

DRONE NATION



UNLOCKING THE COMMERCIAL POTENTIAL OF UNMANNED AIRCRAFT SYSTEMS

With its vision to building a Smart Nation, Singapore could be ideal grounds for an Unmanned Aircraft Systems (UAS) industry to take root and flourish. Several new government and industry-led initiatives have been announced in the past few years, potentially positioning the city state as a leader in UAS implementation.



Today, ready-to-fly multirotor 'drones' for recreational photography and racing have become ubiquitous in Singapore, especially as prices have become increasingly affordable. Anyone can easily purchase a wide range of small, high-performance drones from manufacturers such as DJI, Parrot, and Yuneec.

A similar trend can be observed in the commercial arena, with more professional products and services being offered by a growing number of companies and technology start-ups. These range from unmanned aerial vehicles (UAVs) for use in outdoor applications such as aerial imaging and parcel delivery, to indoor applications including warehouse inventory and surveillance, and confined spaces such as sewers, shafts and chimneys.

Given its applications and operating conditions, commercial UAVs are naturally more complex and sophisticated. Some services also require communication between several drones. The term "Unmanned Aircraft Systems", or (UAS), is defined by the International Civil Aviation Organization (ICAO) as an aircraft and its associated elements which are operated with no pilot on board. It encompasses the UAV itself, the ground control system, camera, GPS, communications

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software, skills needed to operate the system and tools required for maintenance.

SANDBOX IN THE SKY

With its densely clustered industrial and urban landscape, Singapore provides ideal opportunities for test-bedding UAS, especially for Beyond the Visual Line of Sight (BVLOS) applications. The Singapore government appears to have taken a supportive stance on the industry's development, actively facilitating the use of UAS by both the private and the public sectors. In February 2018, One-North was designated as Singapore's first drone estate, to facilitate the trial of innovative UAS technologies and commercial use-cases in a controlled urban environment. Leading aerospace firms Airbus and ST Engineering Aerospace were two of five pioneer users of the One-North drone estate.

Across the nation, UAS applications are being explored by various public agencies such as the Building and Construction Authority, the Maritime and Port Authority, the National Environment Agency and the Public Utilities Board for tasks such as building façade inspection, maritime delivery and tunnel inspection. These agencies are partnering with international firms and local start-ups to find UAS-based solutions for their operational pain points. This provides the necessary drivers and funding support that enable companies to develop and refine



Photo credit: Avetics

ABOVE: Avetics offers UAS-based inspection solutions for a diverse range of commercial and industrial activities.

RIGHT: Training is an important aspect of capacity building for commercial UAS operations in Singapore.

their innovative solutions.

Garuda Robotics is a local start-up that builds and delivers integrated hardware, software, operational services, and UAS pilot training. The young company also leads the Future Flight Consortium, a group of public and private stakeholders, aligned in the pursuit of a connected urban airspace management system for UAS operations in Singapore. The consortium, whose members include the Singapore Civil Defence Force, the Security Industry Institute, and Singtel, was formed in response to calls by the Civil Aviation Authority of Singapore (CAAS) and the Ministry of Transport

to develop systems to enable the safe use of UAS.

"In 2018, we formed the FutureFlight Consortium to design, develop and test a connected urban airspace management system for drones," explained Mark Yong, CEO of Garuda Robotics. "Together with a dozen industry-leading partners, we are building core drone technologies, consulting



Photo credit: Avetics



on the evolution of national regulations, and conducting live flight trials to prove the viability of our technological platform.”

Consortium members are expected to leverage on each other’s unique capabilities and requirements to spur the development of innovative capabilities and technologies, including solutions for navigation, detect-and-avoid, fleet management and UAS traffic management. They will also attempt to establish procedures and best practices for BVLOS flight operations and will integrate complementary technologies and conduct rigorous tests to demonstrate the reliability and safety of the system over a two-year period.

REGULATORY CHALLENGES

UAS has immense potential to transform the way we work and live but nevertheless, pose operational challenges especially in urban environments. In December, unauthorised drone activity crippled Britain’s Gatwick airport for three days just before Christmas, causing around 1,000 flights to be cancelled or diverted, and affecting about 150,000 passengers.

