

**54th CONFERENCE OF
DIRECTORS GENERAL OF CIVIL AVIATION
ASIA AND PACIFIC REGIONS**

*Ulaanbaatar, Mongolia
07 – 11 August 2017*

**AGENDA ITEM 3: AVIATION SAFETY AND
AIR NAVIGATION**

**KEY AREAS IN REGULATING UNMANNED AIRCRAFT
SYSTEMS (UAS) OPERATIONS IN URBAN ENVIRONMENT**

(Presented by Singapore)

SUMMARY

This paper shares Singapore's experience in regulating Unmanned Aircraft Systems (UAS) operations in urban environment. This paper also discusses Singapore's efforts to refine the current regulations to address key challenges faced while adapting to the rapid changes in the UAS industry. States are also invited to give priority to develop regulations and share their experience in regulating key areas of UAS operations and, encourage to attend the ICAO Unmanned Aircraft Systems Industry Symposium.

States are invited to:-

- a) Note the content of the paper.
- b) Discuss and prioritise the development of solutions in the key areas identified; and
- c) Share their experience in regulating UAS by encouraging States to participate in the Unmanned Aircraft System Industry Symposium in September 2017.

KEY AREAS IN REGULATING UNMANNED AIRCRAFT SYSTEMS (UAS) OPERATIONS IN URBAN ENVIRONMENT

1. INTRODUCTION

1.1 As a city state, Singapore is highly urbanised and densely populated. To facilitate the use of Unmanned Aircraft Systems (UAS) for multitude of applications within Singapore, we need to manage the public, aviation safety and security risks associated with the use of UAS. Hence, Singapore promulgated the Unmanned Aircraft (Public Safety and Security) Act, and amended the Air Navigation Order (ANO) on 1 June 2015.

1.2 Under the risk-based framework, UAS operations are regulated by its purpose: recreational or research, commercial or specialised services, as well as by the weight of the Unmanned Aircraft (UA). Two types of permits are issued for the conduct of UAS operations – the Operator Permit (OP) and the Activity Permit (AP).

1.3 The OP, applicable to UAS operations that are non-recreational or research or with total weight above 7kg (regardless of types of operations), is intended to ensure that the organization (or operator) has the capability to operate the UAS safely and for its intended purpose. The assessment takes into consideration the applicant's organisational set-up, the competency of personnel flying the UA, procedures to manage safety, and the airworthiness of the UA. The validity of the OP is up to a duration of one year.

1.4 The AP, (for a single activity or a block of repeated activities), is intended to ensure that the risk level of the UA activities performed at an area of operation, with its specific profiles and conditions, is acceptable. The assessment takes into consideration the location of the activities and the flight operational procedures in place to mitigate risks to both public and aviation safety to an acceptable level. Depending on the types of activity conducted, coordination with other government agencies may also be required. Details of the UA permit regime is as described in [Annex A](#).

2. SINGAPORE'S EXPERIENCE IN REGULATING UAS OPERATIONS

2.1 Since June-2015, Singapore has issued more than 200 operator permits and 2,000 activity permits. Singapore has also seen an increasing number of requests from the industry to perform more complex operations such as Beyond Visual Line Of Sight (BVLOS) operations as well as trials to conduct parcel delivery services in high risk areas such as aerodromes and highly populated neighbourhood.

2.2 Singapore's experience is that the regulatory framework needs to be reviewed and enhanced to cater to the quickly evolving nature of UAS operations. For example, as operations become more complex, the competencies of operators will be more important to ensure that UAS are operated safely. Clear guidelines for such operations will have to be developed to ensure that those operating the UAS meet the required competency standards. It will also be necessary to provide for levers over individual operators whose negligence may cause damages to property or injuries to people.

2.3 At the same time, measures to enhance safety must nonetheless complement and facilitate the use of UAS. As part of Singapore's Smart Nation initiatives, Singapore has also identified the need to improve on the governing processes to facilitate UAS research and operations. A national level coordination body was set up to better coordinate efforts across relevant public agencies and the industry. Through this body, key research projects and operational trials are identified and facilitated. The body also deliberate all relevant UAS issues such as safety, security and privacy concerns and provide guidance on the approach and direction to adopt.

2.4 On a global level, Singapore has collaborated with other authorities through exchange of information and formation of working groups to address specific issues. Through participation in working groups and discussions such as the ICAO RPAS Panel and Joint Authorities for Rulemaking of Unmanned Systems (JARUS), useful lessons learnt were incorporated in Singapore's regulations.

3. DISCUSSION

3.1 Given the fast changing UAS' technological and operational landscape, regulators will have to channel its efforts towards improving the versatility of existing regulations and the efficiency of its governing processes, to be agile and innovative. Cooperation between States and the sharing of best practices will help to improve regulators' capabilities to manage UAS safely. In particular, Singapore would highlight several priority issues:

- (i) UAS Traffic Management (UTM) System. UAS operations must be conducted without increasing the operational risk to existing manned aviation or other airspace users. UTM systems will facilitate safe UAS operations, however, such systems are still at the nascent stage. The UTM solutions being developed must also be able to handle the forecasted volume and an automated operating environment for the UAS. These considerations will influence the required features and functionalities of the UTM system. One key feature of the UTM system will be the need for registration, tracking, and identification of UAS, to enable enforcement of regulatory compliance and conflict management. Singapore is developing UAS Traffic Management (UTM) solutions to ensure that UAS operations can be safely and efficiently incorporated into our airspace. The project seeks to develop a tracking system to identify and track cooperative UAS. When operational, the system will enable the tracking and monitoring of commercial UAS operations in Singapore.
- (ii) Beyond Visual Range Operations. In order to facilitate wider use of UAS operations in its urbanized environment, it is necessary to develop a set of beyond visual line of sight (BVLOS) requirements. With technological advancement, UA flights can now be conducted autonomously and monitoring of environment can be performed through the ground control station (GCS). This enables UA operators to be stationed beyond visual range of the UA during operations, and effectively increases the scope of potential uses for UAS in a fully urbanised environment. In drafting the requirements, it was recognised that the operational needs vary across different BVLOS applications. Therefore, it may not be practical to develop a set of requirements that fits all types of BVLOS operations. A more pragmatic approach is to tier the requirements to commensurate with the types of operations allowed. Each tier of BVLOS operations is tied to the technological capability and the aim is to maintain an acceptable level of safety equivalent to manned aircraft operations. This approach allows operators to conduct their operations commensurate with the BVLOS capability, while at the same time, enables industry to test their UAS progressively before advancing into full BVLOS operations in areas such as the vicinity of the airport.
- (iii) Need to keep pace with new UAS applications. Collaboration with the industry and adoption of the 'regulatory sandbox' approach brings agility to the current regulatory framework to adapt to new UAS applications, and provides a test-bed for validation of new regulations developed. For instance, in order to provide a conducive environment for new technology and operational concept to conduct trials, the regulatory sandbox created provides regulator and the industry flexibility to validate feasibility of conceived technology and operations. One example is the Airbus' Skyways project for which Singapore had partnered with Airbus to develop last mile parcel delivery solution in urban environment.

- (iv) Proliferation of UAS operators. Given the important role that UAS operator plays to ensure safe operations of the UAS, we should consider exploring the option of implementing a pilot competency framework to raise the level of competency across the entire spectrum of UAS users. A rigorous training regime would instil in UA operators a greater sense of responsibility and accountability over the safe operation of their UA, and deter them from unsafe or reckless behaviour. Formalised training may compel individuals to upgrade their knowledge/skills so as to keep pace with new regulations and flying techniques.

3.2 Our success in managing such issues hinges greatly on the collaborative efforts both at the national and international levels. Where possible, partnerships and collaboration with the industry and institutes of higher learning could be initiated to co-create regulations, and ensure adequacy of current regulations. In this context, Singapore had partnered Nanyang Technological University (NTU) to conduct a study, to determine the extent and probability of injury to people on the ground that is caused by a falling UA of different weight from different heights. The outcome of the study will be taken into consideration in the review of the current weight threshold in the UAS regulatory framework. Through a more holistic approach, we will be better able to address the challenges of supporting and regulating UAS operations.

4. ACTION BY THE CONFERENCE

4.1 The Conference is invited to:

- a) Note the contents of the paper;
- b) Discuss and prioritise the development of solutions in the key areas identified; and
- c) Share their experience in regulating UAS by encouraging States to participate in the ICAO Unmanned Aircraft System Industry Symposium in September 2017.

Annex A

The UAS regulatory framework:

- (a) Prohibit the carriage of dangerous materials by unmanned aircraft (among others, weapons, and any bio-chemical or radioactive material);
- (b) Prohibit the discharge of any substance from unmanned aircraft without a permit;
- (c) Require operators to obtain an Operator Permit and/or Activity Permit to fly or operate an unmanned aircraft that weighs more than 7kg in total weight (i.e. weight of laden aircraft) and for certain types of operation;
- (d) Provide for the gazetting of security-sensitive locations as “protected areas,” where overflying by unmanned aircraft or taking of photographs from unmanned aircraft are prohibited without a permit;
- (e) Prohibit the overflight of unmanned aircraft over “special event areas” declared for the venues of major events without a permit (for example, certain venues of the 28th Southeast Asian Games); and
- (f) Require operators to obtain a permit to fly or operate an unmanned aircraft within 5km of an aerodrome regardless of height, or above 200 feet beyond 5km of an aerodrome, or within a restricted or danger area.

An Operator Permit and/or Activity Permit will be required under the following circumstances:

S/N	Purpose	Weight of Unmanned Aircraft	Permit Required
1.	For any purpose	More than 7kg in total weight ¹	Operator and Activity Permits
2.	For any business purpose (i.e. Commercial activities or Specialised ² services) including if not Recreation or Research in nature	Any weight	Operator and Activity Permits
3.	For Recreation or Research ³	Not more than 7kg	No permit required. However, an Activity Permit (only) is required if the unmanned aircraft is flown outdoors: (i) in a Restricted or Danger Area; or (ii) within 5km of an aerodrome/military airbase regardless of operating height, or above 200 feet beyond 5km of an aerodrome/military airbase

Note: In all the above operational scenarios, if the unmanned aircraft is flown indoors at a private residence, or indoor area used for the purpose of constructing or testing unmanned aircraft and accessible only to the persons involved, and the flying does not affect at all the general public, no permits are required.

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1 Total weight refers to weight of laden unmanned aircraft i.e. weight of aircraft plus weight of fuel, payload, equipment etc. that it may be carrying.

2 Specialised services refer to services such as for agriculture, construction, surveying, observation and patrol, flying display performances, search and rescue and aerial advertising.

3 Research refers to any lecture or similar activity on unmanned aircraft, or research and development activity on unmanned aircraft performed by an educational institution.