- If you see it, say it. You should foster an environment where anyone on the crew feels supported and confident to raise safety concerns or even veto an operation without worrying about negative consequences. Observers should always be encouraged to draw attention to anything they consider a safety risk, including pilot fitness-to-fly issues and equipment or location concerns. Pilots should feel comfortable raising issues about an observer's ability to carry out their vital safety roles. If you are in a position of authority, be aware that others may hesitate to bring concerns to your attention unless you expressly tell them that's what you want and encourage them to do so.

- Good crew briefings are essential. They should result in everyone involved in the operation knowing precisely what their roles and responsibilities are, how and when to contact each other, what will be happening (and therefore what "normal" and "abnormal" will look like), and what the emergency procedures are. Use a briefing checklist to ensure all items are covered on every flight.

- Sterile cockpit procedures. The sterile cockpit concept has been used in crewed aviation for many years to help flight crews maintain focus during critical phases of flight. It may seem odd to think about the remote pilot environment as a cockpit, but there are many similarities. Keep unnecessary crew communication to a minimum during take-off, landing or other complex manoeuvres, and keep fully focused on ground and aerial threats. Regular callouts such as battery level and/or remaining endurance are good practise.

- Standardised communications. It's important that all crew members communicate in a standardised way. For example, when announcing different phases of a mission or describing the direction of an aerial threat such as an inbound aircraft. As pilots, it's potentially easy to become overwhelmed if you're presented with too much information that you need to process. This can reduce your situational awareness rather than improve it. Developing a standard communications plan, engaging with communications training, and using consistent and clear crew briefings will aid effective communication.

A remote pilot reported their aircraft colliding with a bridge after a technical failure. The aircraft had exhibited some abnormal compass reading characteristics during the previous flight when piloted by another less experienced crew member, but this had not been mentioned during the handover. Had the more experienced pilot been aware of the issues encountered in the previous flight, they would have grounded the aircraft and undergone more checks.



