



# BUZZING CITY: DEVELOPING UAS IN URBAN SINGAPORE

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Singapore's vision to become the world's first Smart Nation has accelerated the development, deployment and commercialisation of UAS operations on a greater scale. The use of drones in such an urban environment holds great potential but needs to be balanced against the need to ensure public safety. In this *Aerospace Singapore* feature, Skyports looks into efforts by the public, private and academic sectors in Singapore to make the vision of integrating UAS into its skies a reality.

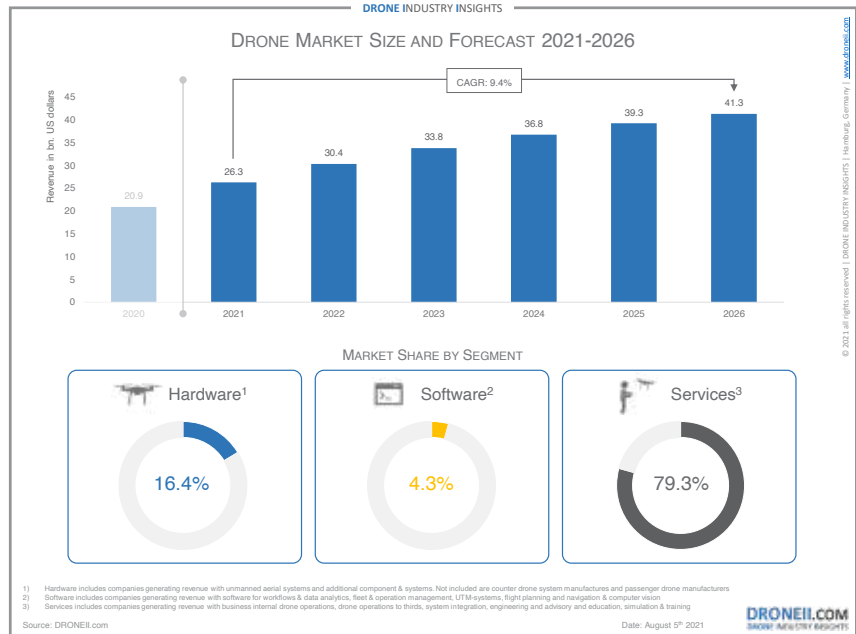
Unmanned aircraft systems (UAS) technology has experienced a major global boom in the number and types of commercial applications over recent years. Gone are the days when drones were seen as simply a recreational gadget. Today, UAS is being applied in numerous commercial sectors across the world. From surveillance and inspection, to crop spraying and delivery of cargo, businesses and other organisations are developing and demonstrating new important uses for drones, proving their huge socio-economic potential.

UAS are already solving real-world problems by completing activities quicker, cheaper and safer than traditional alternatives, while boosting local economies. The COVID-19 pandemic has brought the indispensable role of drones to the fore, showcasing its ability to deliver essential healthcare equipment while keeping people in their homes and socially distanced, for example.

Like many countries, Singapore has been seeking to capitalise on the opportunities and advantages presented by UAS. The Asia city state is, in fact, emerging as a regional leader in the development and application of UAS technology in all its forms. The Government of Singapore has demonstrated confidence in the transformative role that this technology could have in economic, social and environment enhancement. So much so that in 2017, it took the important step of including UAS within its Smart Nation strategy. At its core, the strategy has a vision of harnessing and applying UAS technology in ways that could improve the quality of life for everyone in Singapore.

## POTENTIAL AND BARRIERS TO DRONE PROLIFERATION

In August last year, Drone Industry Insights forecasted that the



Infographic on the Drone Market in 2021-2026 (Source: Drone Industry Insights)

global drone market will grow at a compounded annual growth rate (CAGR) of 9.4% from an estimated value of US\$26.3 billion in 2021. This means that by 2026, the UAS industry is set to become a US\$41.4 billion industry. The report also highlighted Asia and North America as the strongest UAS markets, with the former expected to experience the fastest growth, above 11% CAGR.

To realise the huge opportunity and harness this substantial economic value, industry and government must work together to identify and resolve the barriers to the proliferation of UAS technology. It is important to remember that the use of UAS around the world is largely regulated, even at the lighter and smaller end of the UAS product market. This is in the context of UAS emerging within the strict confines of an aviation system that is strictly regulated for manned aviation.

