



Interim Approach to the Regulation of Remotely Piloted Aircraft Systems

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10 December 2013

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1. Purpose

This paper explores the challenges associated with the rapid development in civilian use of remotely piloted aircraft systems (RPAS). It will detail the proposed interim actions of the Civil Aviation Authority (CAA) to provide regulatory oversight of this burgeoning industry. It will also provide an overview of longer-term policy questions that require resolution to ensure RPAS are integrated safely into the New Zealand aviation system.

Research and development into the civilian applications of remotely piloted aircraft systems (RPAS) is a dynamic and rapidly evolving area. Control and guidance systems are now available that enable these aircraft to perform a variety of tasks that were previously unachievable, unreasonably expensive, or involving too much personal risk. Consequently, RPAS have an increasing presence in controlled and uncontrolled airspace.

While RPAS growth is currently concentrated in smaller aircraft, similar to model aircraft in size (though not necessarily in performance), these systems are beginning to expand into larger aircraft.

RPAS present a number of unique and significant safety risks that require careful consideration before they can be safely integrated into the New Zealand aviation regulatory system.

2. Background

What are Remotely Piloted Aircraft Systems?

Put simply, a remotely piloted aircraft is an aircraft that can fly without a human pilot on board. The International Civil Aviation Organisation (ICAO) defines an RPA as: ‘an unmanned aircraft piloted from a remote station’ (Amendment 6 to Annex 7). There are a wide range of terms that are used to describe these aircraft, including:

- Unmanned aerial vehicle (UAV)
- Unmanned aerial system (UAS)
- Remotely piloted aircraft (RPA)
- Remotely piloted aircraft system (RPAS)
- ‘Drones’
- Model aircraft

The preferred term used by the CAA for these aircraft is RPA. This is consistent with ICAO, and reflects that these aircraft are still piloted, even if the pilot is not on-board the aircraft.

The core difference between a model aircraft and an RPA, is that the former are flown for recreational, sport or educative reasons, under stringent restrictions. Further, an unmanned aerial-, or remotely piloted aircraft-, *system* (UAS, or RPAS) refers to the accompanying

components of the operation outside of the aircraft itself, such as control and communication systems.

While some RPAS resemble traditional aircraft in design and flight capability, there is a significant variation in type. Some RPAS have unconventional capability, with the ability to operate in ways traditional aircraft cannot, not least due to the different relationship they have to their human pilots. Further, given there are relatively cheap high-performance aircraft, with no passengers or pilots, there would be a temptation, and ability, for operators to use RPAS for high-risk activities that would not be pursued in a manned aircraft.

These unique differences from traditional aircraft means that regulators must adjust some of their safety assumptions, and broaden the regulatory framework to account for this aviation activity.

Many of the challenges posed by RPAS, and the responses to them, are also applicable to 'autonomous aircraft'. An *autonomous operation* is defined by ICAO as: 'an operation during which a remotely-piloted aircraft is operating without pilot intervention in the management of the flight'. However, these aircraft can still be regarded as piloted, consistent with the expectations of a 'pilot-in-command' as outlined in the Civil Aviation Act. The challenges explored in this paper relate closely to autonomous aircraft, and the proposed actions are also intended to cover them.

Current New Zealand regulatory framework

Civil Aviation Rule (CAR) Part 101 states:

Model aircraft means a pilotless aircraft with a gross mass of between 100 g to 25 kg and includes—

- (1) control line model aircraft;*
- (2) free flight model aircraft;*
- (3) radio controlled model aircraft;*

This rule outlines the operating requirements for gliders (and other 'special' aircraft), and also states that aircraft between 15-25kg must be constructed and operated under the authority of a model aircraft association approved by the CAA. Model Flying New Zealand (MFNZ) has a Large Model Inspection Program, which includes general design standards, an inspection regime during construction, and a flight permit process. However the MFNZ does not currently exercise oversight of commercial RPAS operations.

CAR Part 19 defines a pilotless aircraft as:

an aircraft, other than a balloon or kite, designed to fly unmanned with a gross mass greater than 25 kg:

Rule Part 19.105 *Pilotless aircraft*, states:

- (a) No person shall operate a pilotless aircraft except with the authorisation in writing of the Director and in accordance with such conditions as may be specified in the authorisation.*
- (b) The Director may, upon application in writing, authorise the operation of pilotless aircraft and impose such conditions on the operator as the Director thinks necessary in the interests of safety.*

Until October 2013, the CAA had a policy that all commercial operations of RPAS would require the authorisation of the Director of Civil Aviation, irrespective of weight. This

policy was based on the CAA duty of care to provide regulatory oversight of a growing and little-understood aviation sector.