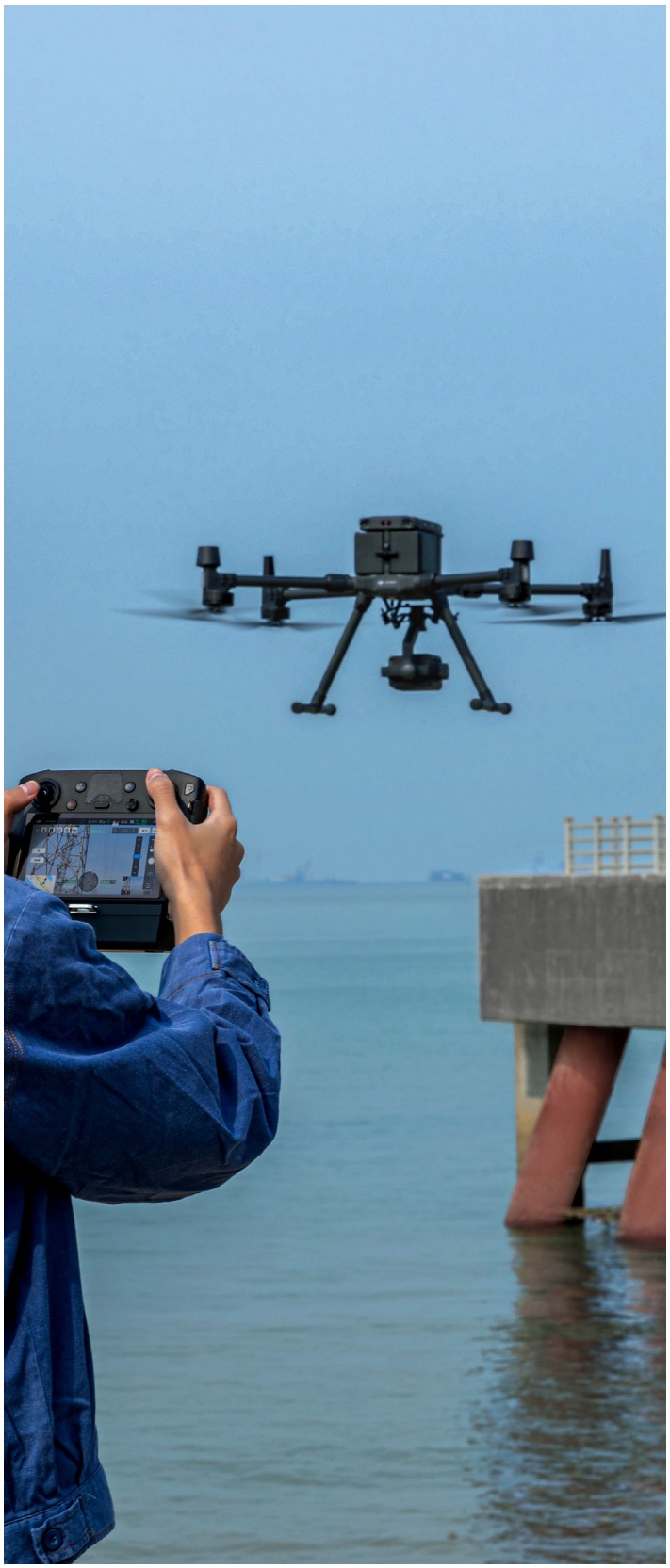
PILOT CURRENCY AND APPROPRIATE PRE-FLIGHT PLANNING

Due to prevailing weather conditions or customer demand, some operators may fly a great deal during the summer but with very few operational flight hours over winter. Others may use drones in addition to their primary business and fly irregularly. In either case, pilot currency can be affected by extended time on the ground. As well as lessening familiarity with technical systems and physical muscle memory, appropriate pre-flight planning, pre-flight checks, and other procedural matters can also suffer from a lack of currency.

- Currency is not proficiency. You may need more than the minimum required hours to make you proficient for a given flight. An intimate knowledge of your drone's systems and emergency procedures may be compromised by low hours. It's almost certain that challenging conditions or a complex flight profile will require a level of competence unlikely to be achieved from only the minimum required flight time.

- Effective flight planning can also be impaired by time away from operations. Failures to check NOTAMs and flight restrictions directly before a flight, failure to check weather forecasts and failure to book pay-as-you-go insurance have all been reported as items missed by low-hours or irregular pilots. Using standardised pre-flight ground planning documents can mitigate the risk of forgetting something.

In the AAIB report Aeryon SkyRanger R60 registration na 01-21, a pilot with only 2 flight hours in the previous 90 days received an unfamiliar message on their control screen. Unaware it was a warning, and in attempts to clear it, they had activated the emergency motor stop function by tapping on the relevant icon three times within three seconds. They had not remembered the significance of the icon.



THE IMPORTANCE OF REPORTING HF OCCURENCES

As an aviation community, we must learn from our shared experiences. It also means that safety regulators, manufacturers, industry groups and other stakeholders can develop safety policies and systems that benefit us all. As well as incidents that are required to be reported, it's important that you share any moments where things nearly went wrong, particularly where human factors may have had an impact. You can do this anonymously.

- **Serious Incidents or Accidents**
  Anyone involved who knows of an aircraft accident or serious incident in the UK, a UK Overseas Territory or a Crown Dependency involved must notify the AAIB without delay. In the case of an accident, you must also inform the police.

- Mandatory Occurrence Reporting (MOR) has been a part of the fabric of UK aviation operations since 1976. Reporting is mandated by UK Regulation 376/2014, which requires the reporting of safety-related occurrences involving UK airspace users. Occurrence reporting helps improve aviation safety by ensuring that relevant safety information is reported, collected, stored, protected, exchanged, disseminated, and analysed. It is not to attribute blame or liability but supports continued learning to make flying safer.

- **Confidential Human Factors Incident Reporting Programme (CHIRP)**
  "CHIRP is the conduit for individuals to share their experience of HF occurrences safely and confidentially in a way that enables many others to learn from them. FEEDBACK is CHIRP's regular publication that seeks to communicate the occurrences we are informed about, draw some lessons, and pass them on to flyers who might benefit."