Review of aviation safety regulation and practices of remotely piloted aircraft systems (RPAS) in China

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Bio:

Yang Lin has over 20 years of experience in the field of aviation safety and is a member of the International Society of Air Safety Investigators (ISASI). Currently she is an Air Safety Investigator and senior engineer at the China Academy of Civil Aviation Science and Technology (CASTC) of Civil Aviation of China (CAAC), which she has been working for since 1994. While at CASTC, she analyses and presents recorded data in support of accident/incident investigations and also conducts flight data recorder readouts on behalf of government authorities and airlines in China and other countries. She has helped to develop and apply CAAC regulatory policies for aviation recorders, FOQA and other areas. Since 2005, she also works for China Postal Airlines in Beijing. Her duties include incident investigation, flight crew safety awareness briefings, and flight data analysis program management.

Development of RPAS in China

The industrial chain related to remotely piloted aircraft systems (hereinafter referred to as RPAS) has developed rapidly.

At the end of 2016, the State Council issued the National Emerging Industry Development Plan for Five-Year (2016-2020) that promotes the development of RPAS that can be used in multiple sectors to meet market demand. National policies and broad prospects will enable the RPAS industry to enter a robust development phase. RPAS has been applied in various industries such as agriculture, forestry, mining, infrastructure assessment, power line and pipeline inspection and monitoring, aerial mapping, firefighting and disaster relief, environmental protection, meteorological observation,

highway management, postal express delivery, film and television production and aerial photography, etc.

According to the forecast 2017-2021, the market scale of industry-level RPAS will grow at a rapid rate of 30% per year, and there is a trend to replace the existing manned aircraft in many fields such as general aviation and freight aviation. RPAS for agriculture will be popularized nationwide in 2019, and in 2022, agriculture and recreational aerial photography will be gaining popularity.

In February 2017, the Civil Aviation Administration of China (hereinafter referred to as CAAC) issued Information Bulletin *General and Small Transportation Operation Overview 2016* (IB-FS-2017-011). As of December 31, 2016, the number of RPA with various certificates managed by industry associations in China totalled 8113, a significant increase compared with 1898 in 2015 and 244 in 2014. In March 2017, CAAC issued the *Annual Report on the Development of Civil Aviation Pilots (2016)*. As of December 31, 2016, the total number of civil RPA pilot licences was 10,255, which is an increase of nearly four times compared with the number of certificates issued in 2015. These certificates were mainly distributed to manufacture, research & development enterprises, and universities. There are 158 qualified RPA pilot training institutions, nearly double that of 2015. Today, most drone operators in China are people under the age of 40.

In February 2018, CAAC issued Information Bulletin *General and Small Transportation Operation Overview 2017* (IB-FS-2018-12) and *Annual Report on the Development of Civil Aviation Pilots (2017)*. As of December 31, 2017, the number of certificates held by various types of RPA pilots managed by industry associations has increased to 24,407, including 2121 fixed wings, 1343 helicopters, 20,833 multi-rotors, 9 airships and 101 vertical take-off and landing fixed wings, which are mainly distributed to companies that manufacture drones, research & development enterprises, and universities. A total of 199 pilot training institutions have training qualifications.

In February 2019, CAAC issued Information Bulletin *General and Small Transportation Operation Overview 2018* (IB-FS-2019-15) and *Annual Report on the Development of Civil Aviation Pilots (2018)*. As of December 31, 2018, the number of registered civil RPA had increased to more than 180,000, with 44,573 pilots' licenses for various types of RPA, including 3131 fixed wings, 1624 helicopters, 39,278 multi-rotor wings, 11 airships and 529 vertical take-off and landing fixed wings. There are eight approved cloud system providers for RPA, six of which are connected to the cloud exchange system, i.e. U-Cloud, U-Care, BD-Cloud, 5U Cloud, FindDrone and Xcloud, with a total of 988625 flight hours in 2018.