As defined under the above rule parts, the CAA currently only has the legal power to authorise those pilotless aircraft 25kg and above. As such, authorisations for RPAS less than 25kg, whether engaged in recreational or commercial activity, have been discontinued. This position is in line with the CARs.

In place of an authorisation for these sub-25kg aircraft, the CAA will conduct an evaluation of a proposed RPAS operation. This will be a review the proposed operation and assess whether it complies with Part 101 Rules and has robust, safe operating procedures. In the interim, those operators that had authorisations can continue to operate as long as they meet the restrictions and conditions of the expired authorisation.

International developments

State regulators around the world, and ICAO, are grappling with the unique challenges and safety risks posed by RPAS activity.

ICAO has thus far adopted three amendments to the Annexes of the Convention on International Civil Aviation. The amendments arose, in part, from the Unmanned Aircraft Systems Study group, of which New Zealand is a member. Although the Amendments are in force, New Zealand is non-compliant. The amendments are to:

- Annex 2 (Amendment 43) International Standards, Rules of the Air: This amendment includes high level requirements related to remotely piloted aircraft systems – general operating rules, certificates and licensing, and requests for authorisation when operating across another state.
- Annex 7 (Amendment 6) International Standards, Aircraft Nationality and Registration Marks: The amendment classifies remotely piloted aircraft as aircraft and makes provision for the diverse size and configuration of airframes which may be ill suited for traditional markings. This amendment gives the state of registration authority to determine the measurement of the nationality, common and registration marks on these aircraft taking into account the need for easy identification.
- Annex 13 (Amendment 13) International Standards and Recommended Practices, Aircraft Accident and Incident Investigation: The definition of ‘accident’ has been amended to include RPAS. Currently, reporting of RPAS accident/incidents could be considered voluntary, depending on the interpretation of AC12 – 1 and 2. It is important to build a complete longitudinal profile in order to address harm before it occurs.

Other state regulators are also advancing work on RPAS regulation. CASA has had separate rules and advisory circulars for RPAS since 2002. It is currently revising its regulations to reflect developments in this sector. The FAA recently released its ‘Roadmap’ for the ‘Integration of Civil Unmanned Aircraft Systems (UAS) in the National Airspace System’. This document is a comprehensive, high-level overview of the intended actions by the FAA.

The work of other international regulators can serve as a model for the CAA. Given these efforts are more advanced than the CAA's, have greater commitment of resource, and are being undertaken by major players in the international aviation system, it is appropriate that New Zealand positions itself as a 'fast-follower' in the development of RPAS regulations.

3 Challenges

The challenges posed by developments in RPAS can be divided into short-term (6-12 months) and long term (12 months and beyond) challenges.

Immediate challenges

Growth in the civilian RPAS sector

The civilian RPAS sector is a burgeoning industry, with considerable growth expected in the civil applications of these aircraft. Operators in New Zealand are already employing remotely piloted aircraft for commercial and research activities, including:

- aerial photography
- surveying and mapping
- stock monitoring
- search and rescue
- conservation activities (Department of Conservation)
- law enforcement (NZ Police)
- power lines-inspection trial by Transpower (150kg RPA).

Figures for the economic growth potential of RPAS in New Zealand are not available, however studies in the United States suggest that the industry will contribute more than \$82 billion to their economy by 2025 (perhaps sooner). While the RPAS sector in the United States is more advanced than in New Zealand (in terms of size and complexity), there is a clear potential for RPAS to significantly contribute to economic growth in this country.

The growth in the use of RPAS has seen the development of a new, dynamic sector of aviation participants that currently have little regulatory oversight. The CAA has received, and continues to receive, enquiries from the aviation sector regarding the private and commercial use of RPAS. As at November 2013, there were 15 CAA-approved operations, with roughly 40 pending enquiries. These enquiries are expected to continue, with increasing demand for greater use of RPA's for a wide range of activities.

