Advanced Drone Operations: Unlocking the Technology's Full Potential

INTRODUCTION

In recent years, drones have expanded beyond consumer or specialist use to become a viable and mainstream commercial option that provides robust return-on-investment (ROI). As unmanned aerial vehicles (UAVs) have become more accessible, operators across a wide range of applications such as GIS & mapping, agriculture and construction, have been embracing the technology to accurately map areas and gather the data and insights needed to make better informed decisions. But technology does not stand still, and the result of ongoing innovation and collaboration is the progress of more advanced drone operations which, in a commercial setting, can help improve safety for both people in the air and on the ground while also saving long-term costs and increasing data collection efficiencies.

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Although approvals can often be lengthy, important steps are underway to ensure the ability to conduct advanced operations is more accessible for the modern drone operator, whatever their project scope. Indeed, the rising use of drones in sectors such as energy and mining, as well as in environmental and humanitarian applications, could draw further investment support, and play an integral part in gathering the insights needed to pave the way for regulations and legislations becoming more accommodating in the future.

But what does advanced drone operations mean, why are they important and what do operators need to know to successfully integrate these types of flights into their workflows? In this white paper, we'll look at:

- The different types of advanced drone operations
- Testing
- The regulatory landscape
- Software considerations
- What's next for the industry

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WHAT ARE ADVANCED DRONE OPERATIONS?

The term 'advanced drone operations' encompasses a wide range of operations, including:

- Flights at extended or beyond the visual line of sight (BVLOS and EVLOS)
- Operations over people (OOP)
- Flying at night
- Flying in restricted airspace
- Flying multiple drones as part of a fleet (or swarm)

These types of flights typically require additional forward planning and permissions from the appropriate authorities, to accommodate or address any safety or logistical considerations. Drone users must first ensure their chosen UAV and supporting software can fly safely while adhering to the stringent regulations that are imposed by the relevant civil and national aviation authorities. Generally, this involves submitting waiver requests and providing detailed flight plans, although the regulations drone users must follow to gain approval vary between countries.

BEYOND THE VISUAL LINE OF SIGHT

BVLOS flights are a rapidly growing area of interest for drone users and the wider commercial drone industry, thanks to their expanded project functionality. While more traditional visual line of sight (VLOS) flights can only operate to a limited maximum distance, BVLOS flights do not have to be within the line of sight of the operator, helping improve efficiencies and increase the mapping potential for companies. For example, BVLOS offers the ability to map larger areas quickly and efficiently, or survey remote and/or hazardous sites more easily and safely.

Given the vast potential of flying BVLOS, there is a significant commercial opportunity to scale up the technology in a fast, efficient, and reliable way. When it comes to flying BVLOS however, not all drones are created equally. For example, fixed-wing drones are ideally suited for BVLOS operations as they are lightweight, safe and easy to operate, with efficient batteries and airframes that mean they are equipped to map areas small and large.

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There is also extensive data supporting the durability and reliability of these systems thanks to thousands of hours of safety testing, which can help streamline and accelerate the approval of BVLOS waiver requests. In contrast, Vertical Take-Off and Landing (VTOL) UAVs are heavier and so may not be able to cover as much distance or pose more of a threat in the event of a crash. Furthermore, due to limited crash testing, these UAVs do not currently have the volume of supporting data required to demonstrate resilient reliability or durability credentials. As such, obtaining the necessary waivers and permissions for BVLOS missions can be more challenging and typically the operation scope is more restricted; indeed, VTOL BVLOS operations currently must generally be limited to remote areas, where there is lower risk of flying over people.

The capability to fly for longer periods of time opens a range of uses, including the mapping of larger sites such as fields in the agriculture sector, by helping operators avoid repeated repositioning to ensure the drone is always within the pilot's line of sight. The result is a solution that can save companies valuable time in the field.

