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The Need for an Integrated Regulatory Regime for Aviation and Space

ICAO for Space?

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Foreword

I read with great interest the Study "ICAO for Space" and found it most interesting, well documented and well structured. I am providing in this Foreword some historical background and new perspectives regarding civil aviation.

At the invitation of the United States of America, 52 States met in Chicago and signed, on 7 December 1944, the Convention on International Civil Aviation, known as the "Chicago Convention", which is one of the most remarkable international legal documents of the 20th Century. I like to refer to it as the "*Magna Carta*" of global air transport for its breadth and scope, and for its enduring capacity to ensure the safe, secure and orderly development of what is today certainly the most efficient mode of mass transportation ever created.

This Convention has proven extraordinarily resilient for more than six decades, having been amended but twice in a substantive way, in areas which the visionary drafters of the Convention could not have foreseen (Article 3 bis dealt with the use of weapons against civil aircraft while Article 83 bis addressed the impact of globalization and wide spread economic liberalization of the air transport sector, emphasizing the spirit of the preamble to the Chicago Convention).

However, the 96 Articles of the Convention and its Annexes, which contain close to 10,000 Standards and Recommended Practices (SARPs), are much more complex in nature and relatively arduous to decipher and understand for those not involved in their application. Full and universal compliance with SARPs remains the first condition for maintaining and enhancing the safety of international civil aviation.

Safety, which is the top priority of the Convention, is another common concern we share. Indeed, there is no growth of air transport without safety. In spite of some accidents, air transport is fundamentally safe and remains the safest mode of mass transportation.

However, since this study is entitled "ICAO FOR SPACE", the first time that sub-orbital flights were mentioned in ICAO was at the 35th Session of the ICAO Assembly in 2004 when I said "100 years from now regular passenger flights in sub-orbital space and even outer space could be common place". To date we have no definition where the air space ends and where the outer space commences and, of course, no international treaty was established.

I am of the opinion that there is no need to establish a special international organization for future commercial civil sub-orbital flights, not even for space

flights. ICAO is very well structured to meet the necessary requirements for such development in the future by simply extending its mandate to cover this aspect of flights. Although there is no reference in the Chicago Convention to aviation security and environment, nevertheless these two items, together with safety, are top priority in the ICAO Programme and well integrated in ICAO activities. ICAO has developed two Annexes, one for the Environment (Annex 16) and the other for Security (Annex 17). New Annexes could be developed to cover sub-orbital flights and space flights. Should an amendment be needed to cover the sub-orbital and ultimately the outer space civil flights, of course this could be done but it may take a long time for the amendment to enter into force.

ICAO, which was created by the Chicago Convention, remains as relevant a global forum as ever, in promoting the safe and orderly development of international civil aviation. Today we find ourselves in a similar situation with respect to space. With the Chicago Convention we have a model at our disposal. We should not ignore this precious lesson of history by acting expeditiously. We can tackle issues before we are forced to do so.

I commend this Study for its in-depth analysis to all those who are interested in aviation, and wish to express my deepest appreciation to the authors of the study. Their vision will guide the policy of civil flights in space for the years to come.

Assad Kotaite
President Emeritus of the ICAO Council

Executive summary

The rise of the international commercial space sector from low Earth orbits to geosynchronous orbits is transforming the use of space. More actors have increased access for a greater number of activities in space. Yet their proliferation creates a commensurate amount of safety risks – for the general public (on the ground, in the air, and on the surface of the sea), spaceport personnel, space objects, human beings and property in orbit. Environmental accidents pose a threat, as does the ever-increasing amount of space debris and uncontrolled spacecraft re-entry.

There are significant differences between the regimes governing air navigation and space activities. A number of legal issues remain unresolved. Most notably, which regime controls a hybrid vehicle that behaves as an aircraft for one part of its mission and a spacecraft for the other? If a vehicle encounters a problem on the way to space but is still in airspace, to which regimes do those involved look for answers regarding liability? For that matter, where does space actually begin?

This Study addresses the question of whether the extension of the mandate of an existing intergovernmental aviation organization, the International Civil Aviation Organisation (ICAO), is the most appropriate means to initiate and manage regulatory and safety issues for civil and commercial spaceflight up to and including geosynchronous orbits, also considering the growing importance of space-based safety critical services (e.g. for navigation).