Risks inherent to RPAS flying

The risks involved in the potential activities identified above are varied and not fully understood at this stage. Identified risk areas include:

- Low-level flying (eg surveying vegetation), reducing the ability of the pilot to recover from an aircraft failure

- Near-structure flying (eg surveying power lines), reducing the ability of the pilot to recover or maneuver out of a dangerous situation
- Dangerous flying incentivised by financial reward
- Flying in populated/congested areas, with a threat to third party persons and property
- Flying in unsegregated airspace, or near an aerodrome
- Operations beyond visual line-of-sight.

As the aviation safety regulator, the CAA has a ‘duty of care’ to understand and mitigate the potential safety risks of RPA activity. As the sector is currently lightly regulated, with little-to-no engagement with the CAA, action is required so these safety risks can be understood and appropriate interventions developed to manage them.

Under current pilotless and model aircraft rules (Part’s 19 and 101), the CAA has little oversight of RPA users operating aircraft weighing less than 25kg. According to CASA, which oversees a more developed RPA industry, approximately 90 per cent of RPAs operating in Australia weigh less than 7kg. This seems likely to be the case for the New Zealand RPA sector.

Lack of awareness amongst RPA operators of risks of their activity

With the increased availability of high-performance and affordable RPA’s, there has been a corresponding broadening in the RPA participant profile. Many of these new participants have no history of engagement with the CAA or model aircraft associations. Thus many have minimal flight experience or understanding of aviation regulations.

These operators pose a risk to the safety of the New Zealand aviation system and persons and property on the ground, because of a lack of understanding of the risks of their activity.

Distinguishing between model aircraft and RPAS

There is currently some difficulty in developing a reasonable distinction, on a safety basis, between what constitutes a model aircraft and an RPAS. One suggestion is to distinguish by commercial and recreational activity, with the RPAS definition relating to the former and model aircraft to the latter. This position would be consistent with the ICAO distinction.

However, from a safety perspective, given that there is (currently) no carriage of passengers, the traditional ‘hire or reward’ distinction is not necessarily appropriate for RPAS. For example, if a photographer was to employ an RPAS for capturing scenic photography, should this activity fall under commercial activity as the CAA currently recognises it, with the corresponding regulatory requirements?

Longer-term challenges

In the longer-term RPAS are expected to continue to develop technologically and be more widely used in ever more complex operations. These operations could include:

- agricultural work, including chemical spraying
- freight transport by small and large RPA’s

- passenger operations, including internationally.

To ensure these operations are safely integrated into the New Zealand aviation system, a number of significant policy questions need to be answered. These include, but are not limited to:

- airworthiness standards
- personnel licensing
- communications requirements
- air traffic management
- airspace design to accommodate for RPAS
- qualifications and training by third party organisations
- adoption of ICAO RPAS amendments
- development and regulation of sense and avoid technology
- human factors relationship with RPAS
- safe integration into non-segregated airspace.

This policy work is guided by a vision of the potential future of RPAS in New Zealand airspace, in which large passenger and freight aircraft are remotely or autonomously piloted. While the immediate challenges posed by RPAS relate to the smaller, high performance aircraft, it is only a matter of time before operators are requesting authorisation for standard, ‘full-size’ aircraft to be flown remotely.

Current work on regulations and education must recognise this future reality, and take steps that will allow the CAA to maintain a safe aviation system while not being a barrier to this activity. The first steps that the CAA takes in its regulatory development for RPAS will form the basis of future regulation (which may include a separate rule part devoted to these aircraft), and so consideration should be given to the longer-term impact of short-term CAA actions.

The CAA is interested in hearing from industry about the prioritisation of longer-term policy work with regard to RPAS.

Out of scope challenges

The mandate of the CAA is aviation safety and security. While the CAA is interested in non-safety concerns related to RPAS, these concerns are largely out of scope of the current policy work. Some of these concerns include threats to privacy and the environmental impact of RPAS activity.

The CAA intends to engage with other government and non-governmental agencies on these issues, to ensure that proposed safety regulations do not unnecessarily conflict with other initiatives in these areas.

