Legal perspectives on the cross- border operations of unmanned aircraft systems

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5 THE SAFE CROSS-BORDER OPERATIONS OF UNMANNED AIRCRAFT SYSTEMS

5.1 SCOPE OF ANALYSIS

Despite the fact that aviation is the safest means of transportation, as measured by the ratio between the number of accidents and that of passenger/kilometres,[1] safety' is perhaps the principal interest of the aviation system, capturing most of the attention of States, industry and ICAO because safety is susceptible to the inherent risk of flight. UAS also face the same risks of manned aviation, but because of their specific condition and nature, other concerns may arise that will require the action of the States, ICAO and operators.

In this chapter, the author will explore safety-related aspects that apply to the international air navigation of UA under the Chicago Convention 1944 and its Annexes. Specifically, the author will examine several subjects, such as the rules of the air, accident investigation, documents carried on board the UA, certificates of airworthiness, personnel licensing and the recognition of certificates and licences. Moreover, the chapter addresses the management of safety and security, incidents involving UAS and future safety and operational challenges that UA may face during their flight planning, including the use of aerodromes and handovers between remote pilot stations.

5.2 APPLICABILITY OF THE CHICAGO CONVENTION 1944 AND ITS ANNEXES TO THE CROSS-BORDER OPERATIONS OF UNMANNED AIRCRAFT SYSTEMS

5.2.1 THE ENACTMENT OF SAFETY REGULATIONS FOR THE OPERATIONS OF UNMANNED AIRCRAFT SYSTEMS UNDER THE CHICAGO CONVENTION 1944

UA face the same risk as manned aviation and, in order to engage in international air navigation while integrating into the existing civil aviation system, UA shall neither represent a threat nor a risk to persons, property or other civil aircraft. To achieve that aim, international regulations on safety, designed specifically for UA, are essential.

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1 ICAO. Report of Accident Investigation and Prevention (AIG) Divisional Meeting (1999) at ii-4. The accident rate (measured in passenger fatalities per 100 million passenger-kilometers) was approximately 0.025 in 2000 and 0.02 in 2006). *ICAO News Release*, PIO 5/02, 9 April 2002 and ICAO Doc 9876, *Annual Report of the Council,* 2006. 27.

The States taking part in the Chicago Conference 1944 agreed on the necessity to accomplish safety in international air navigation through the largest possible degree of harmonisation pertaining to international practice.[2] With that intent, States created ICAO with quasi-legislative powers to regulate international civil aviation and adopt standards on safety that they should implement into their national legal regimes.[3] Certainly, ICAO's principal aim is 'ensuring the safety of international civil aviation worldwide[4] ; therefore, it plays an essential role in paving the road to developing international safety rules for UAS and thereby enable their cross-border operation.

The Chicago Convention 1944 mentions the terms 'safe' and 'safety' combined fifteen times, while safety considerations are present in almost all aspects of aviation. However, what is safety, and why is it so important?

ICAO defines *safety* as:

> "...the state in which risks associated with aviation activities, related to, or in direct support of the operation of aircraft, are reduced and controlled to an acceptable level."[5]

The author considers that aviation safety is important not only for ICAO but also for States, industry, aviation users and society in general, as life's preservation and protection in an activity that entails risks is a natural obligation of all parties involved in the chain process of aviation.

Dr Jiefang Huang postulates that a threat to aviation safety is a threat to life. Thus, to protect aviation safety is to protect the right to life. In view of the importance of the rights and obligations involved with aviation safety, to wit, the duty to provide safety oversight, the duty to refrain from the use of weapons against civil aircraft in flight and the duty to prevent and punish the acts of hijacking and sabotage endangering the safety of civil aviation, have become the concern of all States and are emerging as obligations 'towards the international community as a whole', also known as *erga*

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2 '*Proceedings of the International Civil Aviation Conference*'//' Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). Accessed January 06, 2019. https://www.icao.int/ChicagoConference/Pages/proceed.aspx

3 *"Proceedings of the International Civil Aviation Conference"*//" Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). Accessed January 06, 2019. https://www.icao.int/ChicagoConference/Pages/proceed.aspx

4 *'A32-11: Establishment of an ICAO Universal Safety Oversight Audit Programme'*. Resolutions Adopted at the 32nd Session of the Assembly Provisional Edition. Accessed January 6, 2019. https://www.icao.int/Meetings/AMC/MA/Assembly%2032nd%20Session/resolutions.pdf

5 See definition of 'safety' in *Annex 19 – Safety Management: International Standards and Recommended Practices.* Montreal, Quebec: International Civil Aviation Organization, 2013), 1-2.

omnes.[6] The ICJ, in the *Barcelona Traction* case, manifestly referred to *erga omnes* as an obligation towards all in the following *obiter dictum*:

> "...an essential distinction should be drawn between the obligations of a State towards the international community as a whole, and those arising *vis-à-vis* another State in the field of diplomatic protection. By their very nature, the former are the concern of all States. In view of the importance of the rights involved, all States can be held to have a legal interest in their protection; they are obligations *erga omnes*.
>
> Such obligations derive, for example, in contemporary international law, from the outlawing of acts of aggression, and of genocide, as also from the principles and rules concerning the basic rights of the human person, including protection from slavery and racial discrimination. Some of the corresponding rights of protection have entered into the body of general international law...others are conferred by international instruments of a universal or quasi-universal character."[7]

Dr Jiefang Huang also submits that one of the characteristics of obligations *erga omnes* is their universality and non-reciprocity, as *erga omnes* are obligations of a State towards the international community as a whole, which are the concern of all States. The corresponding rights to these obligations have entered into the body of general international law or are conferred by international instruments of a universal or quasi-universal character.[8]

The allusion 'towards the international community as a whole', which are 'the concern of all States' in the Barcelona Traction case, shows an overarching system that embodies a common interest of all States.[9] In this context, the *erga omnes* obligations do not imply an exchange of rights and duties but adherence to a normative system.[10] It is the 'common interest' against the 'individual interest' that distinguishes a community from its components. Based on this, *erga omnes* are 'non-bilateral', or specifically, 'non-reciprocal' in the sense that they exceed the reciprocal legal relations between States, as all States have a shared legal interest in their observance.[11]

How may the obligations adopted by contracting States under the Chicago

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6 Jiefang Huang. General Conclusions. In *Aviation Safety and ICAO* (Alphen aan den Rijn: Kluwer Law International, 200-241.

7 Barcelona Traction, Light and Power Company, Limited *(Belgium v. Spain)* Judgement, 1970. ICJ Reports 3 32.

8 Jiefang Huang. General Conclusions. In *Aviation Safety and ICAO* (Alphen aan den Rijn: Kluwer Law International, 2009), 165.

9 C. Tomuschat. *Obligations Arising for States without or against their Will'*, 1993), 241.

10 R. Provost. *Reciprocity in Human Rights and Humanitarian Law* 1994), 383-386.

11 C. Annacker. *The Legal Regime of Erga Omnes Obligations under International Law* 1994), 46. She stated that 'the distinguishing feature of an obligation *erga omnes* is its non-bilateral structure'.

Convention 1944 have *erga omnes* universality and non-reciprocal character? By the time the States adopted the Chicago Convention 1944, the bilateral or reciprocal mode of operation prevailed, and the concept of *erga omnes* did not yet exist.[12] Nevertheless, contracting States committed to safety obligations, not in exchange for rights and duties but in observance to a common normative system. The Preamble of the Chicago Convention 1944 provides that States have "agreed on certain principles and arrangements in order that international civil aviation may be developed in a safe and orderly manner...".[13] The Preamble denotes, therefore, a universal obligation that embodies a joint interest of all current 193 contracting States, which is safety.

Another illustration of the State's shared interest in safety is the second portion of Article 8 on pilotless aircraft.

> Article 8: Pilotless aircraft
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> "…Each contracting State undertakes to insure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be so controlled as to obviate danger to civil aircraft."[14]

Article 8 embodies the obligation of all contracting States towards all to ensure the UA shall be so controlled as to prevent danger to civil aircraft. There is no space for reciprocity in this provision as 'safety', and the obligation to keep due regard to obviate danger to civil aircraft applies to all contracting States to the Chicago Convention 1944 without exception.

The SARPs laid down in the Annexes to the Chicago Convention 1944 aim to protect the common interests of the international civil aviation community and enhance the global normative system for the safety of civil aviation. A contracting State shall comply with SARPs, once adopted by such State, regardless of how other States perform. Here, the 193 contracting States to the Chicago Convention 1944 are not pursuing their national or individual interests. Instead, they have a common universal interest, which is, among the *raison d' être* of the Chicago Convention 1944, the accomplishment of safety.[15]

Breaches of *erga omnes* obligations concern the collective interest of *erga omnes partes*.[16] The essence of obligations *erga omnes* commands that such

12 Jiefang Huang. General Conclusions. In *Aviation Safety and ICAO* (Alphen aan den Rijn: Kluwer Law International, 2009), 166.

13 See the Preamble of the Chicago Convention 1944.

14 See Article 8 Pilotless aircraft of the Chicago Convention 1944.

15 Jiefang Huang, General Conclusions. In *Aviation Safety and ICAO* (Alphen aan den Rijn: Kluwer Law International, 2009, 166.

16 Erika, *Invoking Obligations Erga Omnes in the Twenty-First Century: Progressive Developments Since Barcelona Traction,*' SSRN, July 11, 2015, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2629560.

obligations are the interest of all States.[17] Accordingly, all States can have a justified interest in their protection by being a member of a community, for instance, ICAO's member States. If ICAO's member States can demand the fulfilment of an obligation, we are in the presence of a pure rule with effect *erga omnes*.

Erga omnes obligations, therefore, do not prevent a State, other than the injured State, of the capacity to react to the breach of an obligation. *Erga omnes* character gives non-injured States the right to take counter-actions against the State that is in breach of such obligations. [18] We may find events in civil aviation as examples of counter-actions against the breach of *erga omnes* obligations.[19] The first relates to the 'Bonn Declaration on Air-Hijacking of 1978', in which the heads of States of the economic summit (G7) undertook to take joint actions against any country harbouring hijackers.

> Statement on Air-Hijacking
> Bonn, Germany, July 17, 1978
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> "The Heads of State and Government, concerned about terrorism and the taking of hostages, declare that their governments will intensify their joint efforts to combat international terrorism. To this end, in cases where a country refuses extradition or prosecution of those who have hijacked an aircraft and/or do not return such aircraft, the Heads of State and Government are jointly resolved that their governments shall take immediate action to cease all flights to that country. At the same time, their governments will initiate action to halt all incoming flights from that country or from any country by the airlines of the country concerned.
>
> They urge other governments to join them in this commitment."[20]

Based on this declaration, when Afghanistan provided protection to the hijackers of a Pakistani aircraft in1981, these seven States suspended all flights to and from Afghanistan and called upon all States that shared their concern for air safety to take action to compel Afghanistan to honour its obligations under the *Convention for the Suppression of Unlawful Seizure of Aircraft*.[21] The G7 States considered the non-punishment of hijackers as

17 Jiefang Huang. General Conclusions. In *Aviation Safety and ICAO* (Alphen aan den Rijn: Kluwer Law International, 2009, 169.

18 Simma, B., *From Bilateralism to Community Interest in International Law* 1994: IV, 298.

19 Frowein, J. A. *Reaction by Not Directly Affected States to Breaches of Public International Law*, 1994: V.,, 417-420.

20 "1978 Bonn Summit Statement on Airhijacking," G7 Information Centre, accessed May 20, 2019, http://www.g8.utoronto.ca/summit/1978bonn/hijacking.html

21 Convention for the Suppression of Unlawful Seizure of Aircraft signed at the Hague, on December 16, 1970. (The Hague Hijacking Convention 1970)

'a violation of an obligation for the safety of international air traffic'.[22] The action taken by the seven States implicitly recognised that States are under an obligation *erga omnes,* which shall not provide a sanctuary for hijackers. This situation shows that when a State breaches an *erga omnes* obligation, non-injured States may make counteractions against the violating State.

Another precedent of counteractions for violating *erga omnes* obligations relates to the incident involving Korean Airlines flight 007, shot down on September 1, 1983, by the Soviet Union. Here, even though the act of the Soviet Union did not directly injure them, a group of States took action to withdraw the landing rights of Soviet civil aircraft in their territories.[23] The ICAO's Council also adopted a resolution on March 6, 1984, noting that such use of armed force is 'a grave threat to the safety of international civil aviation' and 'is incompatible with the norms governing international behaviour and elementary considerations of humanity'.[24] This is also evidence that the prohibition of the use of weapons against civil aircraft in flight is an obligation *erga omnes*. The breach of such an obligation will entitle any State to take counteractions, irrespective of whether it suffers injury.

The intervention of non-injured States provides support to the argument that condemning hijacker-harbouring and prohibiting the use of weapons against civil aircraft in flight are rules reflecting obligations *erga omnes,* despite the controversy on the topic.[25]

The Chicago Convention 1944 also establishes the legal framework for the enactment of safety regulations, which apply to UA as long as they are operated as civil aircraft. The *magna carta* of international civil aviation has three key provisions that promote safety and command member States to keep, as much as possible, their regulations in conformity in order to achieve the highest uniformity possible in the regulations, rules, procedures and organisation for international air navigation, namely:

1) Article 12 on Rules of the Air holds that:

> "...each contracting State undertakes to keep its own regulations in these respects uniform, to the greatest possible extent, with those established from time to time under this Convention."

22 Frowein, J. A. *Reaction by Not Directly Affected States to Breaches of Public International Law*, 1994: V. 418.

23 Jiefang Huang. General Conclusions. In *Aviation Safety and ICAO* (Alphen aan den Rijn: Kluwer Law International, 2009, 170.

24 ICAO Doc 9416, C/1077, C-Min, Extraordinary, Minutes, 1983. 59.

25 Jiefang Huang. General Conclusions. in "*Aviation Safety and ICAO* (Alphen aan den Rijn: Kluwer Law International, 2009), 170.