In Singapore, restrictions are placed on UAS operation to ensure civil aviation safety, security of government and military facilities, as well as the well-being of the general public. Existing regulations require permits to fly drones above 7kg, and ban the flying drones within 5km of airports or military airbases, or at altitudes above 200 feet (about 60m). CAAS also

requires commercial operators to seek permits for purposes that are not recreational or research in nature. Permits from other agencies may also be required, such as the Singapore Police Force for aerial photography and/or overflight of security-sensitive locations. Drones cannot be flown in parks and nature reserves overseen by National Parks Board.

“Drones in Singapore must operate safely in close proximity to buildings, people and a variety of other obstacles commonly found in urban spaces,” Yong noted. “Operators must also contend with height restrictions and the no-fly zones around five aerodromes on this small island – a challenge unheard of in other urban drone test sites.”

With the growing use of UAS in Singapore, CAAS is proposing enhancements to laws governing their use to ensure public safety. Recently in Parliament, it revealed plans to develop a centralised flight management system that will provide an island-wide picture of unmanned aircraft activities. This will allow authorities to zoom in on individual UAVs, check if they are operating under a valid permit and issue alerts to operators who contravene regulations.

CEO of homegrown company Avetics Global, Mr Zhang Weiliang, agrees with the need for regulation of airspace but noted that an area to be improved was the requirement of permits when flying in an indoor space. The company uses custom-made multi-rotor UAV platforms to offer a range of services, particularly for industrial applications such as visual/

UAS are either operated:

WITHIN THE VISUAL LINE OF SIGHT (VLOS) OF THE PERSON FLYING THE AIRCRAFT

This means that the aircraft must be able to be clearly seen by the person flying it at all times when it is airborne. In simple terms, the aircraft must not be flown out of sight of a human eye. (i.e. the use of binoculars, telescopes, or any other image enhancing devices are not permitted)

By doing this, the person flying the aircraft is able to monitor its flight path and so manoeuvre it clear of anything that it may collide with;

BEYOND THE VISUAL LINE OF SIGHT (BVLOS) OF THE PERSON FLYING THE AIRCRAFT

If the person flying the aircraft is unable to maintain direct unaided visual contact with it while it is airborne, then an alternative method of collision avoidance must be employed to ensure that it can still be flown safely.

BVLOS flight will normally require either:

- ▶ a technical capability which is equivalent to the ability of a pilot of a manned aircraft uses to ‘see and avoid’ potential conflicts – i.e. Detect and Avoid (DAA)
- ▶ a block of airspace to operate in which the unmanned aircraft is ‘segregated’ from other aircraft – so that the unmanned aircraft can operate without the risk of collision
- ▶ clear evidence that the intended operation will have ‘no aviation threat’ and that the safety of persons and objects on the ground has been properly addressed.

Source: Civil Aviation Authority UK

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thermal inspection, 2D/3D mapping and confined space inspection. Its semi-autonomous Aquila In-Tank Inspection UAV – which is equipped with an on-board laser scanning device and designed specifically to perform visual intelligence in confined spaces such as oil tanks – won the Most Innovative Technology Award at the 2018 Tank Storage Awards held in Rotterdam.

“Current regulations in comparison to what is being done in other countries are considered progressive,” said Zhang. “Of course, regulations are always catching up with industry trends instead of leading, but that is to be expected...I hope to see specific UAS applications such as flying in a confined space that do not post safety concerns to the public [be] deregulated.”

This sentiment is echoed by Keith Ng, CEO of another local UAS service provider, Performance Rotors.

“The authorities are generally helpful and open to explore possible-use cases for UAS operations, Mr Ng told Aerospace Singapore. “Restrictions are due more to safety considerations because of our limited air space, heavy manned air traffic, high density of build-up and vehicular traffic.”

The company has developed solutions to replace traditional methods of inspecting for defects in building facades, viaducts, monitoring tree health as well as inspection of dangerous confined spaces such as service tunnels, steel tanks and maritime vessels.