BVLOS also offers opportunities to improve the safety of mapping high-risk areas, such as oil and gas facilities or mining sites, since the drone user can avoid getting too close to hazardous objects. In construction, BVLOS flights are increasingly used to track progress on projects, such as road construction, helping save time and protecting the workforce on potentially dangerous sites. As BVLOS becomes more advanced, there is further potential for insurance companies to use drones as a risk assessment tool in gathering up-to-date data.

EVLOS

The term EVLOS is used to describe the area between VLOS and BVLOS – where a flight is carried out within the Extended Visual Line of Sight. The permitted distances vary between countries, depending on the individual regulations – for instance, in Switzerland legislation permits EVLOS flights from a maximum of 1km to a distance within the pilot's sight. EVLOS is not a universally recognized term nor is it included in the regulatory guidance for drone use in all countries, although it can be used in the UK and Switzerland. Where EVLOS is not offered, drone users must instead align with requirements for flying either VLOS or BVLOS, depending on project needs.

OPERATIONS OVER PEOPLE

OOP, or operations over people, refers to "a small UAV that hovers directly over any part of a person, regardless of the dwell time", according to the Federal Aviation Administration (FAA). Flying over people can benefit commercial companies by allowing them to cover larger distances or previously prohibited areas where uninvolved people may be present. Gaining OOP approval is also essential to fly BVLOS, as it cannot be guaranteed that a drone can avoid people and traffic once it has traveled beyond the line of sight. OOP approval is therefore required not only for urban areas, but in applications such as mines and construction projects where uninvolved people are likely to be on-site. An approved waiver for OOP flights will allow UAVs to be flown everywhere apart from city centers, where they could pose a potential risk to people and property.

FLYING WITHIN RESTRICTED AIRSPACE OR WITH REDUCED VISIBILITY

Both flying a drone at night and in restricted airspace also require considerable additional safety and logistical considerations, and as such gaining approvals can be a lengthy process. Although there are often no specific limitations for night flying, UAVs must always be within the pilot's line of sight, meaning any drone

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should be illuminated to allow the pilot to fly responsibly, without collisions. Similarly, flights around airfields and airports are tightly restricted, unless the appropriate permissions are granted. These zones generally comprise several different levels, such as the Aerodrome Traffic Zone in the UK, which is a 2-2.5 nautical mile radius around the aerodrome, extending 2,000 ft above ground level, centered on the longest runway.[1] Any UAV allowed to fly in restricted airspace must be first deemed safe, with the pilot maintaining direct, unaided vision with the aircraft to avoid collisions.

FLYING DRONES IN FLEETS

Currently, drones must be flown separately, or with multiple pilots. However, advanced operations with fleets has increasingly become a viable option in recent years – particularly with the rise of autonomous flights. The benefits for commercial companies would be significant, enabling improved efficiency for data collection and additional mission capabilities. For example, instead of taking five flights using traditional VLOS methods, the use of BVLOS and the option of fleets could result in just one flight – helping to save costs and ensure operations are more viable.

TESTING

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With the commercial use of drones more widespread than ever, it is important to have the right authorities and approvals in place to help drive the industry forward, however guidelines and progress vary across the globe. Regardless of location, increased testing is a vital part of furthering advanced drone operation capabilities and demonstrating that they are capable of meeting the safety, regulatory and logistical needs of these types of flights. To obtain approval to carry out operations like BVLOS, for example, companies must be able to prove that the UAV can follow specific guidelines in the case of an emergency. For instance, if a drone exhibits a low battery warning or a hardware malfunction, it should return to a designated 'home' point, rather than crash landing.

This thorough level of testing also allows the authorities to check if aircraft are dangerous when flying over people, which could potentially cause injury in the event of a collision. Key components, such as the propeller, must be properly checked to pass stringent approvals. For this reason, some UAVs comply with regulations by placing the propeller at the back and having a frangible design, meaning it will lead with the nose if it does crash and ensuring the aircraft remains benign. In the US, the FAA requires the radio to be tested to gain an OOP waiver, including checks on the conspicuity range and the warnings given to the pilot.