2) Article 37 on the adoption of international standards and procedures requires that:

> "...each contracting State undertakes to collaborate in securing the highest practicable degree of uniformity in regulations, standards, procedures and organisation in relation to aircraft, personnel, airways and auxiliary services in all matters in which such uniformity will facilitate and improve air navigation. To this end, the International Civil Aviation Organization shall adopt and amend from time to time, as may be necessary, international standards and recommended practices and procedures."

Accordingly, all 193 contracting States to the Chicago Convention 1944 commit to conform their national laws, rules and regulations to the international Standards and Recommended Practices, henceforth also referred to as SARPs, adopted by ICAO.

3) Under Article 44(a) of the Chicago Convention 1944, among the most important aims and objectives of ICAO are the assurance of the safe and orderly growth of international civil aviation throughout the world.[26] Moreover, Article 44 (h) mandates ICAO to promote 'safety of flight in international air navigation'.[27] It does so, through several mechanisms, to wit:

- The adoption of SARPs, PANS and guidance material;
- ICAO's Universal Safety Oversight Audit Programme (USOAP) which assesses whether States have effectively and consistently implemented the critical elements of a safety oversight system, which enable States to ensure the implementation of ICAO's safety-related SARPs and associated procedures and guidance material;[28]
- ICAO's Universal Security Audit Programme Continuous Monitoring Approach (USAP-CMA) which promotes global aviation security through continuous auditing and monitoring of States' aviation security performance, in order to enhance their aviation security compliance and oversight capabilities.[29]
- The institution of safety oversight responsibility on States, which is increasingly carried out by regional organisations such as the EASA; and,

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26 See Article 44 (a) on objectives of the Chicago Convention 1944.

27 See Article 44 (h) on objectives of the Chicago Convention 1944.

28 *"Welcome to the USOAP Continuous Monitoring Approach (CMA) Website //* Welcome to the USOAP Continuous Monitoring Approach (CMA) website, accessed May 9, 2019, https://www.icao.int/safety/cmaforum/Pages/default.aspx.

29 *"The Universal Security Audit Programme Continuous Monitoring Approach (USAP-CMA) and Its Objective //"* The Universal Security Audit Programme Continuous Monitoring Approach (USAP-CMA) and its Objective, accessed May 9, 2019, https://www.icao.int/security/usap/pages/default.aspx

– Safety and security management programmes aim to achieve an acceptable level of safety performance in civil aviation and to prevent unlawful interference, which are further analysed in section 5.3.2 of this chapter.

In the next section, the author will address the application and legal force of SARPs to the operations of UAS.

5.2.2 THE APPLICATION OF THE ANNEXES TO THE CHICAGO CONVENTION 1944 TO THE OPERATION OF UNMANNED AIRCRAFT SYSTEMS

The Annexes to the Chicago Convention 1944 are important for the development of international civil aviation and ICAO's member States, as they provide the fundamental basis for harmonised global aviation safety in the air and on the ground.[30] ICAO's Council adopts SARPs, designated for convenience as Annexes, following the mandates of Articles 37, 54 and 90 and to the Chicago Convention 1944.[31] If a State finds that the international standards are impracticable to comply, it must give immediate notification to ICAO's Council.[32]

However, what are SARPs, and what is their legal value for the member States of ICAO? In order to have a uniform understanding of contracting States' obligations under the Chicago Convention 1944 with respect to international standards and best practices and thus facilitate their adoption, the first ICAO Assembly held in Montreal from May 6 to 27, 1947 adopted resolution A1-31, which defined the concepts of 'standard' and 'recommended' practices[33].

> "**Standard:** any specification for physical characteristics, configuration, materiel, performance, personnel or procedures, the uniform application of which is recognised as necessary for the safety or regularity of international air navigation and to which member States will conform; in the event of impossibility of compliance, notification to the Council is compulsory under Article 38 of the Convention. The full name of this class of specifications will be ICAO Standards for Air Navigation. The current abbreviation will be STANDARDS."

30 See Article 37 on Adoption of international standards and procedures of the Chicago Convention 1944.

31 Articles 37 on Adoption of international standards and procedures, Article 54 on Mandatory functions of Council, and Article 90 on Adoption and amendment of Annexes, of the Chicago Convention 1944.

32 Article 38 on Departure from international standards and procedures, of the Chicago Convention 1944.

33 ICAO Doc 7670 *Resolutions and Recommendations of the Assembly 1st to 9th Sessions (1947-1955*), Montreal, Canada, 1956, Assembly Resolution A1-31 'Definition of International Standards and Recommended Practices', now consolidated into Resolution A36-13: *Consolidated Statement of ICAO policies and associated practices related specifically to air navigation*, in Doc 9902, *Assembly Resolutions in Force.*

> "**Recommended practices:** means any specification for physical characteristics, configuration, materiel, performance, personnel or procedure, the uniform application of which is recognised as desirable in the interest of safety, regularity, or efficiency of international air navigation, and to which member States will endeavour to conform in accordance with the Convention. The full name of this class of specifications will be ICAO Recommended Practices for Air Navigation. The current abbreviation will be RECOMMENDED PRACTICES".

Articles 54 (l) and (m) and Article 90 of the Chicago Convention 1944 give the mandate to ICAO's Council to adopt or amend SARPs from time to time on matters concerning, but not limited to, the safety and efficiency of international air navigation. Even though the uniformity of international standards is one of the essential principles governing the ICAO quasi-legislative process, the will of States to adopt and comply with SARPs is the essence of safety in international air navigation.

Under Article 37 of the Chicago Convention 1944, there is an obligation of contracting States to collaborate in achieving uniformity in regulations, standards and procedures[34] whereas under Article 38, States may present objections if they cannot comply with SARPs. They may, therefore, notify ICAO about the differences between national regulations and ICAO SARPs.[35] The Council will proceed accordingly by immediately informing other States of such dissent.

The legal status of the SARPs in the Annexes to the Chicago Convention 1944 is subject to two streams of interpretations.[36] One, with certain exceptions, is that the contracting States have no legal obligation to implement or comply with an Annex or the amendments to it unless they find them practicable to do so.[37] The second stream postulates that contracting States are, in principle, obliged to comply unless they find it impracticable to do so. Under this vision, an international regulation adopted under an international convention becomes an international agreement, and a State's departure from such regulation makes a reservation to this agreement.[38]

Dr Jiefang Huang asserts correctly that despite the preceding streams, the legal importance of the international standards is indisputable as they are an integral part of the Chicago Convention 1944 and should be understood

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34 See Article 37 on adoption of international standards and procedures of the Chicago Convention 1944.

35 See Article 38 on departures from international Standards and Procedures of the Chicago Convention 1944.

36 Jiefang Huang. *Aviation Safety and ICAO* (Alphen aan den Rijn: Kluwer Law International, 2009, 58.

37 Thomas Buergenthal. *Law-Making in the International Civil Aviation Organization* (New York: New York: Syracuse University Press, 1969), 76.

38 H. Saba. '*Quasi-Legislative Activities of the Specialized Agencies of the United Nations*, (in French), 1964. 111 *RdC* 607, 678.

and applied in the context and purpose of the entire Chicago Convention 1944.[39] Securing the highest practicable uniformity[40] and that international civil aviation may be developed in a safe and orderly manner[41] is perhaps the most reasonable way to understand the legal force of the Annexes to the Chicago Convention 1944 and not the freedom of action of the contracting States to file differences. Except in the case of war or national emergency, as mentioned in Article 89 to the Chicago Convention 1944, the only legitimate way for a contracting State to decline compliance with an international standard is to file a difference under Article 38. [42]

Neither the Chicago Convention 1944 nor its proceedings affirm that SARPs , once effective, are not binding on contracting States which file none differences to it. The terms 'become effective' and 'coming into force' used in Article 90 show the intention of the drafters of the Chicago Convention 1944 to give binding force and effect to SARPs to those contracting States that file no differences.[43] Accordingly, the opinion that the Annexes have no compulsory force could only relate to permitting the contracting States to keep their freedom of action through the notification of differences under Article 38.

The Chicago Convention 1944 provides no penalty for failing to notify a departure from SARPs. However, if a State does not comply with SARPs, there are implicit sanctions that may be potentially critical. For instance, under Article 33 of the Chicago Convention 1944, if a State does not comply with SARPs, it may find its onboard or remote airman, air carrier or airport certifications and licences not recognised as valid by another State.[44] This scenario may put an end to the operation to, from or through international airspaces and not allowing UA to engage in international air navigation.

Also, ASAs establish that if any Party finds that the other Party does not maintain safety standards in the areas of aeronautical facilities, flight crew and aircraft that meet the standards established under the Chicago Convention 1944, the other Party shall be informed of such findings and take the steps that deems necessary to conform with the ICAO standards. Under this scenario, States' Parties to the ASA reserve the right to suspend

39 Jiefang Huang. *Aviation Safety and ICAO* (Alphen aan den Rijn: Kluwer Law International, 2009), 60.

40 See Article 37 on Adoption of international standards and procedures of the Chicago Convention 1944.

41 See the Preamble of the Chicago Convention 1944.

42 Jiefang Huang. *Aviation Safety and ICAO* (Alphen aan den Rijn: Kluwer Law International, 2009, 60.

43 Jiefang Huang. *Aviation Safety and ICAO* (Alphen aan den Rijn: Kluwer Law International, 2009. 60

44 See Article 33: Recognition of certificates and licenses of the Chicago Convention 1944.

immediately or change the operating authorisation of an air carrier of another State Party when urgent action is essential to ensure the safety of air carrier operation.[45]

Moreover, because a threat to aviation safety makes up a threat to life,[46] it would be inconceivable that a State could file a difference from Annex 17 on Security which section 4.1 requires each contracting State to prevent unauthorised weapons or explosives from being introduced on board an aircraft engaged in international air navigation. In this regard, Dr Huang also holds that it is arguable that specific standards, such as those in Annex 17, have either become customary rules or emerged as the fundamental norms dictated by the vital interests of the aviation community. Although they still keep the status of standards, they may have become binding rules which could not be subject to the filing of differences.[47]

Regarding the flight of UA, the contracting States to the Chicago Convention 1944 have been allowing their international air navigation regardless of the UAS capacity to comply with SARPs that guarantee their safe operation.[48] The non-compliance of SARPs and the absence of specific SARPs for UAS have not prevented States from authorising such operations.

In this context, the following question can be asked: What is the legal value of SARPs on the operations of UAS, since States have the ultimate decision under Article 8 to accept or deny the entry of UA into their airspace?

The answer is that UA have been operating, and are being operated, in segregated airspace. The routine operations of UA in non-segregated airspace demands harmonised SARPs specific to UAS that support not only the development of required technologies and certification methods,[49] but also comply with the obligation of States to ensure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be so controlled as to obviate danger to civil aircraft.[50]

For UA to engage safely in routine international air navigation, it must sat-

45 See *ICAO Template Air Services Agreements.* Accessed December 14, 2018. https://www.icao.int/Meetings/AMC/MA/ICAN2009/templateairservicesagreements.pdf.

46 Jiefang Huang. General Conclusions. In *Aviation Safety and ICAO* (Alphen aan den Rijn: Kluwer Law International, 2009), 241.

47 Jiefang Huang, *Aviation Safety and ICAO* (Alphen aan den Rijn: Kluwer Law International, 2009), 61.

48 *Thirteenth Air Navigation Conference, Montreal, Canada, 9 to 19 October 2018.* Remotely Piloted Aircraft Systems (RPAS) (Presented by the Secretariat). Accessed December 1, 2018. https://www.icao.int/Meetings/anconf13/Documents/WP/wp_006_en.pdf

49 *Thirteenth Air Navigation Conference, Montreal, Canada, 9 to 19 October 2018.* Remotely Piloted Aircraft Systems (RPAS) (Presented by the Secretariat). Accessed December 1, 2018.

50 See Article 8 on pilotless aircraft of the Chicago Convention 1944.

isfy the requirements defined by and under the Chicago Convention 1944.[51] UA shall have special authorisation from all involved States,[52] an operator certificate and a certificate of airworthiness.[53] The UAS shall comply with communications, navigation and surveillance requirements.[54] The remote pilots shall hold licences[55] and shall submit flight plans following the rules of the air.[56]

To address the challenges on automatic recognition of remote pilot certificates and licences provided for under Article 33, and the requirement for certificates, licences and logbooks to be carried on board under Article 29 of the Chicago Convention 1944, will require uniformity in rules. The contracting States can address these challenges through the adoption of the corresponding SARPs.

The Annexes to the Chicago Convention 1944 are, therefore, relevant to the international air navigation of UA because they refer to the technical regulations of civil aviation. They are summarised in Attachment 2 of this Chapter.

All nineteen Annexes to the Chicago Convention 1944 will require amendments incorporating new SARPs to enable the international air navigation of UA.[57] ICAO's Council has incorporated a few SARPs specifically for UAS by amending Annex 2 on Rules of the Air, Annex 7 on Aircraft Nationality and Registration Marks and Annex 13 on Aircraft Accident and Incident Investigation of the Chicago Convention 1944.

ICAO's Council also incorporated amendments in Annex 1 on Personnel Licensing to address the remote pilot licences that are available for voluntary implementation and will become applicable in November 2022. ICAO has also given priority to developing SARPs for Annex 6 on Operation of Aircraft, Annex 8 on Airworthiness of Aircraft and Annex 10 on Aeronautical Telecommunications.[58]

By no means do the current nineteen Annexes to the Chicago Convention

51 *Thirteenth Air Navigation Conference, Montreal, Canada, 9 to 19 October 2018.* Remotely Piloted Aircraft Systems (RPAS) (Presented by the Secretariat). Accessed December 1, 2018.

52 See Article 8, pilotless aircraft, of the Chicago Convention 1944.

53 See Article 31 Certificate of airworthiness of the Chicago Convention 1944.

54 See Article 30 Aircraft radio equipment of the Chicago Convention 1944.

55 See Article 32 Licenses of personnel of the Chicago Convention 1944.

56 See Appendix 4 of "*Annex 2 on Rules of the Air*" to the Convention on International Civil Aviation.

57 See Chapter One on the topicality of the subject. UA may be capable of daily cross-border operations and will be able to transport passengers, cargo, and mail safely throughout the entire world.