According to the report from *RPA Real Name Registration System*, as of January 24, 2019, about 295,000 RPA had been registered, including 25,000 with a maximum take-off mass (MTOM) of over 25kg to 150kg, 571 RPA with a MTOM of over 150kg, and 49 RPA with a MTOM of over 650kg. There are 268,000 RPA owners, 3,720 types of RPA, and 1,239 manufacturers and agents registered.

Violations cases of RPAS/RPAS incidents

Meanwhile, taking advantage of regulations and new technologies to supervise RPAS attracts more attention. In fact, the safety risks of RPAS are not only a problem for China, but also for the world. In recent years, there have been multiple incidents of flight delays and airport closures caused by the illegal invasion of RPAS. The illegal operation of low, slow and small aircrafts such as RPA has become a significant concern affecting flight safety and even national and social security. As the usage of RPAS become more prevalent, so too are the conflicts between RPA operators and airliners.

On the evening of May 28, 2016, an RPA appeared in the airspace of Chengdu Shuangliu International Airport's eastern runway, resulting in the runway closure for 1.3 hours and 55 flight delays. This is the first time that RPA has affected the flights in Chengdu Airport.

On April 17, 2017, in the airspace near Chengdu Shuangliu Airport, the fourth largest aviation hub in mainland of China, RPA interfered with the flights again. The control center of Southwest Air Traffic Management Bureau (ATMB) immediately started the emergency plan and diverted 11 flights to Chongqing Airport to ensure flight safety and ground safety. In April 2017, eight consecutive RPA disturbances occurred in Chengdu region, causing 138 flights to return and divert.

On the evening of February 6, 2019, several RPA disturbances occurred over Xi'an City, causing flights disruptions for nearly five hours. At 17:34, the pilot on a flight at about 1,600 meters above the ground was passing over Xi'an en route to Xi'an Xianyang Airport, when he reported to the air traffic controller that an RPA was spotted within 100 to 200 meters directly above him. In the past two years, CAAC has issued relevant measures for handling RPAS due to numerous disturbances. Upon receipt of the report, the air traffic controller immediately started the emergency response plan and set up a temporary avoidance airspace. This airspace covered a horizontal radius of 6km and a vertical radius of 600m from the crew. The controller then directed the aircraft to fly around the airspace, reported the situation to subsequent flights, and continuously observed the dynamics of RPA.

About 10 minutes later, another flight crew reported an RPA near the east gate of Xi'an City. Due to poor visibility and fast flight speed, the crew could not determine the specific height and type of RPA. The air traffic controller immediately set up a temporary avoidance airspace at the reported location in accordance with the procedures. At 18:21, a flight crew at a height of 2400 meters above the ground in the southwest of Xi'an City reported that a black barrel-shaped RPA was flying at a horizontal distance of one kilometer away and at a vertical height of 200 meters away from the crew, which is very dangerous. Due to continuous reports from aircrew and the influence of RPA's flight height on the safety of normal flights, the on-duty leader of Northwest Air Traffic Management Bureau (ATMB) immediately decided to change the flight procedures of arriving flights, and all flights should avoid flying over Xi 'an City.

In the next few hours, the air traffic controller instructed all arriving flights to avoid the airspace according to the emergency plan. At about 22:00, the controller gradually directed aircrafts to resume the normal flight procedures and informed the crew to remain alert for RPAS. The airspace restriction was lifted at 22:15 once no additional RPA sightings were reported. Due to the timely and proper execution of emergency protocols, there were no significant disturbances on normal flight operations.

RPA fuselage is mostly made of aluminum and carbon fiber composite materials. After colliding with a manned aircraft, the degree of damage is worse than that of a bird strike. However, due to the limited power and endurance, this type of RPA has an active radius of 5-10km and a maximum relative height of climb no more than 1km. Therefore, the impact on civil aviation is mainly concentrated on the takeoff, approach and landing phases, and conflicts with aircrafts mostly occur in airport terminals. While there have not been any collisions between flights and RPAS in China thus far, there have been many incidents in which RPAS intruded airport runways and approach routes, resulting in serious incidents and posing great threats to safety.