Mr Ng pointed out that as a growing industry, service providers and regulators are trying to find the optimal balance to allow the



Photo credit: Performance Rotors & Singapore University of Technology and Design

ABOVE: Innovative solutions developed here include the Tree Inspection Micro, which is being used to ensure park safety.

growth of UAS operations without compromising safety to the public and manned aviation.

“Current regulations and processes need to be revised to allow for more practicability, given the ever-improving performance and safety capability of UAS technology,” he added. “Once [a compromise or solution] is achieved, for instance, a designated airspace corridor or regulated altitude separation between UAS and manned aviation, we will see the shift towards maintenance, reliability and technical improvement, as well as traffic control.”

According to CAAS, specific areas being reviewed include operating guidelines, pilot competency requirements, as well as requirements for aircraft weighing more than 25 kg. The ultimate aim, however, is to develop technologies and processes that will enable manned and unmanned aircraft

to operate within the same space, as opposed to the current principle of segregation.

BALANCING REGULATION AND INNOVATION

The prevailing lack of an international regulatory framework for UAS operations continues to pose accountability and safety issues that may stymie the rate of adoption of such systems for commercial and public applications.

However, the potential cost efficiencies, productivity gains, as well as improvements in workplace safety have spurred several major efforts by public and private stakeholders to enhance existing regulations and enable wider UAS adoption across a variety of sectors including logistics, maritime, aviation, construction and security.

Singapore is an active member of the Unmanned Aircraft Systems (UAS) Advisory Group under ICAO, which was set up in 2016 to draw up global rules and regulations for the safe use of UAS. CAAS is also partnering with the European Aviation Safety Agency (EASA) and aerospace giant Airbus in the development of safety standards and regulatory requirements for UAS in urban environments. A tripartite Project Document was signed by all three stakeholders in July 2018, establishing a framework for the development of safety standards and regulatory requirements, as

well as operational and technological assessments for the deployment of UAS in urban environments. Airbus has been active in the UAS arena – it conducted a demonstration of its last-mile Skyways delivery technology in Singapore in February 2018.

Moving forward, UAS players in Singapore can look forward to more opportunities and potential for commercialisation. The authorities’ proposed enhancements to UAS laws governing their use to public safety, including airworthiness, type certifications and licenses for operators and pilots, suggest that they are seriously looking into safety standards and frameworks for their operation, and eventually, integration into commercial activities. If safety concerns and air traffic management can be ironed out, the vision

BELOW:
Garuda Robotics has developed the Drone Operations Center to manage beyond line-of-sight UAS operations.



Photo credit: Garuda

PROPOSED AMENDMENTS

On the back of the growing use of drones and unmanned aircraft (UA) in Singapore, the Civil Aviation Authority of Singapore is proposing enhancements to laws governing their use to ensure public safety.

Weight of UA	For recreational / research purposes		For non-recreational / non-research purposes
 7kg and below	Proposed: Successful completions of online training programme, if flying UA of total mass of more than 1.5kg	➤ Class 2 Activity Permit, if flown outdoors: – in a restricted or danger area, or – within 5km of an aerodrome/ military airbase, regardless of operation height, or – Above 200 feet (60m) beyond 5km of an aerodrome/ military airbase	➤ Operator Permit ➤ Class 1 Activity Permit Proposed: UA Pilot Licence
 Above 7kg, but not more than 25kg	Proposed: UA Pilot Licence Removed: Operator Permit		
 Proposed: Above 25kg	Class 1 Activity Permit Proposed: UA Type Certificate / Certificate of Airworthiness Proposed: UA Operator Certificate Proposed: UA Pilot Licence Removed: Operator Permit		

Source: Civil Aviation Authority Singapore

of smart skies to complement our smart city could be realised in the next decade.

Garuda’s Yong summed up the collective optimism of the industry: “We have a challenging urban environment for drones; a supportive regulator who values industry feedback and supports test bedding

of real solutions; and highly developed infrastructure to support connected drone systems. All this is to say, if we can make widespread drone deployments in Singapore a reality, our technology and solutions can be deployed anywhere in the world.” ^{AS}