58 *Thirteenth Air Navigation Conference, Montreal, Canada, 9 to 19 October 2018.* Remotely Piloted Aircraft Systems (RPAS) (Presented by the Secretariat). Accessed December 1, 2018. https://www.icao.int/Meetings/anconf13/Documents/WP/wp_006_en.pdf

1944 deplete all matters of aviation safety. Article 37 leaves broad discretion for ICAO to adopt SARPs and procedures dealing with matters concerned with safety, regularity and efficiency of air navigation as may from time to time appear appropriate. ICAO's Council has, therefore, no limitations to adopting new SARPs or amending them, which may be considered necessary for the safe international air navigation of UA. Accordingly, in order to facilitate the international air navigation of UA and foster unmanned aviation industry, securing the highest practicable uniformity is fundamental.

Finally, we should understand the legal value of SARPs in the context, object and purpose of the entire Chicago Convention 1944, since uniformity of rules for UAS will undoubtedly facilitate not only their integration into the civil aviation system but will also ensure the safe and orderly growth of international civil aviation throughout the world. This understanding will be explained in the next sections.

5.2.3 APPLICABILITY OF SAFETY RULES OF AND MADE UNDER THE CHICAGO CONVENTION 1944 TO THE OPERATIONS OF UNMANNED AIRCRAFT SYSTEMS

5.2.3.1 PRINCIPAL PROVISIONS OF THE CHICAGO CONVENTION 1944

The Chicago Convention 1944 has provisions that reinforce and expressly compel member States to fulfil safety responsibilities because aviation safety is the concern of all States as it is, as said, an obligation *erga omnes*. This section analyses the safety rules of and made under the Chicago Convention 1944, which are most relevant for UAS operations.

The author will examine the following topics consecutively:
- The Rules of the Air (section 5.2.3.2);
- Accident and incident investigation (section 5.2.3.3);
- Documents carried on board aircraft (section 5.2.3.4);
- Certificates of airworthiness (section 5.2.3.5); and,
- Pilot licences, including their international recognition (section 5.2.3.6).

The above sections will be completed with concluding remarks laid down in section 5.2.4.

5.2.3.2 RULES OF THE AIR

Under the Chicago Convention 1944, the following provision pertains to the rules of the air:

> Article 12: Rules of the air
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> "Each contracting State undertakes to adopt measures to insure that every

> aircraft flying over or manoeuvring within its territory and that every aircraft carrying its nationality mark, wherever such aircraft may be, shall comply with the rules and regulations relating to the flight and manoeuvre of aircraft there in force. Each contracting State undertakes to keep its own regulations in these respects uniform, to the greatest possible extent, with those established from time to time under this Convention. Over the high seas, the rules in force shall be those established under this Convention. Each contracting State undertakes to insure the prosecution of all persons violating the regulations applicable."

The rules of the air govern all aircraft, including manned aircraft and UA. The contracting States undertake the same responsibilities as the State of Registry to ensure that every aircraft flying over or manoeuvring within its territory shall comply with the rules in force. The provision also encloses the foundations of international harmonisation and interoperability, which are essential for the safe operations of manned and unmanned aircraft. Such domestic regulations shall be uniform to the greatest extent with SARPs. Under Article 12, international uniformity, required in the interest of aviation safety, may override the otherwise complete freedom of a sovereign State to prescribe air navigation regulations at will in its territory.

As the market for UAS continues to develop, UA flights over the high seas may also experience significant growth. It is common to see UA in civil ventures over the high seas, such as fish spotting, atmospheric research and oil platform inspections. In State functions, we may see UA in such instances operated as State aircraft, as discussed in section 2.2.6 of Chapter Two, engaged in tasks such as fishery compliance, surveillance, search and rescue and security operations.[59]

The rules in force over the high seas are those established under the Chicago Convention 1944, subject to the standards of safety and navigation promulgated by ICAO. Accordingly, air navigation over the high seas is also open to the use of UA as long as they comply with Article 12 and the Rules of the Air drawn up under the Chicago Convention 1944. The State of registry shall supervise at all times that the operations of UAS comply not only with its national regulations but also international regulations on civil aviation. Therefore, SARPs for the rules of the air are directly binding on all flights over the high seas, regardless of its manned or unmanned condition. States shall also prosecute persons violating such rules.

On 7 March 2012, the ICAO's Council adopted Amendment 43 to Annex 2—Rules of the Air to the Chicago Convention 1944. Annex 2 stipulates that a UA shall be operated in such a manner as to minimise hazards to persons,

59 *Study of the Legal Issues Relating to Remotely Piloted Aircraft (Presented by the United States).* https://www.icao.int/Meetings/LC37/Documents/LC37-WP2-8-RPAS.pdf. ICAO Legal Committee, July 24, 2018. LC/37-WP/2-8

property or other aircraft. In this context, Appendix 4 incorporates specific rules to UAS in the following categories: [60]

- General operating rules;
- Certificates and licensing; and
- Request for authorisation.

The terms *national airspace* and *international airspace* are neither mentioned in the Chicago Convention 1944 nor in UNCLOS. Nevertheless, Article 2 of the Chicago Convention 1944 postulates that the territory of a State composes the land and territorial waters, which airspace above can be deducted as national airspace. Accordingly, the author suggests the following definition for international airspace for purposes of giving elements of clarification in the context of this research, which aims to identify the legal aspects of the cross-border operations of UAS:

> "**International airspace** is the airspace above the lands and waters, other than those specified in Article 2 of the Chicago Convention 1944."

Because the airspace beyond the territorial waters of a State falls within the concept of international or high seas airspace, a UA engaged in international air navigation shall comply with the Rules of the Air laid down in Annex 2 of the Chicago Convention 1944, as per the mandate of Article 12, which states:

> "…Over the high seas, the rules in force shall be those established under this Convention…"[61]

In other words, *international airspace* is the airspace envisaged in this phrase of Article 12 of the Chicago Convention 1944.

Moreover, the UA shall also comply with certification requirements, including the carriage of a certificate of airworthiness on the UA. However, ICAO's Council has not yet developed certification and licensing standards specifically for UAS. Accordingly, any certification and licensing need not be automatically deemed to comply with the SARPs of the related Annexes, including Annexes 1, 6 and 8, until the related UAS SARPs are developed.[62]

The existing regulatory framework governing the operation of aircraft over the high seas does not allow States providing ATS the ability to establish

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60 *Annex 2–Rules of the Air* to the Convention of International Civil Aviation, Tenth Edition, July 2005, amendment 43, 2012, xii.

61 See Article 12 on Rules of the Air of the Chicago Convention 1944.

62 See section 2 on Certificates and Licensing of Appendix 4 of *Annex 2 Rules of the Air* to the Chicago Convention 1944. APP. 4-1.

procedures allowing non-certified UA to access such airspace safely. Hence, they cannot address prospective offshore UAS activities. There is a shortfall in the current provisions that demand action from ICAO and the States to facilitate continued progress in the safe integration of UAS and enable extended UAS operations in the airspace above the high seas while ensuring the safety of other aircraft operations in the same airspace.[63]

Concordantly, there is a need to address certified and non-certified UAS under the existing provisions of the Chicago Convention 1944 and its Annexes relevant to international air navigation, which will enable States to allow operations in international airspace and facilitate the continued safe integration of this new entrant into the global aviation framework. Also, States should develop and implement procedures for the authorisation of operations over the high seas for certified and non-certified UAS, provided such procedures are consistent with safety management principles laid down in Chapter 3 of Annex 19 to the Chicago Convention 1944 and applicable regional operational procedures, and take into account aircraft performance capabilities and an operations risk assessment.[64]

ICAO plans an amendment to Annex 2 to the Chicago Convention 1944 aimed at giving blanket approval to UAS operations over the airspace of the high seas that conforms to a pre-specified, low-risk operation. They shall also receive approval by, and meet the requirements of, the State of the operator and the State of the registry. ICAO expects that such blanket approval will bring efficiently and effectively UAS operations legally and safely within the scope of the Chicago Convention 1944 while ICAO continues to integrate UAS into the legal framework governing international civil aviation and oversees global harmonisation of the States' domestic UAS regulations.[65]

Once ICAO's Council issues and States adopt all SARPs for each of the Annexes necessary for UAS operations, unmanned aviation will be able to develop, and the routine cross-border operations of UAS will be a reality.

5.2.3.3 INVESTIGATION OF ACCIDENTS INVOLVING UNMANNED AIRCRAFT SYSTEMS

Article 26 governs the investigation of accidents of aircraft, including civil UA.

63 *Study of the Legal Issues Relating to Remotely Piloted Aircraft (Presented by the United States).* https://www.icao.int/Meetings/LC37/Documents/LC37-WP2-8-RPAS.pdf. ICAO Legal Committee, July 24, 2018. LC/37-WP/2-8

64 *Annex 19 – Safety Management: International Standards and Recommended Practices* Chapter 3 on State Safety Management Responsibilities, (Montreal: International Civil Aviation Organization, 2013, 3-1.

65 *Remotely Piloted Aircraft Systems Survey. LEGAL COMMITTEE 37TH SESSION*, ICAO Secretariat, 27 July 2018, www.icao.int/Meetings/LC37/Documents LC37%20WP%20 2-1%20EN%20Remotely%20Piloted%20Aircraft.pdf

> Article 26: Investigation of accidents
>
> "In the event of an accident to an aircraft of a contracting State occurring in the territory of another contracting State, and involving death or serious injury, or indicating serious technical defect in the aircraft or air navigation facilities, the State in which the accident occurs will institute an inquiry into the circumstances of the accident, in accordance, so far as its laws permit, with the procedure which may be recommended by the International Civil Aviation Organization. The State in which the aircraft is registered shall be given the opportunity to appoint observers to be present at the inquiry and the State holding the inquiry shall communicate the report and findings in the matter to that State."

To determine the events leading up to an accident or incident, the UAS shall carry recording devices for command, trajectory and systems.[66]

Investigations involving UA engaged in international air navigation could require multiple States to take part in the process:[67]

- The State of occurrence, which is the State in the territory of which an accident or incident occurs,[68] or, in other words, the State of the location of the wreckage;
- The State of registry or, in other words, the State in which the UAS is registered;[69]
- The State of manufacture, which is the State having jurisdiction over the organisation responsible for the final assembly of the UAS, engine or propeller;[70]
- The State of the operator in which the operator's principal place of business is located or, if there is no such place of business, the operator's permanent residence;[71] and,
- The State or States of the location of the remote pilot stations.[72]

The State of occurrence, or if it delegates the investigation to another State

66 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 9-12.

67 *"Remotely Piloted Aircraft System (RPAS) Concept of Operations (CONOPS) for International IFR Operations."* Icao.int. Accessed April 19, 2018. https://www.icao.int/safety/UA/Documents/RPAS%20CONOPS.

68 See definition of State of Occurrence in *Annex 13 on Aircraft Accident and Incident Investigation* (Montreal, Quebec: International Civil Aviation Organization, 2016), 1-3.

69 See definition of State of Registry in *Annex 13 on Aircraft Accident and Incident Investigation* (Montreal, Quebec: International Civil Aviation Organization, 2016), 1-3.

70 See definition of State of Manufacture in *Annex 13 on Aircraft Accident and Incident Investigation* (Montreal, Quebec: International Civil Aviation Organization, 2016), 1-3.

71 See definition of State of the Operator in *Annex 13 on Aircraft Accident and Incident Investigation* (Montreal, Quebec: International Civil Aviation Organization, 2016), 1-3.

72 This category is not defined in Annex 13 on Aircraft Accident Investigation to the Chicago Convention 1944. However, under section 5.23 of Annex 13, any State which on request provides information, facilities or experts to the State conducting the investigation shall be entitled to appoint an accredited representative to participate in the investigation.

or regional organisation, the State responsible for investigating, must have access to all the data related to the accident or incident as per Annex 13 on Aircraft Accident and Incident Investigation of the Chicago Convention 1944, including data from the remote pilot station.[73]

Any State that provides an operational base for field investigations or is involved in search and rescue or wreckage recovery operations or is involved as a State of a code-share or alliance partner of the operator may take part in the investigation by appointing accredited representatives. Also, the investigation of the accident or incident may require access to data available in other States under Annex 13.[74]

If a UAS becomes involved in an accident or incident, the UAS operator shall take action to preserve all related UAS data. These data would include the associated flight recorders and their retention in safe custody, pending the accident or incident investigation as per Annex 13.[75]

For UA flying over areas that are difficult to access for search and rescue, such as water, placement of a fixed emergency locator transmitters (ELT)[76] unit will be a vital factor in ensuring optimal and rapid localisation.[77]

5.2.3.4 DOCUMENTS CARRIED ON BOARD

Chapter V of the Chicago Convention, which refers to the conditions to be fulfilled about aircraft, begins with Article 29:

> Article 29 Documents carried in aircraft
>
> "Every aircraft of a contracting State, engaged in international navigation, shall carry the following documents in conformity with the conditions prescribed in this Convention:
> (a) Its certificate of registration;
> (b) Its certificate of airworthiness;
> (c) The appropriate licences for each member of the crew;
> (d) Its journey logbook;

73 *Annex 13 on Aircraft Accident and Incident Investigation,* Responsibility for Instituting and Conducting the Investigation (Montreal, Quebec: International Civil Aviation Organization, 2016), 5-1.

74 *Annex 13 on Aircraft Accident and Incident Investigation,* Participation of Other States (Montreal, Quebec: International Civil Aviation Organization, 2016), 5-8.

75 *Annex 13 on Aircraft Accident and Incident Investigation,* Responsibility of the State of Registry and State of the Operator (Montreal, Quebec: International Civil Aviation Organization, 2016), 5-6.

76 *Annex 6 on Operation of Aircraft,* Emergency Locator Transmitter (ELT) section 6.17.1 (Montreal, Quebec: International Civil Aviation Organization, 2016), 6-17.

77 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 9-13.

(e) If it is equipped with radio apparatus, the aircraft radio station licence;
(f) If it carries passengers, a list of their names and places of embarkation and destination;
(g) If it carries cargo, a manifest and detailed declarations of the cargo."

According to this provision, every aircraft of a contracting State engaged in international air navigation shall carry the specified documents on board. These documents shall be accessible to flight crews during flight and shall also be available to inspectors when the aircraft is on the ground.[78] However, how can this provision be made to apply to UAS?