Evolution of Regulations

In 2009, CAAC issued the airworthiness Management Document *Interim Provisions Related to the Administration of RPA* (ALD2009022), which regulated the registration and administration of civil RPA with reference to the civil aircraft management measures. Before an RPA can fly, the RPA operator must receive temporary registration approval from CAAC and display their registration on the body of the RPA according to the Aviation Procedure *Regulation on the Nationality Registration of Civil Aircraft of P.R. China* (AP-45-AA-2008-01R3). Prior to each flight, the operator should apply for a special flight permit from CAAC Regional Administrations according to the Aviation Procedure *Issuing and Managing Airworthiness Certificates for Civil Aviation Products and Parts* (AP-21-05R1). RPAs with temporary registration certificates and special flight permits shall operate in accordance with the rules of air traffic management, operational management and radio management to ensure the safety.

Later, CAAC continued to carry out the administration of RPAS, and successively published the Advisory Circular *Interim Operating Provisions for Low Level Operation of Light and Small Unmanned Aircraft Systems* (AC-91-FS-2015-31, issued on December 29, 2015) and Management Document *Measures for Air Traffic Management of Civil RPA* (MD-TM-2016-004, issued on September 21, 2016).

In response to illegal RPA flights that affect the operation of civil aviation in many airports across the country, major airports actively carried out special rectification activities for airborne objects such as RPA in accordance with the *Notice on Further Strengthening the Management of Airborne Objects such as RPA in the Airport Clear Zone*. This includes drafting work plans for RPAS and other airborne objects in airport clear zone and becoming more vigilant of such zones. The no-fly zone of the airport has been determined through negotiation with the air traffic control station, and a no-fly zone is an area bounded by 10 kilometers on both sides of the centerline of the runway and 20 kilometers outside both ends of the runway. Major airports coordinate with relevant departments to carry out preventive measures, establish a long-term management mechanism for the joint defense of airports, clarify the stakeholders for the management of RPAS and other airborne objects in the airport clear zone, and publish the map of the airport no-fly zone to the public.

CAAC has implemented the Aviation Procedure *Regulations on Real-name Registration of RPA* (AP-45-AA-2017-03, issued on May 16, 2017), which has gradually strengthened the management of RPA pilots.

On July 19, 2017, CAAC required that flight crew report potential RPA conflicts: after spotting an RPA, the flight crew should immediately report the key information such as the time and location of encounter, flight phase, relative position(left, right or center), relative aircraft altitude(above, below or same altitude), shape (multi rotor, fixed wing, helicoper or other) and color of RPA to the air traffic controller if they believe that it poses a threat to flight safety. Within 24 hours, flight crew shall fill out the *Drone Encounter Report* and submit it to the airline operation control department for review.

These reports play an important role in mitigating the risk of RPA interfering with the operation of flights, promoting the smooth flow of information related to RPA in all aspects of monitoring such as RPA location data gathering, improving the standardization of conflict data reporting of RPA, and optimizing the decision-making process of regulatory authorities in taking timely risk mitigation measures.

In December 2017, CAAC began to implement the Recommended Standards of *RPA Fence* and *RPAS Cloud System Interface Data Specification* to further improve the its legal and regulatory system.

In 2018, it has successively issued the Information Bulletin *Safe Flight Test Report for Low Level Networked RPA* (IB-FS-2018-011, issued on February 6, 2018), Management Document *Interim Administrative Measures for Commercial Flight Activities of Civil RPA* (MD-TR-2018-01, issued on March 21, 2018), and Advisory Circular *Regulations for Civil RPA Pilot* (AC-61-FS-2018-20R2, issued on August 31, 2018).