To satisfy itself and the people of Singapore that UAS use would be safe, the Singapore Parliament approved the

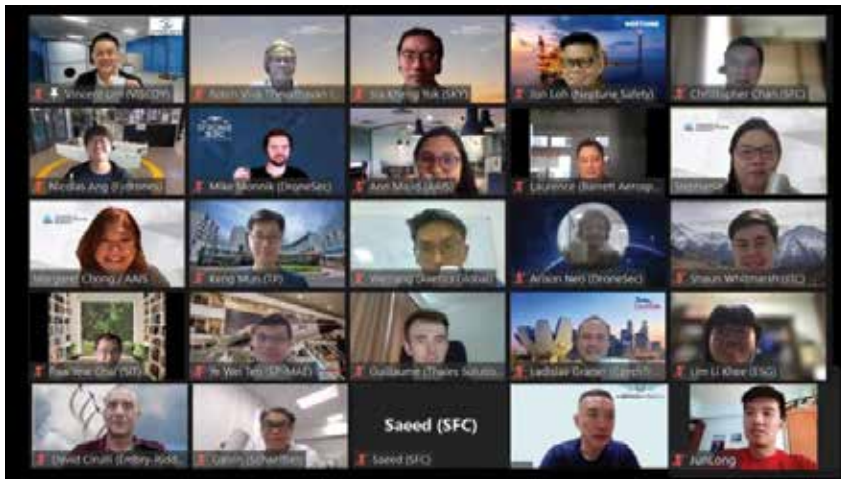
Unmanned Aircraft (Public Safety and Security) Act in 2017. The Act created a clear set of rules for the operations of recreational and commercial UAS "in the interests of public safety and security". Rather than curtail the use of UAS, the introduction of such a regulatory framework, complemented by active support from the Singapore government, has created an environment where the technology can flourish safely and with the confidence of its citizens.

## UAS OUTLOOK IN SINGAPORE

Fast forward five years and the Singapore drone industry is growing at a very healthy rate. There are at least 30 drone start-ups<sup>1</sup> in the city state including UAS manufacturers, providers of aerial inspection, delivery drone operators and collectors of data across industries. This growth is reflected in the number of members joining the

<sup>1</sup>Source: <https://tracxn.com/explore/Drones-Startups-in-Singapore>

## FEATURE



A Singapore UAS Community networking session in October 2021

Singapore Unmanned Aircraft System (SG UAS) Community – part of the Association of Aerospace Industries (Singapore) (AAIS) – which represents the interests of the burgeoning drone industry. The Community has experienced an increase in the number of member organisations from 22 in 2019 to 39 today. This number is expected to grow further in the coming years with more activity in the Singapore drone market.

Early growth of the UAS industry and technology in Singapore was substantially boosted by various initiatives and trials supported by its government agencies. Such efforts were useful in demonstrating the capabilities and possibilities of UAS application in a wide range of uses, generating awareness of, and building confidence in the technology.

Singapore also has an advantage in that its population greatly supports the commercial use of drones. A study of public views conducted by a team of academia from the Air Traffic Management Research Institute (ATMRI) and the Nanyang Technological University in 2019 found that 65% of Singaporeans and permanent residents backed

the commercial deployment of UAS. The study, which involved 1,050 Singaporeans and permanent residents aged 21 to 80, also found that the Singaporean public had a good perception of the potential benefit of drones. More specifically, they believed that drones can benefit consumers, advance the economy and improve workplace safety.

## LEADING THE WAY FOR COMMERCIAL APPLICATIONS

The momentum of UAS development in Singapore has been picking up in the past few years, with increasing interest by the public and private sectors for UAS-based solutions. UAS companies have been responding with the technologies and skills for safe and secure operations. The demand and corresponding efforts to provide tenable solutions will help the sector to scale and become a more permanent fixture in commercial operations.

### Maritime test-bed

One industry that has been actively seeking out drones as part of its “creative solutioning” is Singapore’s bustling maritime sector.