The size and configuration of UA may make placing original paper documents on board impractical. In order to satisfy the requirements of Article 29, new approaches are necessary, such as electronic versions of the documents accessible to remote pilots, inspectors and maintenance personnel, whether at the UA or the remote pilot station. ICAO has proposed the use of electronic versions of the referred documents, which must be accepted by the State of the operator and all other States involved in the operation.[79] However, the contracting States have not yet agreed on a particular procedure to accomplish this mandate.

ICAO has proposed the following four situations in which the documents referred in Article 29 of the Chicago Convention 1944 may be carried, namely:[80]

1. Documents held by the UAS operator;
2. Documents at the remote pilot station;
3. Documents carried on board the UA; and,
4. Documents at or in close proximity of the UA ground operations area.

The referred documents are listed in Attachment 1 to this chapter.

Today, much of the information we access is digital or electronic, namely, our air tickets, data and bank accounts, to name a few. The author considers that nothing impedes this requirement, and for all practical purposes, the use of electronic versions of the documents listed in Article 29 should be promoted because such use does not diminish the safe operations of UAS. From a different perspective, the use of electronic documents may ensure accurate aircraft record-keeping, minimise manual input and errors and the searchability and traceability of documents.

78 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 6-7.
79 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS).* Montreal, Canada: International Civil Aviation Organization, 2015), 1-6.
80 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS).* Montreal, Canada: International Civil Aviation Organization, 2015), 6-7.

5.2.3.5 CERTIFICATE OF AIRWORTHINESS

Under Article 31 of the Chicago Convention 1944, all aircraft shall have a certificate of airworthiness:

> Article 31: Certificate of Airworthiness
>
> "Every aircraft engaged in international navigation shall be provided with a certificate of airworthiness issued or rendered valid by the State in which it is registered."

The provision begins with the words 'every aircraft'. These words imply, with no doubt, that it applies equally to manned and UA engaged in international air navigation. However, it is not clear how the certification process of a UAS, which includes separate components such as a remote station, is to be carried out. ICAO provides neither specific guidance nor procedures for type design and airworthiness certification. The main reason is the lack of sufficient operational service history and certification experience in UAS.[81]

As the industry matures, it is expected that States will establish procedures that may be used by ICAO in future certification guidance as new SARPs are adopted. However, ICAO assumes that the existing process and procedures applied to traditional manned aircraft type design approval, production approval, continuing airworthiness and modifications of aeronautical products may be the benchmark and will also apply to UAS, to the maximum extent possible.[82]

To conclude that UA is suitable for international air navigation, it should go through a process of airworthiness certification that takes into account all the elements of the UAS needed for its safe operation. Such components are the UA itself, the remote pilot station and the C2 link system. The certification process would also take into consideration the system configuration, usage, environment, hardware and software design characteristics, production processes, interoperability, reliability and in-service maintenance procedures that adequately mitigate safety risks. Technical standards will, therefore, be necessary to develop and certify specific components of the UAS.[83]

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81 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS*, First Edition – 2015, International Civil Aviation Organization, 4-1.

82 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS*, First Edition – 2015, International Civil Aviation Organization, 4-1.

83 *"Remotely Piloted Aircraft System (RPAS) Concept of Operations (CONOPS) for International IFR Operations,"* accessed February 9, 2019, https://www.icao.int/safety/ua/documents/rpas conops.pdf

Because of the fast evolution of UAS technology, the airworthiness certifications and oversight of UAS will be challenging. To facilitate the certifications and oversight, States, their Civil Aviation Authorities and UAS manufacturers shall count with agreed technical standards, safety metrics and testing methodologies. Also, they will require guidance material and training for certifying authorities or their designated representatives on the latest technologies and techniques used in the design, manufacturing and hardware and software developments of UAS.[84]

Because of its distributed nature, the UAS airworthiness certification process provides opportunities to apply levels of assurance to the constituent elements. For instance, full airworthiness assurance of the UA is necessary, but alternate methods may be more proportionate to other components of the UAS as a whole. This situation may require new or amended processes appropriate to the potential safety risk concerns.[85]

Finally, according to Article 31, the UA is a component of the UAS that shall hold a certificate of airworthiness when engaged in international air navigation. The State of Registry will issue a certificate of airworthiness to the UAS after receiving satisfactory evidence that the remote pilot station, the UA and other components conform to the type design and are in a condition for safe operation.[86] However, since the airworthiness certificate is carried in the cockpit of manned aircraft, it is also convenient to have an electronic certificate available in the remote pilot station because it resembles the cockpit of a manned aircraft, and the certificate will provide information that the UA is suitable for safe flight.

5.2.3.6 PERSONNEL LICENSING

The safe operation of UAS demands remote pilots who are trained, experienced and qualified in their responsibilities. The licensing authority of the State of registry of the UAS shall ensure these qualification requirements in the same way as manned aircraft are concerned.

Moreover, under Annex 2 on Rules of the Air, remote pilots have the same

84 *"Remotely Piloted Aircraft System (RPAS) Concept of Operations (CONOPS) for International IFR Operations,"* accessed February 9, 2019, https://www.icao.int/safety/ua/documents/rpas conops.pdf

85 *"Remotely Piloted Aircraft System (RPAS) Concept of Operations (CONOPS) for International IFR Operations,"* accessed February 9, 2019, https://www.icao.int/safety/ua/documents/rpas conops.pdf

86 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 4-8.

responsibilities as pilots of manned aircraft.[87] Accordingly, competencies must be assessed carefully to ensure that their knowledge, skills and attitude are appropriate for UAS operations.

Article 32 of the Chicago Convention stipulates the following:

> Article 32 Licences of personnel
>
> "(a) The pilot of every aircraft and the other members of the operating crew of every aircraft engaged in international navigation shall be provided with certificates of competency and licences issued or rendered valid by the State in which the aircraft is registered.
>
> (b) Each contracting State reserves the right to refuse to recognise, for the purpose of flight above its own territory, certificates of competency and licences granted to any of its nationals by another contracting State."

Furthermore, Appendix 4 of Annex 2 on Rules of the Air incorporates a standard requiring remote pilots to be licensed in a manner consistent with Annex 1—Personal Licensing.[88] However, it is expected that in November 2022, amendments in Annex 1 on Personnel Licensing will enter into force to address the remote pilot licences.[89]

UA can take the form of aeroplanes, airships, free balloons, gliders, helicopters and powered aircraft. Class ratings for UAS must also address the remote pilot station and its interaction with the UA.[90] The licensing authority shall take this consideration in the licensing process.[91]

Remote pilots shall also get medical authorisation, procure the essential training, and prove competency before being licensed to fly. The preparation would rely on the nature of the UAS and the purpose of flight. For instance, requirements for smaller, less complex UA flown privately, like fish spotting in the high seas, should be less arduous than the requirements for remote pilots flying large, complex UA in high-density airspaces, such

87 *Annex 2 to the Convention on International Civil Aviation "Rules of the Air"* in *Annex 2 to the Convention on International Civil Aviation Rules of the Air*, 10th ed. (Montreal: ICAO, 2005). APP. 4-1.

88 *Annex 2 to the Convention on International Civil Aviation "Rules of the Air"* in *Annex 2 to the Convention on International Civil Aviation Rules of the Air*, 10th ed. (Montreal: ICAO, 2005). APP. 4-1.

89 *Thirteenth Air Navigation Conference, Montreal, Canada, 9 to 19 October 2018."*Remotely Piloted Aircraft Systems (RPAS) (Presented by the Secretariat). Accessed December 1, 2018. https://www.icao.int/Meetings/anconf13/Documents/WP/wp_006_en.pdf

90 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 7-1.

91 See section 1.1 on Historical Overview of Chapter 1 of this research.

as a UA engaged in the international air transport of cargo, passengers and mail.[92]

Finally, remote pilots shall have the capacity to follow aviation rules and procedures, their license must be issued in accordance to the operation in which they will engage, and authorisations from the issuing authority must not go beyond the privileges of those issued therein.[93]

5.2.3.7 RECOGNITION OF CERTIFICATES AND LICENCES

The legal foundation for the mutual recognition of certificates and licences is laid down in Article 33 of the Chicago Convention 1944.

> Article 33: Recognition of certificates and licences
>
> Certificates of airworthiness and certificates of competency and licences issued or rendered valid by the contracting State in which the aircraft is registered, shall be recognised as valid by the other contracting States, provided that the requirements under which such certificates or licences were issued or rendered valid are equal to or above the minimum standards which may be established from time to time pursuant to this Convention."

The application of Article 33 to UAS is consistent with Articles 31 and 32, which deal with certificates of airworthiness and personnel licensing, respectively. Certification and licensing of UAS and crews cannot comply with current SARPs, including Annex 1 on Personnel Licensing, Annex 6 on Operation of Aircraft and Annex 8 on Airworthiness Certification, until the SARPs become applicable to, or are developed for, UAS operations.

Nevertheless, despite Assembly Resolution A38-12, Article 8 of the Chicago Convention 1944 confirms that each contracting State has absolute sovereignty over the authorisation of UA operations in its territory.[94] This situation means that a State may refuse a UA aircraft even if it satisfies minimum ICAO SARPs on airworthiness and licensing, as Article 8 has, as explained

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92 *"Remotely Piloted Aircraft System (RPAS) Concept of Operations (CONOPS) for International IFR Operations."* Icao.int. Accessed April 19, 2018. https://www.icao.int/safety/UA/Documents/RPAS%20CONOPS

93 *"Remotely Piloted Aircraft System (RPAS) Concept of Operations (CONOPS) for International IFR Operations."* Icao.int. Accessed April 19, 2018. https://www.icao.int/safety/UA/Documents/RPAS%20CONOPS

94 According to ICAO, Assembly Resolution A38-12 Consolidated Statement of Continuing ICAO Policies and Associated Practices related specifically to air navigation, Appendix C-Certificates of airworthiness, certificates of competency and licenses of flight crews (clause 2) resolves that, pending the coming into force of international Standards respecting particular categories of aircraft or flight crew, contracting States shall recognise the validity of certificates and licenses issued or rendered valid, under national regulations, by the member State in which the aircraft is registered.

in section 4.4.3.1 of Chapter Four, a *lex specialis* status in relation to the other provisions of the Chicago Convention 1944 that pertain to access to foreign airspaces, such as Articles 5, 6 and 7.

5.2.4 CONCLUDING REMARKS

As per the current developments in UAS technology, the routine cross-border civil operations of UA carrying passengers, cargo and mail are soon likely to occur. Nevertheless, to enable such type of operations, the Chicago Convention 1944 establishes a set of safety provisions which also apply, *mutatis mutandis,* to UA engaged in international air navigation.

SARPs adopted by the ICAO Council do not address the mandates of the 1944 Chicago Convention completely, but, most importantly, they do not yet address all safety-related aspects to make UAS operations safe. There is still a long way to go, which can only be achieved with the collaboration of ICAO member States and the unmanned aviation industry stakeholders.

Following the above sections regarding the safe operations of UAS, the author points out instances of safety-related challenges that, if overcome, will facilitate the integration and operations of UAS and manned aircraft using the same airspace.

5.3 AREAS OF CIVIL AVIATION THAT REQUIRE RULE-MAKING FOR THE SAFE OPERATION OF UNMANNED AIRCRAFT SYSTEMS

5.3.1 INTEGRATING UNMANNED AIRCRAFT SYSTEMS INTO NON-SEGREGATED AIRSPACES

Without the essential regulations, integrating UAS into the existing air navigation system will impact the safety and performance of other airspace users. UAS, in the form of RPAS, for instance, is one of four emerging priorities of ICAO, according to its *Global Aviation Safety Plan* (GASP, 2017-2019).[95] ICAO's goal is to provide the essential regulatory framework through the amendments or adoption of new SARPs, PANS and guidance material to enable routine international air navigation of UA worldwide in a safe, harmonised and smooth manner, in the same way as manned aviation.[96]

Currently, most civil UA flights take place in national and international segregated airspaces to prevent danger to other aircraft. UA is not yet able

95 The other three being global flight tracking, space transportation, and risk arising from conflict zones. Global Aviation Safety Plan (2017-2019), ICAO DOC. 10004, para. 3.2.1.

96 ICAO Circular 328 – *Unmanned Aircraft Systems (UA).* Accessed April 19, 2018. https://skybrary.aero/bookshelf/content/bookDetails.php?bookId=3202

to integrate with other airspace users routinely because they cannot follow the 'rules of the air' entirely and there is a lack of necessary SARPs to address the essential safety-related aspects of UAS operations.[97] The goal of ICAO in addressing UAS is to implement SARPs with supporting PANS and guidance material to enable the safe routine operations of UAS into non-segregated airspace.[98]

Neither the terms 'segregated' nor 'non-segregated' airspace has an official status within ICAO. Such terms are used in the context of ICAO Circular 328 on Unmanned Aircraft Systems of 2011 and the *Manual on Remotely Piloted Aircraft Systems* of 2015, which have no binding effect on States' Parties to the Chicago Convention 1944. The intent of using such terms is to guide technical and operational matters applicable to integrating UAS into non-segregated airspace and at aerodromes.[99]

Non-segregated airspace refers to the operation of UAS outside of segregated airspace, where segregated airspace is defined as airspace of specified dimensions allocated for exclusive use to a specific user.[100]

According to ICAO, many UA will share national and international airspaces with manned aircraft by 2030.[101] Some will fly under IFR while others fly under VFR[102] in controlled or uncontrolled airspaces.[103] For this purpose, all UA shall be able to follow the applicable procedures and airspace requirements defined by the State, including emergency and contingency procedures. Other UA will only operate at low altitudes, such as border protection, environmental uses and wildfire and utility inspections,

97 ICAO Circular 328 – *Unmanned Aircraft Systems (UA).* Accessed April 19, 2018. https://skybrary.aero/bookshelf/content/bookDetails.php?bookId=3202.

98 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), v.

99 ICAO Circular 328 – *Unmanned Aircraft Systems* (UA) and ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization. 2015

100 See definition of 'segregated airspace' at ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), xix.

101 *Remotely Piloted Aircraft System (RPAS) Concept of Operations (CONOPS) for International IFR Operations.* Icao.int. Accessed April 19, 2018. https://www.icao.int/safety/UA/Documents/RPAS%20CONOPS.