In 2019, three Advisory Circulars (drafts for comments) *Operating Provisions for Low Level Operation of Light and Small Unmanned Aircraft Systems* (AC-91-FS-2019-31R1, amendment to AC-91-FS-2015-31), *Regulations on Submission and Management of Flight Data of Light and Small Civil RPA*(AC-93-TM-2019-01)*, and *Regulations for Civil RPA Pilot* (AC-61-FS-2019-20R3, issued on August 31, 2019, amendment to AC-61-FS-2018-20R2*)* were issued. Advisory Circular *Interim Regulations for Specific Category of RPA Operation* (AC-92-2019-01, issued on February 1, 2019), *Guidance on Airworthiness Approval of RPA Based on Operational Risk* (issued on January 25, 2019), and Recommended Standard of *Data Specifications of Unmanned Aircraft Cloud System* (draft for comments, issued in June 2019) were also issued. The management protocols of RPA training institutions personnel are also being developed.

Meanwhile, the draft of China Civil Aviation Regulation Part 92 *Safety Management Rules for RPAS* (CCAR-92) is under development, to further improve and integrate the relevant regulations for the management of RPAS within the civil aviation area. This CCAR-92

will include the registration and certificate of civil RPAS, personnel management, operational management, airspace management and other aspects.

On the State level, according to the legislative framework of the State Council and the Military Commission, the State Council and the Office of the Air Traffic Control Committee of the Military Commission published a *Interim Regulation on Flight Management of RPAS* (draft for comments) in January 2018, seeking the views of the civil aviation industry and wider community, such as the military. This interim regulation includes seven chapters, presenting a range of safety related issues in a way that RPAS classification, mandatory registration, pilot education and training, airspace, flight plan, commercial operator, role of manufacturers/retailers, and legal liability. It is the first time that China has deployed the management and development of RPAS from the national strategic level. As the highest administrative regulations for RPAS at this stage, it is the regulation that civil aviation authorities must comply with to supervise RPAS.

So far, the *Interim Regulation on Flight Management of RPAS* (draft for comments) has completed the first round of solicitation of opinions.

In July 2019, the *Interim Regulation on Flight Management of RPAS* (draft for examination and approval) and regulation description were issued by the Ministry of Justice for further comments before August 2, 2019. This document is the result of the consultation performed with the *Interim Regulation on Flight Management of RPAS* (draft for comments):

In the airspace management, *Interim Regulation on Flight Management of RPAS* (draft for examination and approval) require that the RPAS's flight airspace is classified by the combination of horizontal protection range for ground target and the restricted height. Under the premise of a clear horizontal protection area, the height of below 50 meters is required for the micro RPA and below 120 meters is for light RPA, which basically meets recreational users.

In the flight plan management, the current policies that all flights should apply for a flight permit in advance are revised that micro RPA, light RPA, RPA for agriculture and some state RPA are no need to apply for a flight plan when they are flying in a specific airspace (light RPA and RPA for agriculture need to report their information in real time). The small RPA can properly simplify the flight plan approval process when flying below 300 meters.

In terms of the legal obligation, it stipulate that the organizitions and private individuals flying the RPAS are the responsible persons to ensure flight safety. Except for obvious faults, when the RPAS involved with the manned aircraft in an occurence, the party responsible for the RPAS flight shall bear the primary responsibility; when the occurence occured between the RPASs, the party which operated in Beyond Visual Line of Sight Operations (BVLOS) shall bear the primary responsibility or share responsibility.

The draft of China Civil Aviation Regulation Part 92 *Safety Management Rules for RPAS* (CCAR-92) will be issued after the release of this *Interim Regulation on Flight Management of RPAS.*

In June 2017, the Standardization Administration Committee(SAC), the Ministry of Industry and Information Technology, the Ministry of Science and Technology, the Ministry of Public Security, the Ministry of Agriculture and Rural Affairs, the General Administration of Sport, the National Energy Administration, and CAAC jointly issued *Guidelines for Developing RPAS Standard System Framework (2017-2018 Edition)* (hereinafter referred to as the Guidelines). The Guidelines establishes a two-phase and three-step roadmap and defines the requirements, framework and implementation methods of RPAS standard system. The framework will be completed in two phases:

The first phase (2017-2018) is to initially establish a standard system for RPAS, and focus on developing a number of key standards urgently needed by the market and supporting regulatory requirements;

The second phase (2019-2020) is to gradually push forward the development of standards. By 2020, the standard system will be basically established and improved, including basic standards, management standards, technical standards and industry application standards, which will meet the application needs of relevant industries.