4 New Zealand Approach to Regulation of RPAS

As noted above, aviation regulators around the world are struggling to understand the challenges posed by RPAS activity, and to design an appropriate regulatory system for this activity. Further, the key technologies required for RPAS to fly in non-segregated airspace ('sense and avoid' technologies, etc) are not yet matured and widely available. As such, the integration of RPAS into the New Zealand aviation system should be gradual and evolutionary. As noted by the 'Roadmap for the integration of civil Remotely-Piloted Aircraft Systems into the European Aviation System', RPAS integration should follow a path of:

'initially restricted access under specified conditions, and subsequent alleviation of the restrictions as soon as technology, regulation and societal acceptance progress'

The CAA is approaching RPAS in a similar fashion, with clear distinction between the short-term 'accommodation' of RPAS, and the longer-term full integration. To ensure that the integrity of the New Zealand aviation system is maintained in the short-term, and future policy work can be built upon, the CAA is pursuing three immediate actions:

- proposing changes to rule Parts 19 and 101, with a review of Part 91 to ensure that the current airspace and operating rules are fit for purpose
- development of a communications and education programme
- ongoing monitoring of international developments, and active engagement with international organisations and state regulators.

Changes to the Civil Aviation Rules are recommended by the CAA to the Ministry of Transport, and involve a comprehensive rule-making process that includes consultation with industry and the wider public through a Notice of Proposed Rule-making (NPRM).

Changes to rule parts 19 and 101

The CAA currently lacks the legal means to provide sufficient regulatory oversight of unmanned aircraft under 25kg. Model aircraft rules (Part 101) apply to these aircraft, but these are regarded as insufficient for regulating those RPAS that are engaging in non-traditional activities. These aircraft are also increasingly flown by operators with little engagement with the CAA or traditional aviation organisations.

As part of immediate steps to provide greater oversight, and thus assess and mitigate the identifiable risks, changes are required to the relevant rule parts (in this case, Part's 19 and 101).

Remotely Piloted Aircraft and Model Aircraft Definitions

Civil Aviation Rule 19 *Transition Rules* defines a pilotless aircraft as: 'an aircraft, other than a balloon or kite, designed to fly unmanned with a gross mass greater than 25 kg'. This definition is inadequate as it does not recognise that these aircraft are being piloted, but from a ground position. ICAO defines an RPA as:

'an unmanned aircraft which is piloted from a remote pilot station'

ICAO also defines a RPAS as:

‘a remotely-piloted aircraft, its associated remote pilot station(s), the required command and control links and any other components as specified in the type design’

The CAA will recommend the adoption of the ICAO definitions, with the addition that it applies to remotely piloted aircraft that are engaged in *non-recreational* activity. Further, the model aircraft definition (Rule 101) will need to be amended to state explicitly that these are aircraft intended for solely *recreational* (including sport and education) purposes. This distinction between recreational and non-recreational is broadly consistent with ICAO

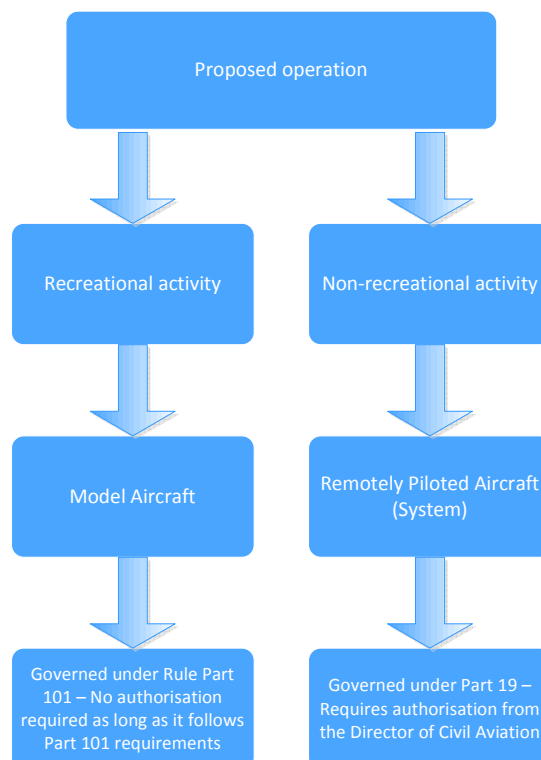
Weight break for model and pilotless aircraft

The current weight break between model and pilotless aircraft (25kg) is a barrier to the CAA providing safety oversight of RPA activity. The elimination of the weight break would allow the CAA to mandate potential or current RPA operators to register and be authorised before they can operate.