102 See *Annex 2 to the Convention on International Civil Aviation Rules of the Air.* IFR: the symbol used to designate the instrument flight rules. VFR: the symbol used to designate the visual flight rules.

103 See *Annex 11on Air Traffic Services to the Convention on International Civil Aviation*. Controlled airspace. An airspace of defined dimensions within which air traffic control service is provided in accordance with the airspace classification. Note. — Controlled airspace is a generic term which covers ATS airspace Classes A, B, C, D and E as described in 2.6.

where manned aviation activities are few. These operations could signify transiting international airspaces. [104]

UA should also be able to comply with the existing airspace requirements, which include but are not limited to communication, navigation, air traffic management (ATM) procedures, separation from traffic and distances from clouds.[105] Because of these issues, the revision, amendment and improvement of existing SARPs and PANS are necessary to define how UAS will have to comply.

5.3.2 THE MANAGEMENT OF SAFETY AND SECURITY IN THE OPERATIONS OF UNMANNED AIRCRAFT SYSTEMS

5.3.2.1 PROTECTING AVIATION SAFETY AND SECURITY

Flight is a venture full of risk carried out at high speeds, in a sometimes dangerous environment, and thus is subject to threats. Aviation safety and security concerns are, therefore, inevitable. Under Annex 19 on Safety Management to the Chicago Convention 1944, States shall establish a safety management programme to achieve an acceptable level of safety performance in civil aviation.[106]

Under Annex 17 on Security to the Chicago Convention 1944, States shall develop and implement regulations, practices and procedures to safeguard civil aviation against acts of unlawful interference taking into account the safety, regularity and efficiency of flights.[107]

The safety and security of UAS have aspects comparable to manned aircraft. For instance, a remote pilot station is similar in purpose and design to the cockpit of a manned aircraft. The UA must be able to neutralise threats related to hijacking or unlawful interference. Also, because of the motionless and visible characteristics of the remote pilot station, a more significant consideration is necessary regarding the potential vulnerability of the cockpit and interference in the command and control (C2) link, which connects

104 *Remotely Piloted Aircraft System (RPAS) Concept of Operations (CONOPS) for International IFR Operations.* Icao.int. Accessed April 19, 2018.

105 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 14-1.

106 See Chapter 3, State Safety Management Responsibilities of *Annex 19 – Safety Management: International Standards and Recommended Practices*. Montreal, Quebec: International Civil Aviation Organization, 2013), 3-1.

107 See Chapter 2, General Principles of *Annex 17 Security: Safeguarding International Civil Aviation against Acts of Unlawful Interference*, 10th ed. (Montreal: International Civil Aviation Organization, 2017), 2-1.

the remote pilot station and the UA to manage the flight.[108] Similarly, the UA shall park and get ready for the flight in such a way that has the capacity to quickly prevent and detect all threats while ensuring the integrity of the whole system.

Because safety and security are two sides of the same coin, both aim at avoiding injuries, damages to persons and property and deprivation of life. However, there are differences between them, namely:[109]

> "***Safety***. The state in which risks associated with aviation activities, related to, or in direct support of the operation of aircraft, are reduced and controlled to an acceptable level."[110]

> "***Security***. Safeguarding civil aviation against acts of unlawful interference. This objective is achieved by a combination of measures and human and material resources."[111]

As per the definitions above, the line of differentiation between the two concepts is perhaps that safety emphasises on preventing harm caused by internal, that is aircraft-related factors, whereas security puts its effort on preventing intentional harm coming from an outside source.

The author considers that the understanding of the risks associated with UAS operations raises the necessity to make safety and security management indispensable. Implementing safety and security management programmes by States and UAS operators will definitively contribute to the ability to assess and, therefore, avoid and reduce the risks associated with the international air navigation of UA and their potential impact on other service providers and users, such as ATM, UAS Traffic Management (UTM), manned aircraft and airports. Moreover, proper oversight of safety and security management programmes will support the ability of States to

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108 See the definition of Command and Control (C2) link on ICAO Doc 10019 AN/507 'Manual on Remote Piloted Aircraft System (RPAS)', first edition 2015, April 2015: The data link between the remotely piloted aircraft and the remote pilot station for the purposes of managing the flight.

109 ICAO Council Working Paper C-WP/11799, *"Aviation Security Plan of Action"* 17 April 2004; see also, ICAO Doc 9809-C/1142 C-Min. 166/1-14, *Council – 166th Session, Summary Minutes with Subject Index,* 2002.182; Kotaite, Aviation Safety and Security – Two Sides of the Same Coin. Keynote Address to the Aviation Study Group at Linacre College, Oxford University, 27 June 2003, 2-3.

110 See definition of 'safety' in *Annex 19 – Safety Management: International Standards and Recommended Practices.* Montreal, Quebec: International Civil Aviation Organization, 2013), 1-2.

111 See definition of security in *Annex 17 Security: Safeguarding International Civil Aviation against Acts of Unlawful Interference.* 10th ed. Montreal: International Civil Aviation Organization, 2017), 1-2.

accomplish higher levels of aviation safety and security in the operation of UAS.

5.3.2.2 PROPOSALS FOR ENHANCING SAFETY MANAGEMENT

Annex 19 on Safety Management to the Chicago Convention 1944 and its related guidance material harmonise the implementation of safety management practices for States and organisations involved in aviation activities.[112] SARPs in this Annex apply to safety management functions related to, or to support the safe operation of aircraft.[113] However, they do not address specific aspects of the operations of UAS. Under Annex 19, States shall implement a State Safety Programme (SSP), and the operator shall implement a Safety Management System (SMS) to allow the identification of systemic safety deficiencies found in aircraft operations and to resolve safety concerns.[114]

Regrettably, as aviation has proven in the past, it is likely that incidents and accidents involving UAS, as it appears from the incidents in Gatwick, London, Newark and Dubai,[115] may occur in the future. ICAO believes it is imperative that provisions regarding safety data collection, analysis and exchange require that the voluntary incident reporting system be non-punitive and affords protection to the sources of information. States shall secure a compulsory and voluntary incident reporting system and promote these reporting systems by changing their relevant national laws, regulations and policies as they may deem necessary to achieve this goal. UAS operators, remote pilots and other stakeholders may report safety deficiencies using these systems. Appendices 2 and 3 to Chapter Four of Doc 9859 provide guidance on a State's mandatory reporting procedures and its voluntary and confidential reporting system.[116]

Regardless of the operation in which UAS is engaged, the operator shall receive a certification from the State of registry,[117] which, among other requirements, the operator shall hold and implement as per Annex 19. The operator's SMS should take into consideration the potential impact

112 See Annex 19 on Safety Management to the Chicago Convention 1944 in Attachment 2 of this chapter.

113 See Attachment 2 to this chapter.

114 *Annex 19 – Safety Management: International Standards and Recommended Practices*, Montreal, Quebec: International Civil Aviation Organization, 2013), 2–1.

115 See section 5.4 of this Chapter on Incidents involving UAS.

116 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 7-1.

117 Under the *Manual on Remotely Piloted Aircraft* (RPAS), operators must hold an RPAS operator certificate (ROC) as specified in Annex 2, Appendix 4 to the Chicago Convention 1944. When granting a ROC, the regulator will consider the RPAS operator's ability to meet specified responsibilities.

resulting from the interaction of internal and external aviation stakeholders while assessing the safety performance of UAS. UAS operations should specifically incorporate SMS framework elements of Appendix 2 to Annex 19, proportionate with the size of the operation and the complexity of its aviation products or services.[118] The UAS operator's SMS should, therefore, embody safety-related accountabilities, responsibilities and authorities of all appropriate senior managers. Essential safety functions performed by the technical staff involved in the establishment and implementation of the SMS shall be consistent with the existing job descriptions, processes and procedures.[119]

The size, structure and complexity of the organisation may vary, but the safety functions shall remain intact. The UAS operator should be able to handle the safety performance of products or services provided by contractors that do not require separate safety certification or approval, including when the products and services are available directly from the service provider via a worldwide network of independent distribution partners and third parties in different locations, such as Inmarsat, SITA and ARINC,[120] among others.[121]

The UAS operator should be able, therefore, to ensure the safety performance of the contracted services under its SMS.[122] In other words, the UAS operator should secure an emergency response plan and coordinate with those organisations with which it will interact.[123] New SARPs under Annex 19 shall address a mandate for both States and service providers to adopt SSP and SMS applicable specifically to UAS.

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118 *Annex 19 – Safety Management: International Standards and Recommended Practices*, Montreal, Quebec: International Civil Aviation Organization, 2013), 4–1.

119 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 7-1.

120 *Inmarsat:* an international organization founded in 1978 that provides telecommunication services, as well as distress and safety communication services, to the world's shipping, aviation, and offshore industries. *SITA* is a multinational information technology company providing IT and telecommunication services to the air transport industry. The company provides its services to around 400 members and 2,800 customers worldwide which it claims is about 90% of the world's airline business. *ARINC.* Aeronautical Radio, Incorporated, established in 1929, is a major provider of transport communications and systems engineering solutions for eight industries: aviation, airports, defense, government, healthcare, networks, security, and transportation.

121 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015) , 7-1.

ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 7-2.

122 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 7-3.

123 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 7-3.

5.3.2.3 SECURITY MANAGEMENT

Annex 17 on Security to the Chicago Convention 1944 mandates that States shall,

> "...establish measures to prevent weapons, explosives or any other dangerous devices, articles or substances, which may be used to commit an act of unlawful interference, the carriage or bearing of which is not authorised, from being introduced, by any means whatsoever, on board an aircraft engaged in civil aviation."[124]

However, it does not address specific SARPs to prevent unlawful interference during the operations of UAS.

The access of authorised personnel, such as the flight crew or maintenance staff to the remote pilot station, should equal the standards to those applicable to manned aircraft when accessing the cockpit. In this regard, ICAO has published procedures and systems to ensure the security of the flight crew compartment, which may serve as a reference when addressing the complex environment of remote pilot stations. Annex 6 on Operation of Aircraft to the Chicago Convention 1944 incorporates SARPs to secure the flight crew compartment. Section 13.2.3 provides the following:

> "In all aeroplanes which are equipped with a flight crew compartment door in accordance with 13.2.2:
> a) this door shall be closed and locked from the time all external doors are closed following embarkation until any such door is opened for disembarkation, except when necessary to permit access and egress by authorised persons; and,
> b) means shall be provided for monitoring from either pilot's station the entire door area outside the flight crew compartment to identify persons requesting entry and to detect suspicious behaviour or potential threat."

The remote pilot station of a UA shall also comply with this rule with more restricted access, as it is located on the ground, and therefore the potential for unlawful interference of the premises becomes greater. Manned aircraft are less exposed to intrusion and use of heavier weapons because of their restricted nature.

The Aviation Security Manual Doc 8973 of ICAO presents guidance and further details on how to protect aircraft from unlawful interference, which may work as a reference for the security management of UAS operations.[125]

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124 *Annex 17 Security: Safeguarding International Civil Aviation against Acts of Unlawful Interference.* 10th ed. Montreal: International Civil Aviation Organization, 2017), 2-1.

125 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 9-11.

For instance, as a measure to prevent unlawful interference, UAS operators should be able to store and prepare the UA for flight while blocking all possible intrusion that may endanger the integrity of UAS components. [126]

The Air Traffic Management Security Manual Doc 9985 of ICAO may also render relevant material for the security management of remote pilot stations. In this regard, implementing biometrics authentication systems to verify that only those allowed to have access to the system with different levels of entrance may increase security access to the remote pilot stations.[127]

As per section 4.2.4 of Annex 17 on Security to the Chicago Convention 1944, the remote pilots should also be subject to check standards as persons granted unescorted access to restricted security areas of airports:

> "4.2.4 Each contracting State shall ensure that background checks are conducted on persons other than passengers granted unescorted access to security restricted areas of the airport prior to granting access to security restricted areas."[128]

Last but not least important, the C2 link, essential for the operations of the UAS, uses hardware and software managed by third parties and must also be free from hacking, spoofing or other forms of interference.[129]

Because threats against security are always present, regardless of the type of aircraft, situation or location, the author suggests that specific SARPs for UAS should also encompass rules which include, but are not limited to measures relating to the following:

- Passengers and their cabin baggage;
- Hold baggage;
- Charge, mail and other goods;
- Special categories of passengers;
- The landside; and,
- Cyber threats.

Finally, the initial SARPs on security will not address all scenarios to prevent acts of unlawful interference using UAS. However, the accumulated experience gathered in manned aviation shall be the starting point.

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126 ICAO Doc 8973 *Security Manual for Safeguarding Civil Aviation against Acts of Unlawful Interference*, Montréal, Québec: International Civil Aviation Organization, 1987), 5–1.

127 *Air Traffic Management Security Manual Doc 9985-AN/492 – Restricted.* ICAO. Accessed February 13, 2019. http://www.aviationchief.com/uploads/9/2/0/9/92098238/icao_doc_9985_-_atm_security_manual_-_restricted_and_unedited_-_not_published_1.pdf

128 *Annex 17 Security: Safeguarding International Civil Aviation against Acts of Unlawful Interference.* 10th ed. Montreal: International Civil Aviation Organization, 2017), 4-1.

129 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 9-13.

5.3.2.4 OPERATIONAL ASPECTS OF UNMANNED AIRCRAFT SYSTEMS

International air navigation of UA defies the current manned aviation system infrastructure and raises multiple challenges. For instance, pilots prepare themselves for emergencies and unforeseen flight events throughout their entire professional lives. They do so in the initial and recurrent training. However, UA have experienced a higher accident rate than conventionally manned aircraft. Many of these accidents and incidents appear to reflect the unique human challenges associated with piloting a UA and design issues with the human/system interface.[130]

The remote pilot, as opposed to manned aircraft, operates in an environment with reduced or no sensory cues at all. These cues include visual, auditory, prior-perceptive and olfactory sensations, of which the absence of these cues make UAS operations more difficult. Pilot errors on manned aircraft are frequent, yet most of them are rapidly identified and corrected by the crews themselves. Self-correction is more difficult if the remote pilot station is far from the UA.[131] Technological advancements and regulations to address human factors in the operations of UAS are fundamental to overcome the lack of sensory cues and that ensure that remote pilots have the necessary means to identify risks during all phases of flight.