Here, the basic standards includes terminology, classification and identification. Management standards includes research & development, manufacturing, registration, and operation, etc. Technical standards includes system, sub-system and component level standards, and application standards includes different applications field standards. Basic standards are mainly national standards, management standards, technical standards and industry application standards are mainly industry standards.

CAAC's policy is to implement an effective aviation safety regulatory framework to enable the safe and efficient integration of RPAS into the aviation system. To accomplish this, CAAC will develop policy, standards, regulations and guidance material reflecting an appropriate and proportionate approach to the relevant levels of risk that is consistent with international best practice.

Integration of RPAS into the system of aviation safety should provide enough flexibility for innovation in the RPAS industry, without adversely affecting other airspace users, the travelling public, or posing unacceptable risks to people or property on the ground. CAAC will continue to engage with relevant International Civil Aviation Organization (ICAO) and other international aviation safety agencies to address key policy issues, including the equitable access to airspace, privacy, national security and the environment. It is a long-term process to expand the flight activities of civil RPA from isolated airspace to non-isolated airspace and finally integrate into the national airspace system. The management of RPA will refer to the existing management system of civil aviation and could be broadly divided into flight standards, RPAS airworthiness certification, market management and air traffic management.

Classification of RPA

In *Interim Regulation on Flight Management of RPAS* (draft for comments) dated of January 2018, according to flight safety risks, taking mass as the main index and combining with RPA performance such as flight height, speed, radio transmission power, airspace maintenance capability, RPAs are divided into micro, light, small, medium and large RPAs. These are:

- micro – RPA with an unloaded weight 250 grams or less;

- light – RPA with an unloaded weight of more than 250 grams but less than 4 kilograms and 7 kilograms maximum takeoff mass (MTOM);

- small – RPA with an unloaded weight of at least 4 kilograms but less than 15 kilograms, or 25 kilograms MTOM;

- medium – RPA with a MTOM of at least 25 kilograms but less than 150 kilograms, and more than 15 kilograms unloaded weight;

- large – RPA with MTOM of more than 150 kilograms.

Here, the classification of micro and light RPA refer to the practices of most countries in deregulating RPA below 250 grams. The concept of *maximum takeoff mass* is mostly used for manned aircraft and is an important indicator for airworthiness certification. Many countries have directly adopted this concept in RPA. However, as small and light RPAs do not have airworthiness requirements, they may not be able to provide the officially tested maximum certificated take-off mass. For ease of management, it regards *maximum takeoff mass* and *unloaded mass* as two important classification criteria for light, small and medium RPA. Light and medium RPA should meet two conditions, and small RPA only need to meet one of them.

According to the requirements of Advisory Circular *Interim Regulations for Specific Category of RPA Operation* (AC-92-2019-01, issued on February 1, 2019) issued by CAAC, RPAS operation management has categorized as follows:

Category	Unloaded Weight (kg)	Maximum Takeoff Mass (kg)
I	$0<W\leqslant1.5$	

II	$1.5 < W \leqslant 4$	$1.5 < W \leqslant 7$
III	$4 < W \leqslant 15$	$7 < W \leqslant 25$
IV	$15 < W \leqslant 116$	$25 < W \leqslant 150$
V	RPA for agriculture and forestry use	
VI	Unmanned airship	
VII	RPAS in categories I and II operated Beyond Visual Line of Sight(BVLOS)	
XI	$116 < W \leqslant 5700$	$150 < W \leqslant 5700$
XII	$W > 5700$	

According to the operation management mode, civil RPA are also divided into categories of open, specific and certified. Category specific RPAS include Categories IV, III with higher risk of operation, and XI and XII with less risk. CAAC believes that category specific RPA can be certificated for operation, while other categories RPA no need to be certificated.