To best answer this inquiry, the Study employs the following methodology. First, it describes current regulations and standards bodies that either have developed, or are developing, with regard to space activities, providing an overview of these entities and their activities, be they domestic or international. Next, it assesses the (in)adequacy of the contemporary regime of regulatory protection and promotion of space safety. Further examination is extended to existing international regulatory frameworks in other similar international activities, such as the ITU (International Telecommunication Union) and the IMO (International Maritime Organization) for maritime shipping.

Subsequently, ICAO is analyzed thoroughly and carefully, as it is the entity responsible for promulgating the rules, regulations, procedures and standards that ensure a safe and viable aviation industry. The conflicts between the legal regimes for air and space are identified, including the ongoing functionalist/spatialist debate and the ambiguity regarding definition of an aircraft and a space object and boundary between air space and outer space. This detailed

scrutiny of ICAO includes a discussion of a transition to a new aerospace law, how to extend ICAO's current mandate to include jurisdiction over space activites, and the feasibility of expanding current aviation space traffic management to include suborbital flights.

Finally, in order to understand precisely what a new or extended regime would be regulating, safety issues pertinent to aerospace activities are described in great detail, from launch site processing and ground safety to the launch itself. Ground, orbital, and suborbital risks are addressed, including collision, debris, and traffic management.

The Study led to the following main Findings and Conclusions.

Findings

1. At present, there are no common safety standards and procedures for space operations, thus the public worldwide is not equally protected from the risks posed by launching, over-flying and re-entering space vehicles.
2. Current activities in space are unsustainable in the long term without uniformly implemented debris mitigation measures, well coordinated debris remediation operations, and global space traffic management (STM).
3. The focus of the regulatory regime should be on enhancing the safe and efficient use of space by all actors and the long-term sustainability of Earth orbit without imposing undue restrictions that stifle innovation and commercial development. It should not be so onerous that it undoes benefits for Earth by limiting potential for use.
4. There is no territorial sovereignty or national control in international common spaces such as outer space, the high seas, and international airspace, but only outer space is left without any form of international safety coordination. Furthermore no mutual aid provisions exists for space missions emergencies.
5. It is necessary to traverse airspace to get to outer space. Often this is the international airspace because, many launches occur from locations that are contiguous to the oceans for safety reasons.
6. ICAO already provides ATM, thorough its SARPs, to aircraft in airspace over the high seas (i.e. 72% of the airspace).
7. The prevailing functionality of a vehicle, safety of people on the ground, accumulated knowledge, and best practices in the most closely related fields should drive efforts to classify vehicles.
8. There is a current trend to operate aero-spacecraft from dual-use (airport/spaceport) ground infrastructure.

Conclusions

1. ICAO is a fully experienced and operational legislative and implementing intergovernmental body ideally suited for taking up the issues identified in this Study in relation to aerospace activities.
2. ICAO has in place detailed rules, regulations, guidelines, and operational procedures for aviation that could be gradually extended to space with the necessary modifications.
3. Initially relevant ICAO Annexes should be amended and/or new Annexes should be adopted by ICAO Council in order to address issues such as, *inter alia*, licensing of spaceports, human space flight, space traffic management, safety of personnel and astronauts, and security.
4. Eventually, as the need arises, the Chicago Convention should be appropriately amended to fully establish ICAO's jurisdiction over relevant space activities.
5. It is better to address these issues proactively than retroactively before threats and hazards to public safety become intolerable; now is the appropriate time.
6. A proposed STM regime, to prevent collision between space objects and of space objects with space debris, must be based on a technologically advanced and globally shared space situational awareness system. Such a regime must have its roots in existing international space law, particularly equal rights to space and freedom of use.
7. An international STM organization must be established primarily for the civil and commercial use of outer space and not appended to, or negotiated with, space arms control or disarmament.
8. ICAO's system is sufficiently sophisticated to effectively process these various STM regulatory needs. It is necessary to appropriately classify suborbital (aerospacecraft) vehicles before they begin flying commercially, though yet difficult to do so because of a lack of standard definitions.