A remote pilot should be able to communicate with ATC and other airspace users when and where necessary in an environment where it can see, avoid and remain well clear of other traffic and potential collisions with other airspace users, obstacles and harsh weather.[132] For instance, the remote pilot cannot comply with ATC visual clearances in the same way as onboard pilots. They must rely on alternative sources of information in the absence of an out-the-window view. UAS cannot meet the 'see and avoid' requirement as a pilot onboard a manned aircraft would, but they will eventually incorporate DAA capabilities with other aircraft and hazards. DAA, separation assurance technology and rules or alternate means of compliance are therefore essential to enable the safe international air navigation of UA.[133] In

130 Robert Nullmeyer and Gregg Montijo. *Training Interventions to Reduce Air Force Predator Mishaps.* CORE Scholar. Accessed February 15, 2019. https://corescholar.libraries.wright.edu/isap_2009/61/

131 *International Civil Aviation Organization (ICAO).* https://standards.globalspec.com. Accessed February 15, 2019. https://standards.globalspec.com/std/632047/ICAO%209803

132 *Remotely Piloted Aircraft System (RPAS) Concept of Operations (CONOPS) for International IFR Operations.* Accessed February 9, 2019, https://www.icao.int/safety/ua/documents/rpas conops.pdf

133 *Remotely Piloted Aircraft System (RPAS) Concept of Operations (CONOPS) for International IFR Operations.* Accessed February 9, 2019, https://www.icao.int/safety/ua/documents/rpas conops.pdf

A. Hobbs. *Human Factor Guidelines for UAS in the National Airspace System.* science.gov. Accessed February 15, 2019. https://www.science.gov/topicpages/m/multiple+unmanned+systems.html

this context, revising, amending and enhancing existing SARPs and PANS is imperative, and so does the method for UA to comply.

In addition to flying the UA, the remote pilot must manage and monitor the C2 link, which demands to be aware of its current status, anticipate potential changes in the quality of the connection as the flight progresses, and diagnose and respond to any changes that occur. The C2 link may introduce operationally significant delays between remote pilot station input, UA response and display of the response to the pilot. These latencies are noticeable when the link is made via a geostationary satellite. However, terrestrial radio systems may also introduce latencies. In the event of a link interruption, the UA must be capable of continuing the flight safely and meeting the expectations of the remote pilot and ATC.[134]

A safe flight plan follows a command chain that involves pilots, the operator's technical staff, Civil Aviation Authorities (CCA) and Air Navigation Service Providers (ANSP). CCA and ANSP provide and oversee unique infrastructure with procedures, routes and services aimed at managing safe and efficient air traffic flow.[135] In an emergency, the remote pilot may attempt an off-airport landing or ditching. The remote pilot will also be responsible for the protection of life and property on board and on the ground or in other aircraft.[136] Furthermore, maintenance staff will require the skills and knowledge to interact with a complex distributed system containing elements not typically supported by aviation maintenance personnel.

Troubleshooting and fault rectification of the UAS may also occur while a flight is underway. For that reason, rules and technological advancements aimed at supporting and providing information to remote pilots and maintenance staff to carry out such an action are vital.

Another element that requires attention for the safe international air navigation of UA is the UTM. Over the last ten years, UAS technological development has disrupted manned aviation, introducing enhanced capabilities with unprecedented speed. As a result, States, including their aviation authorities, have received an increasing number of applications for access to low-level airspace where the operation of manned aircraft is limited or restricted.[137]

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134 *Human Performance Considerations for Remotely Piloted Aircraft Systems (RPAS).* NASA, June 19, 2015. https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/20150011435.pdf

135 *Annex 2, Rules of the Air* to the Convention on International Civil, 10th ed., Montreal: ICAO, 2005. 3–7.

136 *Annex 6, Operation of Aircraft* to the Convention on International Civil, 10th ed., Part I: Montréal, Quebec: International Civil Aviation Organization, 2016), 4–18

137 *UTM Guidance* // accessed April 25, 2019, https://www.icao.int/safety/UA/Pages/UTM-Guidance.aspx

The future of aviation will require manned aircraft and UA to fly together within the same airspace, unlocking potential operations that will cross both UTM and ATM environments. ICAO forecasts that civil UAS operations will soon surpass the number of manned aircraft operations. ANSPs expect that such operations will include either controlled or uncontrolled airspace and those that transit across their boundaries.[138]

ICAO defines UTM as follows:

> "**UAS traffic management (UTM)** – A specific aspect of air traffic management which manages UAS operations safely, economically and efficiently through the provision of facilities and a seamless set of services in collaboration with all parties and involving airborne and ground-based functions."[139]

Integrating UAS will impact the primary elements of ATM, such as airspace classification, flight rules and automation. Aircraft taking part in the UTM system, therefore, needs separation from each other and other hazards, such as buildings and weather. This separation management would include guidance and responsibilities complemented by other tools and procedures to address scalability adequately.[140] Additional standards, policies, capabilities or tools will be essential to support separation management.

While UTM is under development, a general agreement among States on its framework and principles is crucial to ensuring global harmonisation and interoperability. ICAO has taken the step into the world of UTM, where the goal is to synthesise best practices gleaned from States into a globally harmonised common framework to support the integration of UAS into the national airspace.[141]

5.3.2.5 FLIGHT PLANNING

Before a UA engages in international air navigation, a flight plan[142] is necessary per Chapter 3 of Annex 2 on Rules of the Air to the Chicago Conven-

138 *UTM Guidance* // accessed April 25, 2019, https://www.icao.int/safety/UA/Pages/UTM-Guidance.aspx

139 *UTM Guidance* // accessed April 25, 2019, https://www.icao.int/safety/UA/Pages/UTM-Guidance.aspx

140 *UTM Guidance* // accessed April 25, 2019, https://www.icao.int/safety/UA/Pages/UTM-Guidance.aspx

141 *ICAO – Drone Enable Conference – 170922-23 – Videos.* RPAS Regulations. Accessed February 19, 2019. https://rpas-regulations.com/community-info/icao-drone-enable-conference-170922-23-videos/

142 *Flight plan.* Specified information provided to air traffic services units, relative to an intended flight or portion of a flight of an aircraft.

tion 1944, or as otherwise mandated by the overflown State.[143] Accordingly, the pilot is responsible for planning a safe flight and also for the prior submission of the flight plan. The UA shall adhere to the flight plan and ATC clearances.

The overflown States or the State into which the flight will be operated may require additional information related to the intended operation of the UAS. Also, the ANSP may admit or change the flight plan of the UA for reasons such as route, timing and any unique considerations associated with the UA, cargo or contingency procedures. Moreover, the ANSP shall have the capacity to provide and approve contingency plans for each UA flight plan before going airborne in the case an unforeseen situation occurs.[144] For example, a UAS may encounter a situation of loss of the C2 link. The contingency actions will depend on the segment of flight where the failure occurs, the UA characteristics and performance, the risk it represents to other airspace users and the risk to persons and property. One contingency option could be the continuation of the original flight plan; this may be appropriate if the planned flight is short and the planned destination is a low-density aerodrome or landing site, or if the planned flight occurs in low-density airspace.[145]

UAS operations offer the potential for increased point A to point A operations, as opposed to point A to point B, where the vast majority of manned aircraft international operations take place, typically flown to and from aerodromes.[146] For instance, a UA may transit to distant operational areas while crossing international airspaces and subsequently return to the point of origin. These scenarios could happen while providing scheduled international air services and non-scheduled services operated by UA, wildlife monitoring operations, surveillance or fish spotting, to mention a few. Accordingly, due to similarities with manned aircraft and in order to accomplish comparable safety standards, UA engaged in international air navigation should mirror procedures of flight planning for manned aircraft while taking into account the specific characteristics and risk in which unmanned flight unfolds.

The flight planning of UAS should consider situations for an emergency landing of the UA in different locations to avoid representing a threat to

143 *Annex 2, Rules of the Air* to the Convention on International Civil Aviation, 10th ed., Montreal: ICAO, 2005. APP-4-1

144 *Annex 2, Rules of the Air* to the Convention on International Civil Aviation, 10th ed., Montreal: ICAO, 2005. 3-7.

145 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 11-13.

146 *"Remotely Piloted Aircraft System (RPAS) Concept of Operations (CONOPS) for International IFR Operations,"* accessed February 9, 2019, https://www.icao.int/safety/ua/documents/rpas conops.pdf

people or property. During an emergency, remote pilots have a limited capacity to observe actual details on the ground near their aircraft. Remote pilots must rely on pre-planning emergency scenarios that may occur during take-off, en route or landing of the UA.[147]

5.3.2.6 ACCESS TO AND THE USE OF AERODROMES BY UNMANNED AIRCRAFT SYSTEMS

Under Article 15 on Airport and similar charges of the Chicago Convention 1944, contracting States are free to allow civil UAS operations to or from designated aerodromes under national treatment conditions. Such and other conditions about access to airports serving international civil aviation have to be confirmed in national legislation.

> Article 15: Airport and similar charges
>
> "Every airport in a contracting State which is open to public use by its national aircraft shall likewise, subject to the provisions of Article 68, be open under uniform conditions to the aircraft of all the other contracting States…"

ICAO forecasts that by 2030, UA may depart from and land to low-congested or congested aerodromes, for which the remote pilot shall be in the capacity to identify, in real-time, the physical layout of the aerodrome and associated equipment, lighting and markings to manoeuvre the UA safely regardless of the location of the remote pilot station.[148] Advancements in technology and procedures are, therefore, essential to achieve this goal.

Annex 14 on Aerodromes to the Chicago Convention 1944 sets forth the specifications for aerodromes and mandates that States must certify aerodromes used for international operations.[149] States' regulatory framework shall include the establishment of criteria and procedures for certification.[150]

For international air navigation of UA of long duration, multiple and distributed remote pilot stations may be necessary at different aerodromes, or perhaps at off-aerodrome locations, even in different States. Moreover, there are unique characteristics of UA that may also impact aerodrome operations

147 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015. 9-10

148 *"Remotely Piloted Aircraft System (RPAS) Concept of Operations (CONOPS) for International IFR Operations,"* accessed February 9, 2019, https://www.icao.int/safety/ua/documents/rpas conops.pdf

149 *Annex 14 Aerodromes: Volume 1: Aerodrome Design and Operations*, 5th ed. (Montreal: ICAO, 2009).

150 *Annex 14 Aerodromes: Volume 1: Aerodrome Design and Operations*, 5th ed. (Montreal: ICAO, 2009).

which States, aerodrome operators, UAS operators and manufacturers shall take into account, namely:[151]

- The UA's ability to detect aerodrome signs and markings;
- The UA's ability to avoid collisions while manoeuvring;
- The UA's ability to follow ATC instructions in the air or on the manoeuvring area;
- Applicability of instrument approach minima to UA operations;
- The necessity of UA observers at aerodromes to assist the remote pilot with collision avoidance requirements;
- Implications for aerodrome certification requirements of UAS;
- Infrastructure, such as approach aids, ground handling vehicles, landing aids and launch/recovery aids;
- Rescue and fire-fighting requirements for UA and the remote pilot station;
- Integration of UA with manned aircraft near and on the movement area of an aerodrome; and,
- Aerodrome implications for UAS specific equipment.[152]

States shall assess whether UAS can integrate safely without representing a threat to safety. States shall also determine the suitability of the aerodrome qualifications to embrace UAS operations. Perhaps one solution at the first stage of routine UAS operations is that States may establish aerodromes open exclusively to the operations of UAS, rather than combined aerodromes for both manned aircraft and UA operations. Economic factors and the interest of States on safety will be the main drivers to determine the convenience of this proposal.

5.3.2.7 HANDOVERS BETWEEN REMOTE PILOT STATIONS

The versatility of UAS will make handovers occur in flight between pilots at the same remote pilot station, between consoles at the same remote pilot station or between physically separated remote pilot stations.[153] As handovers may represent a risk while the UA is airborne for an extended period, regulations are necessary to increase safety while reducing the cumulative level of danger at the moment of transferring the command of UA to another pilot.

UA operations may require more than one remote pilot station, which may

151 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 15-1.

152 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 15-1.

153 Heather Pringle and Nancy J. Cooke. *Human Factors of Remotely Operated Vehicle.* Bingley: Emerald Group Publishing Limited, 2009), 116–119.

also be spread across different States or even in the high seas.[154] Remote pilots shall, therefore, secure the safe handover of piloting control from one station to another.[155]

There are many reasons for UA handovers between remote pilot stations, such as operational range, permit precision control for a terminal area or maintenance of the UAS. ICAO suggests that UA handovers may occur in two common scenarios, specifically:[156]

1. The handover of piloting control to a collocated, but not coupled remote pilot station, in which the handover may be to a second remote pilot or, if of a remote pilot station malfunction, the remote pilot moving to a standby remote pilot station; or
2. The handover of piloting control to a remote pilot station at another location.

A remote pilot relieved by another at the same remote pilot station is equivalent to a relief pilot/crew taking over on board a manned aircraft, rather than a handover. Also, a remote pilot transferring piloting control to another within a dual seat remote pilot station is equivalent to exchanging control in a manned aircraft, rather than a handover.[157]

UAS operations have the potential to operate for several months and be piloted from different locations, possibly from different States.[158] This scenario has legal implications because one individual cannot fulfil the remote pilot-in-command responsibilities for the duration of the flight. If there is no transfer of command, the remote pilot in command will be off duty for some portion of the flight. If the State allows the transfer of remote pilot responsibilities, handovers between remote pilots, whether at collocated or widely spaced remote pilot stations, will need to identify explicitly whether the remote pilot responsibility is transferred coincident with the handover of the UA.[159]

UA may also reconfigure during flight, such as by handover from one

154 See section 4.5.4 on freedoms of the air in relation to the operation of unmanned aircraft systems in Chapter Four.
155 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 9-9.
156 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015. 9-9
157 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015). 9-10.
158 See section 4.5.4 on freedoms of the air in relation to the operation of unmanned aircraft systems in Chapter Four.
159 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 9-9.

remote pilot station to another or changing from terrestrial to satellite C2 links.[160] This scenario has a new implication on maintaining the validity of the certificate of airworthiness for the UAS, and additional requirements may be necessary to fulfil, as the remote pilot requires real-time communication capability with any UA at all times. The remote pilot will also need real-time communications with the ATC or ANSP units.[161] A reliable voice communication link between the transferring and receiving remote pilots in the remote pilot station to support coordination of the handover is therefore essential.[162]

5.3.3 CONCLUDING REMARKS

While the above considerations apply to UAS, these are not all safety and security-related rules that SARPs should encompass, because the situations above are foreseeable circumstances based on previous experiences in manned civil aviation. As technology develops rapidly, safety and security risks also increase.