Mandatory registration

A requirement for RPAs to display registration and/or contact details would assist the people in identifying the owners involved in a reportable incident or accident. On May 16, 2017, CAAC has implemented the Aviation Procedure *Regulations on Real-name Registration of RPA* (AP-45-AA-2017-03, issued on May 16, 2017), which is required the manufacturer and owner of the civil RPA with a gross weight of 250 grams or over must carry out real-name registration from June 1, 2017. After August 31, 2017, if the real name registration and registration marks are not implemented, the flight will be regarded as illegal in violation of laws and regulations, and the regulatory authorities will impose penalties according to relevant regulations.

The owner of the civil RPA includes individuals and organizations. The process of real-name registration is that the manufacturer and the owner apply for an account on the *RPA Real-name Registration System*(https://uas.caac.gov.cn). The manufacturer fills out the information of all its products, and the owner registers the information of the RPAs he owns with his name. The registration mark picture (including registration number and QR code) given by the system is pasted on the body of RPA. The owner must ensure that the registration mark is attached to the RPA during each operation. In case of sale, transfer, damage, scrap, loss or theft, the information of the RPA shall be updated in time. After the ownership is transferred, the changed owner must register the information of RPA in accordance with the requirements. The details are available on the CAAC website (accessible using the links provided), as is the https://uas.caac.gov.cn.

Education and training

In 2018, CAAC has successively issued the Management Document *Interim Administrative Measures for Commercial Flight Activities of Civil RPA* (MD-TR-2018-01, issued on March 21, 2018) and Advisory Circular *Regulations for Civil RPA Pilot* (AC-61-FS-2018-20R2, issued on August 31, 2018).

With certain exceptions introduced under two documents above, commercial operators of RPA must hold a remote pilot licence (PL) and/or RPA operator's certificate (OC) (RPA at and above 250 grams). The exception to the pilot licence requirement is when an RPA is being operated in the categoris I and II in compliance with document above. To obtain a license or certificate, a person above the age of 16 must have successfully completed a specific training course and passed an examination. Other operations do not require a a license or certificate and do not impose a mandatory education or training requirement.

From September 1st, 2018, the current effective RPA pilot licence issued by the industry association is automatically converted into the RPA pilot's electronic license issued by

CAAC. The rights contained in the original licence are transferred to the electronic license.

From January 1st, 2019, the applicant's training experience data should be connected to the RPA cloud system approved in accordance with the Advisory Circular *Interim Operating Provisions for Low Level Operation of Light and Small Unmanned Aircraft Systems* (AC-91-FS-2015-31, issued on December 29, 2015) to meet the application for license and/or rating for instruction received and solo pilot time.

To obtain an RPA operator's certificate, the following conditions shall be met:
(a) The entity engaged in commercial activities shall be an enterprise legal person, and the legal representative shall be a Chinese citizen; (b) The enterprise shall have at least one RPAS, and the real name registration shall be completed in the name of the enterprise in the RPA Real-name Registration System; (c) The training institution shall have the training capacity approved by the competent authority or by its authorized institution. (d) Insuring third-person liability insurance for RPA. Applicants should apply for the RPA operator's certificate online through the *Civil RPA operator's certificate Management System* (https:// uas.ga.caac.gov.cn).

The *General Aviation Air Operator's Certificate Management Regulations* (CCAR-290-R1) include four types of certificate items, namely passengers, cargo, training and aerial work. Management Document *Interim Administrative Measures for Commercial Flight Activities of Civil RPA* (MD-TR-2018-01, issued on March 21, 2018) only apply to aerial work and training, excluding passenger and cargo transportation. In order to meet the actual needs of the RPAS operation activities, CAAC approved two pilot operations of logistics and distribution of RPAS in Jiangxi and Shaanxi in August and December 2018. At the same time, relevant legislation was initiated to improve the regulatory system, and the relevant provisions related to cargo transportation will be assessed to determine whether it will be regulated in the same regulations.