The CAA will recommend that this weight break be eliminated, with *all* remotely piloted aircraft to require authorisation from the CAA. Those operators engaging in traditional model flying activity will not be required to seek an authorisation, but rather adhere to Part 101 model aircraft rules. Figure 1 below outlines the new process.

The proposed authorisation process will require potential operators to register their RPAS with the CAA, and give a detailed overview of their intended operation. The operation would then be assessed by the Special Flight Operations & Recreational Aviation team, who would mandate operator requirements depending on the a number of key factors, including:

- pilot qualifications
- maintenance and airworthiness programmes and systems
- scope and complexity of the proposed operation (eg is it over congested areas, within visual line-of-sight, etc).



Rule amendments to Part 19 and Part 101 will give the CAA the power to regulate this growing industry, with RPA operators (non-recreational operators) required to be authorized by the CAA. Part 91 *General Operating and Flight Rules* will also be reviewed to ensure it is fit for purpose for RPAS operations, using ICAO material for guidance as appropriate.

Accompanying guidance material and acceptable means of compliance in the form of advisory circulars will supplement rule changes and further highlight CAA expectations. This guidance material will be essential to ensuring that operators have a clear understandings of the expectations of the CAA with regard to RPAS operations, and will need to detail how requirements may differ for differing operations.

Development of an RPAS register

To gain a good understanding of the RPAS sector, and provide the appropriate regulatory oversight, it is important that the CAA develops a register of all RPAS and their operators. Ideally, this would be driven by voluntary engagement from RPAS operators, who would recognise the benefit of early and regular engagement with the CAA.

The information gained from this process will be essential to future policy and technical work by the CAA. The CAA will need to design a registration system (likely online) that can be easily understood, engaged with, and asks for the relevant information.

Development of a communications and education programme

Engagement with new and traditional participants in the RPA/model aircraft sector is a priority of the CAA. By engaging with these participants, the CAA can ensure they are aware of the risks and regulatory obligations associated with their activity.

The development of a comprehensive communications and education programme aimed at RPAS operators, potential and current, is an important step in this engagement. This programme will need to be in step with regulatory developments. Initial work will include:

- communicating to all current or potential RPAS operators their current regulatory requirements
- acknowledging the confusion concerning the previous CAA approach of ‘authorising’ sub-25kg RPAS activity, and the subsequent change in this process
- providing an overview of impending changes to the regulatory system for RPAS, and their future requirements as operators
- providing an overview of intended longer-term policy work.

The communications and education programme will need to be tailored for traditional model aircraft operators, and the burgeoning private and commercial RPA market. This will require coordination with other government agencies, who can approach the sector from a different perspective, with different powers. For example, the Ministry of Business, Innovation and Employment has a responsibility for ensuring consumer products are safe and used safely, and advising consumers and businesses about consumer-related issues, rights and responsibilities.

With the growing commercial application of RPAS, this and other avenues for communicating safety requirements will need to be explored.

On-going monitoring of international developments

International developments in RPAS regulation will be a core driver of New Zealand regulatory efforts. This includes work currently underway at ICAO, which is focusing on developing RPAS standards for global interoperability.

The CAA is committed to engaging with key international aviation organisations in the development of RPAS regulations. By working in concert with other regulators, New Zealand will be able to leverage off the significant work being conducted in other jurisdictions, while ensuring consistency in regulatory expectations for RPAS.

An immediate goal of the CAA is to ensure we become compliant with ICAO on RPAS matters. This will require the adoption of the promulgated ICAO amendments for international operations, as well as a decision on whether these amendments should be applied to domestic operations.

5 Conclusion

RPAS operations represent a new frontier in civil aviation, with the potential for considerable economic and social benefits. However, significant work is required before these aircraft will be able to integrate safely into the New Zealand aviation system. While these aircraft present as exciting opportunities and a wide range of potential benefits, RPAS operations must still meet the same standards expected of manned aircraft, before they can enjoy the same access to airspace.

A graduated, evolutionary integration of these aircraft into the aviation system is the appropriate approach. Significant technological and regulatory developments must be

achieved before this integration can take place. Until that time, the CAA will undertake some immediate actions that will allow the accommodation of RPAS activity to ensure good safety outcomes.