The author considers that in addressing safety and security concerns in the operation of UAS, we must acknowledge that there are things we know we know that create certainty. There are also known unknowns, which are the things we know we do not know in unmanned aviation. Perhaps the most dangerous situation when addressing safety and security concerns in unmanned aviation is that there are unknown unknowns, which are the ones we do not know we do not know. The latter category is the most difficult to address.

In the following section, the author analyses how some incidents involving small UA expose current flaws in aviation safety and security, which must be overcome for the adequate integration of UAS into international civil aviation.

5.4 INCIDENTS INVOLVING UNMANNED AIRCRAFT SYSTEMS

5.4.1 THE GATWICK, LONDON, NEWARK AND DUBAI INCIDENTS

Society is shocked when the media broadcasts news about aircraft acci-

160 Robert J. Kerczewski et al. *"Progress on the Development of the UAS C2 Link and Supporting Spectrum"* from LOS to BLOS, *2017 IEEE Aerospace Conference*, 2017, https://doi.org/10.1109/aero.2017.7943926.

161 Robert J. Kerczewski et al. *"Progress on the Development of the UAS C2 Link and Supporting Spectrum"* from LOS to BLOS, *2017 IEEE Aerospace Conference*, 2017, https://doi.org/10.1109/aero.2017.7943926.

162 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS)*, Montreal, Canada: International Civil Aviation Organization, 2015), 9-11.

dents or incidents, as these incidents primarily relate to aviation safety.[163] Although there have not yet been severe accidents involving UAS, incidents with these aircraft have caught the attention of the public worldwide.

For instance, on December 20, 2018, the Gatwick Airport in London, the second most important airport in the United Kingdom, suspended its flights after the runway was closed because of the apparent presence of several UA in the terminal's vicinity. This incident affected approximately 110,000 passengers who had planned to take off or land on some 760 flights during the Christmas season.[164]

On January 8, 2019, only three weeks after the Gatwick UA incident, the busiest airport in the United Kingdom, London's Heathrow, was forced to suspend take-offs for one hour due to the sighting of a small UA on one runway.[165]

On January 22, 2019, the FAA briefly suspended arrivals at New Jersey's Newark Airport, the 11th busiest airport in the USA, after a pair of small UA were seen flying over 3,500 feet near Teterboro Airport, which is a smaller aerodrome about 17 miles away from Newark. The disruption lasted about 90 minutes, and the airport quickly resumed normal activities.[166]

On February 15, 2019, between 10:13 a.m. and 10:45 a.m., the Dubai airport in the United Arab Emirates (UAE), one of the world's highest international passenger traffic airport, briefly suspended its operations because of an alleged UA sighting.[167]

The use of small UA has caused an impact on commercial aviation and has become more relevant after incidents for unauthorised overflights in the surroundings of airports in the UK, USA and UAE, as they have threatened aviation safety. Do the member States have obligations under the Chicago Convention 1944 and other treaties to prevent acts that jeopardise safety

163 Jiefang Huang. *Aviation Safety and ICAO* (Alphen Aan Den Rijn, Netherlands: Kluwer Law International, 2009), 13.

164 Rafa de Miguel, Rafa. '*Cancelados Todos Los Vuelos En Gatwick Por La Interferencia deliberada" De Varios Drones*.' EL PAIS. December 21, 2018. Accessed January 08, 2019. https://elpais.com/internacional/2018/12/20/actualidad/1545274386_639692.html.

165 *"Heathrow Airport Drone Investigated by Police and Military."* BBC News. BBC, January 9, 2019. https://www.bbc.com/news/uk-46804425

166 Patrick McGeehan. *"Newark Airport Traffic Is Briefly Halted After Drone Is Spotted."* The New York Times. The New York Times, January 22, 2019. https://www.nytimes.com/2019/01/22/nyregion/drones-newark-airport-ground-stop.html

167 Helen Coffey. '*Drone Attack Grounds Flights at Dubai Airport.*' The Independent. Independent Digital News and Media, February 15, 2019. https://www.independent.co.uk/travel/news-and-advice/dubai-airport-drones-attack-ground-flights-cancelled-delayed-a8780496.html

and security on passengers and aircraft? This question will be addressed in the next subsection.

5.4.2 PRINCIPAL DOMESTIC RULES THAT MAY APPLY TO PREVENT THESE INCIDENTS

Because the international safety-related regulations applying to the operation of UAS have been analysed and discussed in the preceding sections, the author will, in the following paragraphs, concisely address how domestic legal instruments may apply to the referred UA disruptions and what lessons we can learn to prevent similar incidents or accidents in the future.

The incidents in question occurred within the airspace of States Parties to the Chicago Convention 1944. Therefore, the provisions mentioned above apply to these incidents. States must impede that a UA is not misused[168] and shall take the necessary actions to reduce or eliminate the risk associated with the situation in which a UA is a threat or risk to the lives of people on board civil aircraft airborne or in the airport surroundings.[169] The national regulations on the operations of UAS also apply because the incidents occurred within the airspace of sovereign States.

The UK, USA and UAE have issued national regulations aimed at permitting the flight of UA in their national airspaces. For instance, regulations in the USA[170] and the UAE[171] mandate that all UA shall be registered therein. This is not the case for UA in the UK as, beginning on November 30, 2019, UAS operators will begin registering their UA with the CAA of the UK and take an online safety test. Anyone who does not take the competency tests could face fines of up to £1000.[172]

All three States have also issued regulations that require keep small UA within the visual line of sight at all times and be aware of designated 'no-fly

168 See Article 4 on misuse of civil aviation of the Chicago Convention 1944.

169 See Article 8 on pilotless aircraft and Article 9 on prohibited areas of the Chicago Convention 1944.

170 *Register Your Drone.* FAA, November 1, 2018. https://www.faa.gov/uas/getting_started/register_drone/.

171 GCAAIT. "*UAE General Civil Aviation Authority."* مرحباً بكم في موقع الهيئة العامة للطيران المدني بدولة الإمارات العربية المتحدة . Accessed April 16, 2019. https://www.gcaa.gov.ae/en/pages/UASRegistration.aspx.

172 "*Screen Reader Navigation."* Updates about drones | UK Civil Aviation Authority. Accessed April 16, 2019. https://www.caa.co.uk/Consumers/Unmanned-aircraft/Our-role/Updates-about-drones/.

zones', which most notably include airports, prisons, stadiums and sporting events and security sensitive airspace restrictions.[173]

If the UA had been registered in the national registry of the involved States, those UA would hold the nationality of the USA and UAE as per the mandate of Article 17 of the Chicago Convention 1944.[174] Not so with the UA involved in the incidents in Gatwick and London airports as the obligation to register UA will take effect on November 30, 2019.

The State of Registry has several duties concerning registered aircraft. According to Professor Cooper, "each State is reciprocally responsible for the international good conduct of the aircraft having its nationality".[175] As explained in section 5.2.3.1, Article 12 of the Chicago Convention 1944 requires States to ensure that aircraft flying over their territory or carrying their nationality mark shall comply with the rules and regulations governing flight therein force, even more in its own territory.

Remote pilots of UA are obliged to respect the rules of the air of each State, which under Article 12, conform to those of Annex 2 to the Chicago Convention 1944 and not fly over the vicinity of the airports of Gatwick, London, Newark and Dubai, as they are no-fly zones for UA. Moreover, the UA shall be operated under the conditions specified by the State of registry, the State of the operator if different and the State in which the flight is to operate. Prior to the flight, flight plans shall have been submitted in accordance with Chapter 3 of Annex 2 on Rules of Air to the Chicago Convention 1944 or as otherwise mandated by the State in which the flight is to operate.[176] Most importantly, the flight of UA in regions open to civil aircraft shall be so controlled as to obviate danger to civil aircraft.[177]

The States of Registry of the UA have the authority to prosecute the persons involved in the incidents for violating not only their national laws but also the rules of the air, as per the mandate of Article 12 of the Chicago Convention 1944.[178]

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173 See *"Airspace Restrictions."* FAA seal, December 11, 2018. https://www.faa.gov/uas/recreational_fliers/where_can_i_fly/airspace_restrictions/; *"Screen Reader Navigation."* Airspace restrictions for unmanned aircraft and drones | UK Civil Aviation Authority. Accessed April 16, 2019. https://www.caa.co.uk/Consumers/Unmanned-aircraft/Our-role/Airspace-restrictions-for-unmanned-aircraft-and-drones/.; GCAA. *"Airport Restrictions."* مرحباً بكم في موقع الهيئة العامة للطيران المدني بدولة الإمارات العربية المتحدة . Accessed April 16, 2019. https://www.gcaa.gov.ae/en/Pages/noflyzone.aspx.

174 See Article 17 on aircraft nationality of the Chicago Convention 1944.

175 John Cobb Cooper, "*Backgrounds of International Public Air Law*," 1 YEARBOOK OF AIR AND SPACE LAW 3, 31(1967).

176 See General Operating Rules in Appendix 4 on Remotely Piloted Aircraft of Annex 2 on Rules of the Air to the Chicago Convention 1944.

177 See Article 8 on pilotless aircraft of the Chicago Convention 1944.

178 See Article 12 on rules of the air of the Chicago Convention 1944.

Article II of the *Protocol for the Suppression of Unlawful Acts of Violence at Airports Serving International Civil Aviation,* Supplementary to the *Convention for the Suppression of Unlawful Acts against the Safety of Civil Aviation*, henceforth called 'the treaty', prohibits disrupting the services of an airport.[179] The treaty also imposes an obligation to present the case to the appropriate authorities who decide at their discretion, whether prosecution is appropriate.

Based on this provision, the UK, USA and UAE can make such offences punishable by penalties.[180] In this regard, the UK initiated actions to investigate and enforce penalties for the persons responsible for these incidents.[181] The FAA also opened an investigation to determine who was responsible for the incident.[182] Despite a high-profile police investigation in the UAE, the perpetrators are yet to be found.[183] The referred States, following international and national law, shall also endeavour to take all possible measures to prevent the offences mentioned in Article 1 of the *Convention for the Suppression of Unlawful Acts against the Safety of Civil Aviation,* as amended by its Protocol. When due to the commission of one offence a flight has been delayed or interrupted, any State in whose territory the aircraft or passengers or crew are present shall facilitate the continuation of the journey of the passengers and crew as soon as practicable.[184] All States acted accordingly and facilitated the continuation of the journey of the passengers and crews as soon as they found sufficient grounds that flight operations were safe.

5.4.3 LESSONS TO PREVENT SIMILAR INCIDENTS IN THE FUTURE

What lessons can we learn from these incidents? Are more controls and regulations necessary? The author suggests that the UA incursions at Gatwick, London, Newark and Dubai revealed the lack of preparation, information and control for UA operations near airports. Perhaps, these are not

179 See Article II of the Protocol for the Suppression of Unlawful Acts of Violence at Airports Serving International Civil Aviation, Supplementary to the Convention for the Suppression of Unlawful Acts Against the Safety of Civil Aviation.

180 See Article 3 of the Convention for the Suppression of Unlawful Acts Against the Safety of Civil Aviation.

181 Vikram Dodd and Matthew Weaver, '*Heathrow Drone: Police Investigating Whether It Is Linked to Gatwick Chaos,*' The Guardian (Guardian News and Media, January 9, 2019), https://www.theguardian.com/uk-news/2019/jan/09/heathrow-drone-police-investigating-whether-it-is-linked-to-gatwick-chaos

182 CBSNewYork, 'FAA Investigating Drone Scare That Grounded Flights At Newark Airport,' CBS New York (CBS New York, January 23, 2019), https://newyork.cbslocal.com/2019/01/23/faa-investigating-newark-airport-drone-scare/

183 Jon Porter, Dubai Airport Forced to Halt Departures Due to Drone Sightings,' The Verge (The Verge, February 15, 2019), https://www.theverge.com/2019/2/15/18226077/dubai-airport-drone-closure-ground-flights.

184 See Article 10 of the Convention for the Suppression of Unlawful Acts Against the Safety of Civil Aviation.

the only cases with UA disruptions worldwide. Many airports, CAA and States around the world are likely unprepared to respond to unauthorised UA incursions.

The author considers that the increasing use of UA may also test the limits of ATM infrastructure, forcing States to revise not only their existing regulatory framework but also their technology. Nevertheless, the regulations for UA registration already in place would make a substantial difference as they will allow the tracking of UAS operations.

The FAA has developed an app that tells UAS operators whether their aircraft can fly in an area, based on their location. It also provides information to new remote pilots and updates in regulation changes on UAS operations.[185] While the FAA app can be helpful to those who use UAS, it might not be enough to support an airport's security measures. An ATM designed to maintain safe integration and separation of UA and other aircraft and objects in low-altitude airspace is therefore essential. Furthermore, a technology that identifies if a small UA is flying in a restricted or prohibited area will also be necessary to take countermeasures if they represent a threat or risk to public safety.

States could also implement geofencing technology[186] and procedures to prevent future UA disruptions. Geofencing technology creates effectively virtual location-based barriers that prevent UA flights and take-offs in sensitive areas, such as airport surroundings and one-off locations where crowds will be present, like festivals and sporting events.[187]

Even though preventing UA incursions in aerodromes could be the first step to make airports safer, direct intervention might not solve the challenges that protecting the safety of passengers and staff require.