In 2021, the Maritime and Port Authority of Singapore (MPA) set up a Maritime Drone Estate (MDE) to serve as a test bed for drone operations. The MDE will act as a launchpad from which to test drone technologies, creating opportunities to improve safety

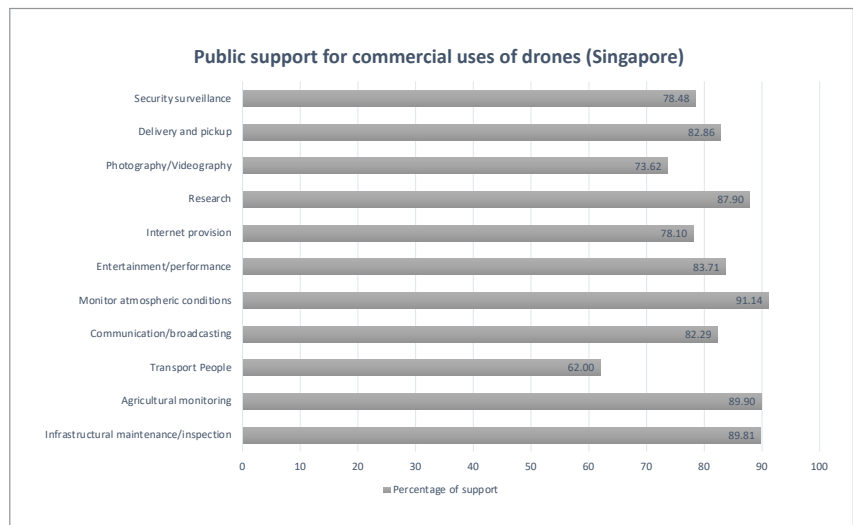


Chart by Aerospace Singapore. Data source: Tan et al, Public acceptance of drone applications in a highly urbanized environment, 2021

<sup>2</sup> Tan, L. K. L., Lim, B. C., Park, G. G., Low, K. H. & Yeo, V. C. S, Public acceptance of drone applications in a highly urbanized environment, 2021



Mr Chee Hong Tat (right), and Ms Quah Ley Hoon, MPA Chief Executive at the launch of the Maritime Drone estate. Photo: Maritime and Port Authority of Singapore

standards, efficiency, sustainability and access.

At the Singapore Maritime Technology Conference in April last year, Mr Chee Hong Tat, Senior Minister of State for Foreign Affairs and Transport said, "(UAS) technologies can help the port of Singapore, and ports around the world, to become more productive and efficient." In the last couple of years, Singapore authorities had been facilitating the testing of drone use cases for maritime industry players in a sandbox environment. The new drone estate location at Marina South is located next to port waters and near active anchorages used by thousands of vessels annually. This would make it ideal grounds to test out UAS services concepts as well as its reliability, safety and accuracy. Mr Chee added, "We hope to grow more maritime start-ups...and will continue to support them at the Maritime Drone Estate at Marina South."

One particular area that is being explored at MDE is the movement of maritime logistics between ship and shore. Traditionally, this is a labour-intensive, time-consuming process, with higher risks and a sizeable carbon footprint. With drones, essential

supplies can be transported safely and securely, and in a more cost effective and less carbon-intensive manner. Trials have already been completed from the drone estate, including ship-to-shore use-cases by various shipping and logistics companies. UK-headquartered drones-as-a-service provider,

Skyports, had also recently initiated a flight demonstration from the MDE, where its aircraft flew circuit profiles with a total distance of 50km travelled in 30 minutes.

### **Reservoir inspection**

Skyports has also been supporting Singapore aerospace giant, ST Engineering Aerospace, in carrying out automatic inspection of local reservoirs using unmanned aircraft capabilities.

The project, launched by Singapore's National Water Agency (PUB) at the end of May 2021, saw the deployment of Beyond Visual Line of Sight (BVLOS) drones to conduct monitoring at six reservoirs. The unmanned aircraft is equipped with remote sensing systems and cameras that help monitor water quality, identify overgrown aquatic plants and algae, and potential concerns such illegal water activities in

a particular area.

PUB plans to have one drone deployed at each reservoir. At MacRitchie and Marina, the drones are housed in an automated pod, capable of taking off and landing autonomously. It will embark on pre-programmed flight paths within the reservoir compound, monitored remotely by an operator. PUB officers will be able to monitor the statistical data and live-video feed from the drone via an online dashboard and receive near real-time alerts via their mobile phones.

