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The Editors believe the papers included in this book will contribute to discussion on the subject matters covered. However, the contents of this book neither represent the views or opinions of the Editors nor of the organisation with which they are affiliated. The authors are exclusively responsible for the contents of their papers as well as propriety of any material used in this book.

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LIST OF ABBREVIATIONS

AGA	Aerodromes and Ground Aids (section, of ICAO)
ANS	Air Navigation Systems
ATC	Air Traffic Control
ATM	Air Traffic Management
CAA	Civil Aviation Authority
CSLA	(US) Commercial Space Launch Act
CSOWG	(UK CAA) Commercial Space Operations Working Group
EASA	European Aviation and Safety Agency
EDA	European Defence Agency
ESA	European Space Agency
EU	European Union
FAA	(US) Federal Aviation Administration
FAA-AST	(US) Federal Aviation Administration-Office of Commercial Space Transportation
FIRs	Flight Information Regions
FL	Flight level
HAPS	High altitude platform systems
HTHL	Horizontal takeoff /horizontal landing
IAASS	International Association for the Advancement of Space Safety
IADC	Inter-Agency Space Debris Coordination Committee
IASL	(McGill University) Institute of Air and Space Law

IASTA	International Air Services Transit Agreement
ICAO	International Civil Aviation Organization
ICJ	International Court of Justice
IFR	Instrument Flight Rules
IMO	International Maritime Organization
ISO	International Standards Organization
ISS	International Space Station
ITU	International Telecommunication Union
JAA	Joint Aviation Authorities
kg	kilogramme(s)
LEO	Low Earth Orbit
LIDAR	Laser Interferometry Detection and Ranging
MTOW	maximum take-off weight
NASA	National Aeronautics and Space Administration
NAS	National Airspace System
NOTAM	Notice to Airmen
OA	Orbital aircraft
OST	Outer Space Treaty
PAROS	Prevention of an arms race in outer space (UNGA resolution)
POC	Point of Contact
REMAT	Regulation of emerging modes of aerospace transportation
RPA	Remotely piloted aircraft
RPAS	Remotely piloted aircraft systems

SARPS	(ICAO) Standards and Recommended Practices
SDA	Space Data Association
SDRs	Special Drawing Rights
SFR	Space Flight Rules
SOA	Sub-orbital and Orbital Aircraft
SoA	Sub-orbital Aircraft
TCAS	Traffic alert and collision avoidance system
TFEU	Treaty on the Functioning of the European Union
UAS	Unmanned Aircraft Systems
UAV	Unmanned Aerial Vehicle
UN	United Nations
UNCOPUOS	United Nations Committee on the Peaceful Uses of Outer Space
UNEP	United Nations Environmental Programme
UNGA	United Nations General Assembly
OOSA	United Nations Office for Outer Space Affairs
US	United States
USSR	Union of Soviet Socialist Republics
UK	United Kingdom
UKSA	United Kingdom Space Agency
VCLT	Vienna Convention on the Law of Treaties
VFR	Visual Flight Rules
VTOL	Vertical take-off and landing
VTVL	Vertical take-off/ vertical landing
WMO	World Meteorological Organization

PREFACE

Many remarkable achievements have been made in the evolution of both air and space transportation systems over the last few decades. Space transportation systems continue their rapid technological and commercial development. The long-standing issue surrounding the international legal boundary between the airspace and outer space legal regimes has become even more pressing due to the emergence of aerospace transportation systems, i.e. vehicles that are capable of seamless operation within both airspace and outer space. As these new and emerging modes of aerospace transportation continue to develop, it is envisaged that they will soon be used in regularly transporting people and freight from point-to-point on the surface of the Earth through airspace and outer space.

Since the trajectory followed by an aerospace vehicle will normally cut through portions of airspace and outer space, it would be subject to different international legal regimes depending on where it is located on the trajectory at any point in time. Thus, an aerospace vehicle could be considered to be an aircraft while flying in airspace. The same vehicle could also be considered to be a space object when passing through outer space. This duality of identity and classification of aerospace vehicles raises several important questions and unprecedented challenges related to—only to mention a few— the safety of both aviation and space transportation, navigational and communication services, airworthiness and space worthiness, personal training and certification, use of aerodromes and spaceports, traffic rights, liability for damage and injury, and the scope

of jurisdiction of international organizations, such as the International Civil Aviation Organization (ICAO), as well as national regulatory authorities.

Since its establishment in 2004, the International Association for the Advancement of Space Safety (IAASS) has promoted the ICAO set-up as the most suitable model for organising and coordinating commercial and civil space operations internationally. The Association has even pushed the idea that ICAO could one day become the sole world agency for the regulation of safety and environmental protection in both domains of aviation and space. Civil and commercial space operations need to be organised internationally, but why duplicate by creating a separate organisation while aviation and space share so many intertwined interests? After all, integrating aviation and space regulatory bodies in a single organisation is truly not a completely new idea. For almost two decades, the US aviation regulatory body, the Federal Aviation Administration (FAA), has shouldered the responsibility to regulate commercial space transportation. It is the FAA that licenses the launch and return of commercial cargo and crew vehicles to the International Space Station.