Because UA is an aircraft, shooting them down would violate Article 3*bis* of the Chicago Convention 1944 that mandates that "State must refrain from resorting to the use of weapons against civil aircraft in flight."[188] Nevertheless, UAS technology in the wrong hands can be weaponised and represent an uncontrollable threat to safety and security. However, it is also true and has been demonstrated that UAS are providing more useful service than

185 *"B4UFLY Mobile App Update."* FAA seal, February 26, 2019. https://www.faa.gov/uas/recreational_fliers/where_can_i_fly/b4ufly/.

186 Geofencing is a virtual 3-dimensional perimeter around a geographic point either fixed or moving, which can be predefined or dynamically generated, that enables software to trigger a response when a device approaches the perimeter. (also referred to as geoawareness or geocaging).

187 Malek Murison. '*5 Technologies Improving Drone Safety,*. DRONELIFE, January 23, 2019, https://dronelife.com/2019/01/23/5-technologies-improving-drone-safety/

188 See Article 3 of the Chicago Convention 1944.

harm. The author is confident that the best way to tackle UA disruption is through regulatory framework, training, technology and enforcement actions.

5.4.4 CONCLUDING REMARKS

The incidents analysed in this section confirm that there are gaps requiring rule-making to prevent future accidents or incidents involving UA when interacting with manned aircraft. While it is impossible to forecast all events that may create a danger to aviation safety in using UAS, it is essential to accomplish minimum standards that contribute to reducing or controlling all the risks associated with the operation of UAS and, thus, facilitate its integration into the international civil aviation.

5.5 CONCLUSIONS

The routine operations of UAS in national and international airspace is still limited as it depends on the ability of the States and UAS operators to ensure safety. The current SARPs do not address all necessary regulatory aspects to protect the safety of operations carried out by UAS. UA, therefore, when engaged in international air navigation, must operate following the Chicago Convention 1944 and its Annexes, which conditions include but are by no means limited to the following:

- The remote pilot shall follow the rules of the air, and the UA flight plan must comply with the conditions in Annex 2 on Rules of the Air;
- The UAS operator shall get a special authorisation from all involved States in the flight, and the UA must be so controlled as to obviate danger to civil aircraft;
- The UAS shall have an operator certificate (ROC);
- The UAS shall have a certificate of airworthiness in accordance with type design;
- The UAS shall comply with the communications, navigations and surveillance requirements for the airspace in which it will fly; and,
- The flight crews of the UA shall have valid licences suitable for the UAS operations.

To achieve the routine safe operations of UAS in international airspace, all nineteen Annexes to the Chicago Convention 1944 will require amendments to incorporate new SARPs as to enable the international air navigation of UA. The new SARPs shall aim not only at facilitating UAS integration but also at securing the continued safety of international air navigation.

Even though ICAO works arduously with States and the industry to achieve UAS integration and to make UAS operations as safe as manned

aircraft, several challenges require attention that concern, among others, the establishment of the following:

- SMS rules specific for UAS;
- Security Management Systems rules specific to UAS;
- Rules on DAA and separation assurance technology to enable the safe international air navigation of UA;
- UTM rules on UA flight operation levels;
- UTM rules for flight separation between manned aircraft and UA;
- Rules for interactions in traffic management for UA between both UTM and ATM;
- Rules on access to the cockpit/compartment of remote pilot stations;
- Rules on the access of pilots and technical personnel to the locations of remote pilot stations and related infrastructure;
- Rules to prevent hacking, spoofing or other forms of interference of the C2 link;
- Rules on human factors specific to the operation and nature of UAS;
- Rules for the flight planning particular to UAS;
- Rules for the use of aerodromes by UAS, along with manned aircraft;
- Rules for safe handover process of UAS airborne;
- Rules for the simultaneous operations of UA; and
- Procedures for UAS in emergencies.

Not only SARPs but also procedures, policies and infrastructure of the current aviation system, therefore, require modification to assist UAS to integrate civil aviation without jeopardising the current aviation safety level.

ICAO and the contracting States to the Chicago Convention 1944 must, therefore, continue working together to secure that regulatory measures keep the pace with UAS technological developments and support their safe and efficient integration into the global aviation system. In this regard, because UAS technology is in continuous development, States and competent regional organisations must cooperate to achieve the highest uniformity concerning the regulations, standards and procedures aimed at facilitating and improving the international air navigation of UA engaged in civil uses.

In the next and final chapter, the author summarises the fundamental aspects of this research, which include a review of the research questions and how the findings respond entirely or partially to these questions, or if they give no answers at all. The author will also formulate proposals designed to promote the safe and efficient use of UAS in a new era.

ATTACHMENT 1

DOCUMENTS TO BE KEPT BY THE UNMANNED AIRCRAFT SYSTEM OPERATOR

The following documents, manuals and information specific to the UAS operator should be available, in the authentic form, at the location of the UAS operator's operational management office or other location specified by the State of the operator:[189]

- The UAS operator certificate (ROC)[190], which allows an operator to carry out specified UAS operations;
- Operations specifications relevant to the UAS and remote pilot stations models, associated with the ROC;
- Operations manual, including the UAS operating manual and the remote pilot station manual;
- Flight manual;
- Maintenance control manual (MCM);
- Third party liability insurance certificate;
- Certificate of registration of the UA;
- Certificate of Airworthiness of each UA;
- UAS Manual;
- Certificates of any additional UAS components, if applicable;
- All radio station licence, if applicable;
- All noise certificates, if applicable;
- Notification of special loads, if applicable; and
- Cargo manifests, if applicable.

DOCUMENTS AT THE REMOTE PILOT STATION

Documents, manuals and information including, but not limited to, the following must be available at the remote pilot station during the flight:[191]

- Operations manual including the Minimum Equipment List (MEL)[192], Configuration Deviation List (CDL), UAS operating manual and remote pilot station manual;
- UA and UAS flight manual;

189 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS).* Montreal, Canada: International Civil Aviation Organization, 2015), 6-7.

190 *RPAS operator certificate (ROC)*.* A certificate authorizing an operator to carry out specified RPAS operations.

191 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS).* Montreal, Canada: International Civil Aviation Organization, 2015), 6-8.

192 *Minimum equipment list (MEL).* A list which provides for the operation of aircraft, subject to specified conditions, with particular equipment inoperative, prepared by an operator in conformity with, or more restrictive than, the MEL established for the aircraft type.

- Operations specifications relevant to the UA and remote pilot station models associated with the ROC;
- Journey logbook;
- Maintenance Control Manual (MCM), maintenance logbook and technical log for the UA;
- MCM, maintenance logbook and technical log for the remote pilot station;
- Details of the filed, current, ATS and operational flight plans, if applicable;
- Aeronautical charts for the route of flight and all routes along which it is reasonable to expect that the flight may be diverted, including departure, arrival and approach charts for all relevant aerodromes/heliports;
- Information concerning search and rescue services for the area of the intended flight;
- Notice to Airmen (NOTAM) and aeronautical information service (AIS) briefing documentation;
- Meteorological information;
- Fuel requirements, fuel load and records;
- Cargo manifests and information on dangerous goods, if applicable;
- Mass and balance documentation; and
- Any other documentation that may be pertinent to the flight or required by the State(s) involved in the operation.

Technical information regarding the UAS, such as the journey and maintenance logbooks, flight plan changes and fuel status must be up to date, and all pertinent information shall be conveyed to successive remote pilots. Remote pilots shall update the logbooks as soon as practicable during or immediately after the flight segment, and the electronic format of the documents listed above must be acceptable to the State of the operator and all other States involved in the operation.[193]

DOCUMENTS CARRIED ON BOARD THE UNMANNED AIRCRAFT

The following documents in electronic format must be available on board the UA, which also shall be acceptable to the State of the operator and all other States involved in the operation, namely:[194]

- The ROC;
- Certificate of registration of the UA;
- Certificate of Airworthiness of the UA;
- Licences of each remote pilot involved in the current flight;
- Journey logbook;

193 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS).* Montreal, Canada: International Civil Aviation Organization, 2015, 6-8.

194 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS).* Montreal, Canada: International Civil Aviation Organization, 2015, 6-9.

- Operations specifications;
- Cargo manifests and information on dangerous goods, if applicable;
- Noise certificate, if applicable; and
- Aircraft radio station licence.

DOCUMENTS AT OR IN CLOSE PROXIMITY TO THE UNMANNED AIRCRAFT GROUND OPERATIONS AREA

The following documents, manuals and information should be available at or nearby of the UA ground operations area, namely:[195]

- UA flight manual, or a pertinent subset thereof; and
- Cargo manifests and information on dangerous goods, if applicable.

195 ICAO Doc 10019 AN/507, *Manual on Remotely Piloted Aircraft Systems (RPAS).* Montreal, Canada: International Civil Aviation Organization, 2015, 6-9.

ATTACHMENT 2

THE 19 ANNEXES TO THE CHICAGO CONVENTION 1944

- Annex 1 on Personnel Licensing refers to the licensing of flight crews, ATC & aircraft maintenance personnel.
- Annex 2 on Rules of the Air applies to aircraft bearing the nationality and registration marks of a contracting State, wherever they may be, to the extent that they do not conflict with the rules published by the State having jurisdiction over the territory overflown. Also, this Annex provides the rules relating to the flight and manoeuvre of aircraft within the meaning of Article 12 of the Chicago Convention 1944. Over the high seas, consequently, these rules apply to UAS without exception.
- Annex 3 on Meteorological Service for International Air Navigation contributes towards the safety, regularity and efficiency of international air navigation. The Annex provides to operators, flight crew members, air traffic services units, search and rescue services units, airport management and others concerned with the conduct and development of international air navigation with meteorological information necessary for performing their respective functions.
- Annex 4 on Aeronautical Charts requires the preparation of three sets of charts for planning and visual navigation along different scales.
- Annex 5 on Units of Measurement to be Used in Air and Ground Operations contains specifications for the use of a standardised system of units of measurement in international civil aviation air and ground operations. This standardised system of units of measurement is based on the International System of Units (SI) and certain non-SI units considered necessary to meet the specialised requirements of international civil aviation.
- Annex 6 on Operations of Aircraft contributes to the safety of international air navigation by providing criteria of safe operating practice and by encouraging States to facilitate the passage over their territories of aeroplanes in international commercial air transport belonging to other States that operate in conformity with such Standards. The SARPs contained in Annex 6, Part I shall apply to the operation of aeroplanes by operators authorised to conduct international commercial air transport operations, whereas SARPs contained in Annex 6, Part II shall apply to international general aviation operations with aeroplanes as described in section 2 and section 3 of the referred Annex.
- Annex 7 on Aircraft Nationality and Registration Marks contains SARPs adopted by ICAO as the minimum Standards for the display of marks to indicate appropriate nationality and registration which have been determined to comply with Article 20 on display of marks of the Chicago Convention 1944.

- Annex 8 on Airworthiness of Aircraft specifies the broad SARPs which define, for the application of the national airworthiness authorities, the minimum basis for the recognition by States of certificates of airworthiness for the purpose of flight of aircraft of other States into and over their territories, thereby achieving, among other things, protection of other aircraft, third parties and property.
- Annex 9 on Facilitation provides the SARPs dealing with customs and immigration procedures and such other matters concerned with the safety, regularity and efficiency of air navigation as may from time to time appear appropriate. The foundation concerning the implementation by States of the SARPs on Facilitation is strengthened by Article 22 on facilitation of formalities and Article 23 on customs and immigrations procedures of the Chicago Convention 1944. Article 22 expresses the obligation accepted by each contracting State to adopt all practicable measures, through the issuance of special regulations or otherwise, to facilitate and expedite navigation by aircraft between the territories of contracting States, and to prevent unnecessary delays to aircraft, crews, passengers and cargo, especially in the administration of the laws relating to immigration, quarantine, customs and clearance.[196] Article 23 asserts the undertaking of each contracting State to establish customs and immigration procedures affecting international air navigation in accordance with the practices which may be established or recommended from time to time, under the Chicago Convention 1944.[197]
- Annex 10 on Aeronautical Telecommunications addresses: (1) radio navigation aids; (2) communications procedures; (3) communications systems; (4) surveillance radar and collision avoidance systems; and, (5) aeronautical frequency radio utilisation.
- Annex 11 on Air Traffic Services requires the establishment of flight information centres and ATC units, and division of the world's airspace into a series of contiguous flight information regions (FIRs) within which ATS are provided.
- Annex 12 on Search and Rescue applies to the establishment, maintenance and operation of search and rescue services in the territories of contracting States and over the high seas, and to the coordination of such services between States.
- Annex 13 on Aircraft Accident and Incident Investigation applies to activities following accidents and incidents wherever they occurred.
- Annex 14 on Aerodromes applies to all aerodromes open to public use in accordance with the requirements of Article 15 on airports and similar charges of the Chicago Convention 1944.
- Annex 15 on Aeronautical Informational Services ensures the flow of information/data necessary for the safety, regularity and efficiency of

196 See Article 22 on Facilitation of formalities of the Chicago Convention 1944.
197 See Article 23 on Customs and immigration procedures of the Chicago Convention 1944.

international air navigation. Corrupt or erroneous aeronautical information/data can potentially affect the safety of air navigation.

- Annex 16 on Environmental Protection provides the SARPs and guidelines for noise certification and aircraft engine emission applicable to the defined classes of aircraft.
- Annex 17 on Security: Safeguarding International Civil Aviation Against Acts of Unlawful Interference governs the SARPs and procedures to safeguard civil aviation against acts of unlawful interference taking into account the safety, regularity and efficiency of flights.
- Annex 18 on the Safe Transport of Dangerous Goods by Air govern the international transport of dangerous goods by air. The broad provisions of this Annex are amplified by the detailed specifications of the *Technical Instructions for the Safe Transport of Dangerous Goods by Air* (Doc 9284).
- Annex 19 on Safety Management assists States in managing aviation safety risks. Given the increasing complexity of the global air transportation system and its interrelated aviation activities required to assure the safe operation of aircraft, this Annex supports the continued evolution of a proactive strategy to improve safety performance. The foundation of this proactive safety strategy is based on the implementation of an SSP that systematically addresses safety risks.
- Finally, best practices for air navigation have been identified in PANS.