By integrating UAS technologies into its processes, PUB is able to save thousands of 'man-hours' each year and significantly reduce the carbon footprint associated with traditional means of completing these tasks. Mr Yeo Keng Soon, Director of PUB's Catchment and Waterways Department



A Skyports drone being piloted at the MDE in Singapore. Photo: Skyports

said, "With 17 reservoirs – which are an important water supply source for Singapore – under our care, it can be a challenge manpower-wise to effectively monitor what goes on at each reservoir and ensure the reservoirs are in optimal condition... With the drones, we can channel manpower to more critical works such as the inspection and maintenance of reservoir gates, as well as pump and valve operations."

## FEATURE

### Unmanned traffic management

Complex commercial operations such as the reservoir inspection system and shore-to-ship deliveries that are undertaken in an urban landscape are often dependent on the drones being flown BVLOS. However, many countries still require pilots, visual observers and flight controllers to see a drone throughout its flight. To become a permanent feature on the future landscape, UAS will ultimately need a means to be safely and securely managed with other aircraft users operating within the low-level airspace.

In 2017, the Civil Aviation Authority of Singapore (CAAS) and Singapore's Ministry of Transport (MOT) launched an industry call for proposals to research, develop, test and introduce a functioning Unmanned Traffic Management (UTM) system. Nova Systems led a consortium of partners including OneSky and M1 to research and develop a suite of advanced UTM services over a three-year period. Considerations for the system include flight authorisation, strategic deconfliction and remote identification capabilities. The project came to a conclusion in early 2021,



Infographic on PUB's drone deployment (Source: PUB, May 2021)

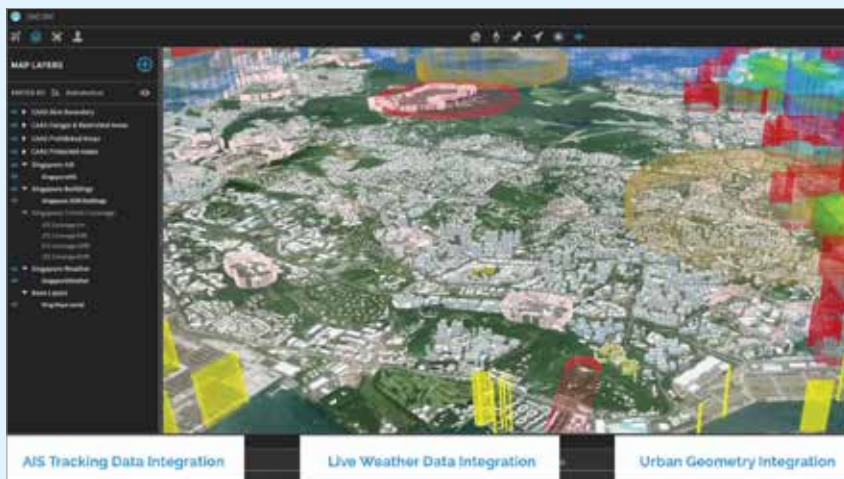
with a demonstration of those capabilities in a working UTM system through live BVLOS flight trials in the skies above Singapore.

Projects like these aid CAAS in developing operation concepts for unmanned traffic management in preparation for a scale up of commercial operations in Singapore.

### UAS Pilot Training

As unmanned aircraft do not have pilots on board, UAS will need to be remotely piloted or operated from nearby or at a central location, at least in the near future. As the number of use cases and commercial operations increases, the supply of qualified and skilled UAS pilot personnel must keep pace to avoid the emergence of a skills gap. Singapore is blessed with a number of drone pilot training schools and academies that are approved by the CAAS.

Autonomous drone systems designer and manufacturer Garuda Robotics, was the first organisation in Singapore to receive CAAS approval as an Unmanned Aircraft Training and Assessment Organisation (UATO), setting the standard for professional drone training in the region. Meanwhile, in 2017, tertiary education institution Republic Polytechnic (RP) established the first dedicated drone training facility among Singapore's institutes of higher learning. RP has been offering industry-focused



Overview of OneSky's UTM Portal, demonstrating airspace constraints such as aerodromes, restricted flight areas, weather and urban geometry (Image: OneSky)

courses involving subjects like thermal imaging, search and rescue, and photogrammetry. As of January 2022, there are 13 CAAS-approved UATO in Singapore.