Based upon these Findings and Conclusions, a regulatory model is proposed at the end of this Study, outlining the structure of an ICAO for Space organization and how best it should eventually be established and implemented.

To facilitate extension of ICAO's mandate, the following actions would be helpful:

1. A study of the experience gained by those countries which have already established a national licensing system for commercial space operations should be undertaken.
2. Exploration of methods of linking/merging the ITU information/notification system with an improved UN registration system, with the goal of a unified international notification/information system.

3. Further inquiry into the interests and expectations of private actors and costs and benefits of a global STM system into commercial activities is necessary.
4. A study should be made of the latest trends in technical international organizations regarding the adoption of safety technical regulations/standards, to provide more flexibility than the traditional system of negotiation and ratification.
5. Exploration of policy and regulatory initiatives to achieve and maintain common safety standards and avoid "flags of convenience".

Commencement of these actions would also facilitate timely and smooth introduction of emerging human suborbital and orbital spaceflight international services and eventual implementation of the overall model regulatory regime as suggested by this Study.

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The contents of this Study are developed with the intention of initiating international discussion on the subject and do not necessarily reflect the

personal views or opinions of the members of the ICAO for Space? Working Group, the editors, researchers and reviewers of this Study. Neither do they represent the official views of any organizations with which they may be associated or affiliated.

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List of acronyms

A
ADS: Automatic Dependent Surveillance system
ADS-B: Automatic Dependent Surveillance-Broadcast
AIAA: American Institute of Aeronautics and Astronautics
ATM: Air Traffic Management

C
CAIB: Columbia Accident Investigation Board
CEOS: Committee on Earth Observation Satellites
CINA: *Commission Internationale de la Navigation Aérienne*
CoC: Code of Conduct
COPUOS: United Nations Committee on the Peaceful Uses of Outer Space
COTS: Commercial-Off-The-Shelf
CNES: *Centre National d'Études Spatiales* (French Space Agency)
CSG: *Centre Spatial Guyanais* (Guyana Space Centre)

D
DARPA: Defence Advanced Research Projects Agency of the U.S.
DOD: Department of Defence of the U.S.
DSTs: Decision Support Tools

E
EEZ: Exclusive Economic Zone
ELV: Expendable Launch Vehicle
ESA: European Space Agency
EU: European Union
EVA: Extra-Vehicular Activity

F
FAA: Federal Aviation Administration of the U.S.
FAA-AST: Office of Commercial Space Transportation of the U.S. FAA
FSOA: French Space Operations Act of 2008

G
GALILEO: Satellite Navigation System of the EU and ESA
GEO: Geosynchronous (Geostationary) Earth Orbit
GLONASS: Satellite Navigation System of Russia
GNSS: Global Navigation Satellite System

GPS: Global Positioning Systems of the U.S.
GSE: Ground Support Equipment

I

IAA: International Academy of Astronautics
IAASS: International Association for the Advancement of Space Safety
IADC: Inter-Agency Space Debris Coordination Committee
ICAO: International Civil Aviation Organization
ICAN: International Commission for Air Navigation
ISFO: International Space Flight Organization
IMO: International Maritime Organization
ISO: International Organization for Standardization
ISS: International Space Station
ITU: International Telecommunication Union

L

LAAS: Local Area Augmentation System
LEO: Low Earth Orbit

M

MOL: Manned Orbiting Laboratory

N

NAS: National Airspace System
NASA: National Aeronautics and Space Administration of the U.S.
NRC: National Research Council of the U.S.

R

RFI: Request for Information
RCC: Range Commanders Council of the U.S.
RLV: Reusable Launch Vehicle
RORSATs: Radar Reconnaissance Satellites of the Soviet Union
RTS: Radio Thermal Generator

S

SMS: Safety Management System
SAR: Search and Rescue
SARPs: Standards and Recommended Practices adopted by the ICAO Council as Annexes to the Chicago Convention
SATMS: Space and Air Traffic Management System of the U.S. FAA
Space Shuttle: Space Transportation System of the U.S.
SSA: Space Situational Awareness
STM: Space Traffic Management

W

WAAS: Wide Area Augmentation System

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