Operation management of RPA

Since various RPAS operated in different ways and they use much more airspace than manned aircrafts in China, it is therefore necessary to implement categorical management. The management of light and small RPAs could be done in the following way due to the state of development of technology of RPA.

Operation management of RPA- Deployment of geo-fencing

An electronic geo-fence is a hardware or software system which is coordinated with flight control system to ensure a certain delimited area of electronic geographic zones to exclude any intruding aircrafts in order to ensure the safety of the area.

Under the Advisory Circular *Interim Operating Provisions for Low Level Operation of Light and Small Unmanned Aircraft Systems* (AC-91-FS-2015-31, issued on December 29, 2015), for RPAS of categories III, IV, VI and VII, and categories II and V operated in key areas and airport clear zone, the electronic fence should be installed and used.

Operation management of RPA- RPAS registered in Cloud system

An RPAS cloud system (UACS), is a dynamic database system for light and small RPA operations. This system provides navigation, meteorological and other services for users, and conducts real-time monitoring of RPA operation data (including operation information, position, altitude, speed, etc.). RPA uploads flight data immediately when connecting to cloud. If any RPA invades an electronic fence, RPA cloud will send an alarm.

Under the Advisory Circular *Interim Operating Provisions for Low Level Operation of Light and Small Unmanned Aircraft Systems* (AC-91-FS-2015-31, issued on December 29, 2015):

(1) RPAS of categories II and V operated in key areas and airport clear zone should be connected to UACS or send the position of ground control equipment to UACS at intervals of at least once per minute; RPAS of categories III, IV, VI and VII (gross weight over 7 kg)should be connected to UACS and report its flight date once per second in populous areas and once per thirty seconds in low population density areas.

(2) RPAS of category IV, should be equipped with passive feedback systems.

(3) For RPAS not registered in UACS, the operator should apply to the authority for approval and provide an effective surveillance method before the operation.

Since March 2016, when the first UACS obtained the qualification for trial operation, as of December 31, 2018, CAAC has approved a total of 8 cloud systems (Table 1-1), including 5 new UACSs and 2 UACS updated approval letters in 2018, as follows:

Approval letter number	Name of UACS	Name of UACS provider	Date of approval	Note
01	U-Cloud	Beijing U-Cloud Intelligence and Aviation Technology Co.Ltd	Mar.12, 2018	First update
02	U-Care	Cloud Century	Mar. 21, 2018	First update
03	Flying-Cloud	Chengdu Flying General Aviation Company	Aug. 31, 2016	Expired
04	BD-Cloud	BEIING COMPASS TECHNOLOGY CO.,LTD	Aug. 28, 2017	
05	5U Cloud	Beijing 5U Cloud Big Data Technology Co.，Ltd	Jan. 2, 2018	
06	KITE BEAM	Nanjing Dwing Aviation Technology Co.,Ltd.	Mar. 2, 2018	

07	Finddrone	Qianxun SI	Mar. 21, 2018	
08	UGRID	Smart Grid(Beijing) Tech Co.,Ltd.	Jun. 4, 2018	
09	Xcloud	Guangzhou Xaircraft Technology Co.,Ltd.	Sep. 20, 2018	for agriculture and forestry's exclusive use

RPAs connected to this UACS shall upload flight data to the UACS during the flight.

In 2017, CAAC conduct research on the cloud data exchange, and developed a cloud exchange system for RPAS, through which several UACSs can be connected, and real-time data exchange and sharing are realized, that is, the registered RPAS in the same airspace are mutually visible.

RPAS cloud system has an operational history for nearly three years in China. Mainly registered in the cloud system are light and small RPAS, and agricultural RPAS. At present, these cloud systems have realized real-time monitoring of RPAS position, speed, altitude, heading, registration etc., and for RPAS invading the electronic fence, it has an alarm function. These systems meet the requirements of the recommended standards of *Fence of Unmanned Aircraft System*(MH/T 2008-2017) and *Interface Specification of Unmanned Aircraft and Cloud System* (MH/T 2009-2017). In June 2019, CAAC published the recommended standards of *Data Specification of Unmanned Aircraft Cloud System (draft for comments)* , seeking the views of the aviation industry and community.