### UAS IN URBAN SETTINGS: ADDRESSING CHALLENGES

Despite such a bright outlook for the future of UAS solution, there are parts of the drone ecosystem that need to be further developed for the full potential of the technology to be realised. These include the technological performance of the unmanned aircraft and the regulation of more complex operations.

Drone technology is still in relative infancy despite the large number of platforms available and use cases being operated. It is much easier to make a safety case for operations over sparsely populated areas - where the risk to those on the ground is less - than in urban centres like Singapore. In order to operate in more densely populated settings, UAS operators will have to achieve a higher level of safety standards that can satisfy regulators. In reality, the unmanned aircraft being used is going to have to achieve the

same level of airworthiness as manned aviation to operate in the likes of cities. This will not be an easy or cheap process but UAS technology must continue to evolve at pace so that it stands up to the rigours of certification processes.

Similarly, operation of UAS in locations where the airspace is lightly used by manned aviation can achieve approval more easily. However, the holy grail is the integration of manned and unmanned in the same airspace and in areas of greater air traffic density. A regulator is unlikely to approve these operations without the drone flown beyond the remote pilot being able to automatically and, most importantly reliably and safely, avoid manned traffic. Systems that enable UAS to autonomously 'detect and avoid' other aircraft are achieving a good level of maturity and, with regulator approval in time, will be a gamechanger for the UAS industry and its commercial operators.

### ONWARDS AND UPWARDS

Drone technology, especially for commercial operations, is proving day-by-day that it is a reliable solution



**A dazzling display of a Singapore icon, the Merlion, made up of 500 drones hovering above The Float @ Marina Bay during the Star Island Singapore Countdown Edition on 31 December 2019. (Image: Star Island Youtube channel)**

to real-world problems. In many instances, UAS have proven that it can support businesses and public sector organisations to execute essential activities more quickly, cost-effectively and safely. The economic value of the UAS market is set to be huge and will translate into revenue generation, the creation of new jobs and export opportunities.

Singapore has emerged as a regional leader in UAS solutions. Through close coordination between a proactive and forward-leaning government and an innovative and ambitious industry, the city state is fast developing a drone ecosystem that will support permanent commercial UAS operations. Further technological development and regulatory advancement, especially public acceptance, will be key to the industry having a rosy future. Government and the industry will need to take the public with them on this exciting journey.

All in all, UAS is set to be an exciting and enduring feature in the landscape of tomorrow, with a bright future ahead where the sky will not be the limit.

### Singapore Unmanned Aircraft Training and Assessment Organisations

AETOS Security Management Pte Ltd	<a href="https://www.aetos.com.sg/Training/WSQ-Courses">https://www.aetos.com.sg/Training/WSQ-Courses</a>
Air Beacon Pte Ltd	<a href="https://www.airbeacon.com.sg">https://www.airbeacon.com.sg</a>
Apollo Global Academy Pte Ltd	<a href="http://apollodronesacademy.com/">http://apollodronesacademy.com/</a>
Avetics Global Pte Ltd	<a href="https://www.avetics.com/academy">https://www.avetics.com/academy</a>
CWT Aerospace Services Pte Ltd	<a href="https://www.cwtaerospace.com">https://www.cwtaerospace.com</a>
Drone Element Pte Ltd	<a href="https://www.droneelement.com/">https://www.droneelement.com/</a>
Garuda Robotics Pte Ltd	<a href="https://uato.sg">https://uato.sg</a>
Institute of Technical Education	<a href="https://www.ite.edu.sg/courses/part-time-courses/skillsfuture-series-certificate-of-competency">https://www.ite.edu.sg/courses/part-time-courses/skillsfuture-series-certificate-of-competency</a>
MF Media Academy Pte Ltd	<a href="https://www.mfmedia.sg/drone/">https://www.mfmedia.sg/drone/</a>
MIRS Innovate Pte Ltd	<a href="http://www.mirs-innov.com/uato">http://www.mirs-innov.com/uato</a>
Republic Polytechnic	<a href="https://www.rp.edu.sg/ace">https://www.rp.edu.sg/ace</a>
Singapore Polytechnic	<a href="https://www.sp.edu.sg">https://www.sp.edu.sg</a>
Singapore Flying College	<a href="https://www.sfcpl.com/">https://www.sfcpl.com/</a>

Source: Civil Aviation Authority of Singapore