THE REGULATORY LANDSCAPE

The US, in particular, has made great strides in shaping national processes for advanced operations, and can be looked at as an example of how regulations might be implemented across the globe as other countries formalize their approaches. The FAA reviews all flights on a case-by-case basis and requires all advanced drone operations to complete a Part 107 Waiver – an official document that approves certain operations of aircraft outside the limitations of regulation.[2] Its Detect and Avoid system uses computers and sensors to detect air traffic in the area and navigate the drone accordingly to avoid collisions. To assist drone operators in gaining swifter approvals, the FAA recently published the proposed rules for OOP and flying at night, including a notice of proposed rulemaking (NPRM).[3] Further to this, in December 2019, it issued a document about the use of Remote ID, which would require operators to use a broadcast and network method to relay information on positioning and approvals to people on the ground. The document received more than 50,000 comments from the drone community – a signal of the rising interest in advanced drone operations.

In addition to the current regulations that necessitate aircrafts to have completed airworthiness certification assessments, it is becoming increasingly important in the US that systems are also type certified, which covers durability and reliability, failure and performance testing and design requirements. The new Type Certification is currently being pursued and facilitated by the Los Angeles Aircraft Certification Office (LA-ACO), signaling a potential move away from waivers in the future and paving the way to a quicker and more streamlined approvals process.

However, drone regulations are not harmonious worldwide, and remain an area that is continually evolving as user needs expand. Some are more aligned than others, for example, in order to operate BVLOS flights in any country operators must either use visual observers and a radio link, or a Detect and Avoid system to ensure safe and smooth integration with other air traffic. However, many regulations still differ considerably between countries.

DETECT AND AVOID SYSTEMS

Although Detect and Avoid systems are not yet widespread in the industry, they are an important step in making advanced drone operations planning more achievable and easier to scale up in the future. As Detect and Avoid technology becomes more refined and sophisticated, it may eventually replace the need and use of visual observers, which must currently be stationed every 1km on the ground. But while it can simplify approvals, adding extra people to operations can create financial stresses for commercial companies.

Another key consideration in implementing a Detect and Avoid system is the additional weight it can add to UAVs. This is particularly true when it comes to 360-degree Detect and Avoid systems which, while providing a radial view of an area, can add more weight than their counterparts with more limited fields of view. Operators must therefore balance the potential safety improvements of using these systems with the drawbacks of additional drone weight. This technology may also require the provision of more on-the-ground equipment, which can add additional set-up and operational costs, although these costs typically would not outweigh the value of the system itself.

Despite the benefits of operations like BVLOS flights, the lengthy and often complex approvals process has created a barrier in recent years. For instance, thousands of companies applied for a FAA waiver to fly BVLOS in 2018, with only 23 approved, according

[1] https://www.caa.co.uk/Consumers/Unmanned-aircraft/Our-role/Airspace-restrictions-for-unmanned-aircraft-and-drones/

[2] https://www.faa.gov/uas/commercial_operators/part_107_waivers/

[3] Ibid.

[4] https://www.auvsi.org/waivers-under-part-107-interactive-report-0

to the Association for Unmanned Vehicle Systems International (AUVSI).[4] However, there has been progress. In 2019, ANAC (the National CAA of Brazil) approved BVLOS flights for the first time, while in Canada, IN-FLIGHT Data recently partnered with senseFly to test BVLOS flights (see case study on page 4). Regulations are also becoming more accommodating; Transport Canada published a Notice of Proposed Amendments (NPA) in 2020 to allow routine low-risk BVLOS operations. In addition, new European rules published in summer 2019 contained a category called 'Specific', which outlines BVLOS operations.

To move forward, it will be important to maintain a two-way collaboration between the regulatory bodies and UAV operators. This will allow both parties to work together to develop regulatory frameworks using mission data and the data gathered from drone testing, ultimately helping to make advanced drone operation planning more accessible for commercial companies.