In addition, some cloud systems also have relatively rich functions, such as online reporting of flight plans, meteorological services, aviation insurance purchase, operation

environment monitoring and other functions, such as monitoring the engine parameters, the temperature and humidity of the surrounding environment.

Most RPAS cloud service providers have also established quality management systems and safety management manuals according to ICAO Doc. 9859 Safety Management Manual(SMS).

Operation management of RPAS Operator

According to civil aviation law of PRC, the operator of a civil aircraft shall be covered by insurance against liability for third parties on the surface or obtain corresponding guarantee.

Flight plan application and approval process

The *Interim Regulation on Flight Management of RPAS (draft for comments)* issued in January 2018 broke through the current requirement that all flights must be applied in advance and implemented only after approval, and appropriately simplified the application and approval process for flight plans in some operation scenarios.

The micro RPA flies outside the prohibited airspace will not need to apply for a flight plan, and there is no need to apply for a flight plan for light RPA and agriculture application RPA flying in the appropriate airspace, but dynamic information must be submitted in real time to the supervision platform for RPA.

In addition, organizations or individuals engaged in other categories RPA flight activities shall submit an application for a flight plan to the local air traffic control department prior to the implementation of the flight, and the flight plan shall not be implemented until it is approved.

Dedicated RPAS Branch- National Aircraft Standardization Technical Committee RPAS Sub-technical Committee

In December 2018, the first sub-technical Committee on RPAS (SAC/TC435/SC1) of the national aircraft standardization technical Committee was established to be responsible

for the development of national standards in the fields of design, manufacture, delivery, operation, maintenance and management of civil RPAS. In line with the International Organization for Standardization's Technical Committee on Aeronautics and Spacecraft's Technical Sub-Committee on Unmanned Aircraft Systems (ISO/TC20/SC16), it aims to promote the construction of the industry standard system for RPA, improve the safety and quality level of RPA products, and promote the high-quality development of China's RPA industry.

Air Traffic Management System for Civil RPA

On November 19, 2018, the pilot project of RPA flight management in Shenzhen was launched and the comprehensive supervision platform was put on line for trial operation. At the same time, the *Implementation Measures for RPA Flight Management* were issued in Shenzhen, announcing that the comprehensive supervision platform would efficiently connect users and management departments.

The platform mainly consists of modules of airspace management, civil aviation management and flight information service, public safety management and user service.

Airspace management mainly realizes the functions of airspace planning, approval, release, flight plan declaration and approval, and real-time monitoring of flight.

Civil aviation management and flight information management is undertaken by the RPAS air traffic management information service system (UTMISS) of CAAC(www.utmiss.com). It mainly implements the functions of monitoring information collection and processing, civil aviation flight safety assessment, information transmission, user information management, user and RPA information verification, information integration service, etc. it is deployed in the Center-Southern region administration of CAAC, Air Traffic Management Bureau(ATMB), Civil Aviation Shenzhen Administration and local air traffic control station. Through communication with civil aviation service, public safety service and other systems, UTMISS can provide RPA flight application information, real name registration information of inspectors,

pilot license information, RPA airworthiness information, RPA operator's certificate information and RPAS owner information to all service systems.

Public safety management mainly realizes the functions of public security filing, real-time flight monitoring, networking of detection and countermeasures equipment, etc.

User service mainly realizes the functions of user registration, information inquiry, flight plan application, submission of flight dynamic information, notification and reminder, etc.

The integrated monitoring platform for RPA takes flight management as its core, including core elements such as airspace management, civil aviation management and public safety management, to meet the needs of fast flight approval, real-time visibility of flight paths, rapid verification of control, and release of comprehensive information. Through the platform, the functions and tasks of military, civil aviation and public security are defined, and the coordination relationship is clarified.