USING THE RIGHT SOFTWARE

For today's drone operators, the software used is as vital as the hardware for ensuring safety and reliability; it too must be recognized as safe for an authority to approve it for use in advanced drone operations, and it can also go a long way in helping drone users to streamline and optimize complex workflows. Typically, UAV software is required to have several different 'fail safe' features to support performance of the drone during flights, including maximum distances set up and procedures in place for emergency landing. Operators must also be trained on the relevant software, to establish they are certified to fly drones and are ready to operate the device during emergency scenarios. In addition, access to the right supporting equipment, which is typically determined on a case-by-case basis for each operation, is crucial; flying BVLOS, for example, requires an additional radio and second computer on-site.

CASE STUDIES: IN-FLIGHT DATA

in 2018, Canadian commercial drone operator, IN-FLIGHT Data, carried out the country's largest BVLOS UAV Operations trial to date, with support from senseFly. The trial returned more than 120 datasets, spanning 14 different test sites and covering over 1,500m total linear flight distance, enabling data to be gathered across several different verticals. The flight safety data collected was subsequently provided to Unmanned Systems Canada and Transport Canada, to help define BVLOS risk models for different categories of unmanned aircraft for future operations. IN-FLIGHT Data also conducted the first urban BVLOS UAV project in a major city (Calgary). The goal was to demonstrate that BVLOS UAV flights could be conducted safely and efficiently, while providing cost reductions and operational efficiencies. Both studies were pivotal for exploring how BVLOS could apply to – and benefit – different sectors. They represented a significant step forward in advanced drone operations, helping to lay the foundations for future projects.

WHAT'S NEXT IN ADVANCED DRONE OPERATIONS?

In time, the potential benefits for advanced drone operations in commercial settings are significant. Partnering with authorizing bodies or institutions will be integral to enabling the commercial drone industry to be able to collect more data and build on the regulations already in place. For example, working with a university can encourage knowledge sharing, allowing companies to follow regulatory progress from key stakeholders, like the FAA. Authorities are also looking more closely at the possibilities for improved UAV Traffic Management (UTM), where airspace is effectively shared between all drones and other aircraft. This development could be crucial for being able to fly over cities in the future.

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In the long-term, autonomous BVLOS and OOP flights are the aim for many, where people take on a management role, rather than piloting a drone. However, this is still plenty of work to be done before autonomous flights on this scale are a viable, safe option.

Although regulations are becoming more flexible, there is still progress to be made to ensure widespread understanding and recognition of the benefits of advanced drone operations, as well as help make them more accessible to operators looking to navigate the often long field of approvals. Previously, for instance, waiver request communications and processes have not been streamlined and do not always transcend across companies, or even countries – but there is optimism for the future scalability of these operations as progress continues to be made. Indeed, the FAA and Swiss Federal Office of Civil Aviation (FOCA) recently signed a declaration of intent to strengthen collaboration in the Unmanned Aircraft Systems (UAS) space and cooperate to advance the harmonization of domestic and international UAS safety standards. This collaboration will facilitate improved R&D capabilities and knowledge sharing and allow valuable steps forward in supporting safe UAS integration into airspace.

For operators, the key to supporting progress in this area will be maintaining communication with the relevant authorities at every step in the approval process. Connections are vital and working with the authorities is a two-way process: both parties want to learn more about advanced drone operations and streamline the administration requirements. Working directly with a drone manufacturer can also be helpful, as they can provide the knowledge to build a strong case for the authorities. With the right connections, advanced operations can be carried out easily and efficiently, and commercial companies can reap the rewards. With access to more data and improved operations, the future for advanced drone operations is exciting and the outlook for the industry is positive.

ABOUT SENSEFLY

At senseFly, we believe in using technology to make work safer and more efficient. Our proven drone solutions simplify the collection and analysis of geospatial data, allowing professionals in surveying, agriculture, engineering and humanitarian aid to make better decisions, faster. The company is a commercial drone subsidiary of Parrot Group.

For more information on advanced drone operations and the requirements needed to get your UAV off the ground, please contact:

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