Currently, only a few countries regulate space activities performed by their nationals or originating from their territory. Furthermore, although space safety risks are international in nature, those countries act unilaterally. Today, space is probably the only realm of human activities in which one country manages the risk of its own operations on foreign populations, without any consultation with the affected countries or in accordance with internationally agreed rules. As a matter of fact, harmonisation and cooperation were not the aims the international space treaties signed several decades ago. They were simply aimed to avoid interferences between the players of the time,

primarily the United States and former Soviet Union, and to avoid the appropriation of celestial bodies. A completely different reality existed at that time which differs greatly from the multitude of parties and organisations which operate in space today.

In 2006, the IAASS formed a working group called “An ICAO for Space?” to make the case for organising space on the ICAO model. It moved from the aforementioned considerations of intertwined operations (and common risks). First, space-bound and returning traffic often crosses international airspace under ICAO jurisdiction (i.e. the airspace above international waters); second, key components of the aviation infrastructure, like navigation systems and communications, are being moved to space; and third, new vehicles are emerging with the capability to operate in both domains: from ground to orbit and back, and point-to-point.

As the IAASS working group progressed, reports were periodically presented at IAASS international safety conferences. At the Conference of 2007 in Chicago, the NASA Associated Administrator for Safety and Mission Assurance, Bryan O’Connor, suggested that advocating the establishment of an organisation on the model of ICAO, or extending the ICAO mandate, would be a long and difficult process because of possible resistance of some countries. Instead he recommended a bottom-up approach of first developing international space safety standards as voluntary consensus standards. The IAASS decided therefore to pursue both directions concurrently. The IAASS drafted a study Memorandum of Understanding (MoU) titled “Concerning Cooperation on Civil and Commercial Space Safety Standards”, which was informally discussed with the heads of safety at NASA, European Space Agency (ESA) and JAXA in the course of an annual trilateral space safety

meeting. Later, NASA discussed the proposal with the FAA Office of Commercial Space Transportation, and jointly raised the issue to the US Department of State. In September 2008, an official letter arrived from the US Department of State, which stated that although supportive of the IAASS as professional forum, the US considered the detailed proposal on international space safety standards premature. The IAASS MoU was put on hold and later reformulated as a possible cooperative initiative among industries.

In 2011, with encouragement and support of the European Space Policy Institute (ESPI), Springer published the IAASS-McGill University book on “The Need for an Integrated Regulatory Regime for Aviation and Space: ICAO for Space?”, edited by Ram S. Jakhu, Tommaso Sgobba and Paul S. Dempsey.

Then, on the initiative of McGill University's Institute of Air and Space Law, an international conference was organised in collaboration with the International Civil Aviation Organization (ICAO), the International Association for Advancement of Space Safety (IAASS) and the International Foundation for Aviation, Aerospace & Development (IFFAAD). The *1st Manfred Lachs Conference on the Regulation Emerging Modes of Aerospace Transportation* was convened on 24 and 25 May 2013 in Montreal, Canada. The myriad of issues and challenges related to air and space transportation systems are not restricted to any one discipline. As such, an international and interdisciplinary approach is required in order to objectively examine and appropriately address matters related to the technological, economic, social, legal and policy developments in this budding field of human activity.

The main objectives of the Conference were to:

- (a) assess the current situation and future plans for aerospace transportation;
- (b) critically examine and identify precisely the regulatory challenges to operation of aerospace vehicles; and
- (c) suggest viable policy and regulatory steps (mechanisms) that may be considered by States and other stakeholders to facilitate aerospace transportation and to ensure the safety of global aviation.

At the Conference, it was agreed in principle that a Study Group under the lead of IAASS would be proposed to the ICAO Council to draft a manual which may in time become the forerunner of future standards and guidelines on commercial human spaceflight safety.

The Conference was attended by almost a hundred participants and speakers delivered close to thirty presentations, which were discussed following Chatham House rules.

This book, which is in fact the Proceedings of the Conference, contains some of the papers that were delivered and brief summaries of the discussions that took at the Conference. These papers, though not peer-reviewed, are of high quality and direct relevance to the theme of the Conference.

The book opens with keynote addresses by Ms. Nancy Graham, the Director of ICAO's Air Navigation Bureau; Mr. George Nield, Associate Administrator for Commercial Space Transportation at the FAA; and Dr. Tomasso Sgobba, the Executive Director of the IAASS. The introductory remarks by representatives from institutions with an interest and strong influence in the regulation of aerospace transportation highlight the importance of further research and discussion in this field of study. This is followed by five sections, each focusing on a particular aspect of aerospace transportation, and a summary of the discussions that took place.

Part One opens with an overview of a new curriculum offered at Embry-Riddle Aeronautical University, which specifically aims to foster talents for the nascent commercial space industry. The second article outlines the historical beginnings and future strategy of Spaceport Malaysia in providing leadership in a country without a space travel culture and the proper infrastructure for space travel.

Part Two illustrates the "Big Picture" and brings together experts to share their views on the extent to which the current regulatory regime governing international air transportation is relevant to aerospace transportation. The first article illustrates the various issues and concerns that will require new or integrated processes to regulate new commercial services involving space transportation and high altitude systems. This is followed by a paper outlining how problems with the legal definition of concepts such as space transportation, space tourism and space transportation will have bearings on clarifying issues related to liability and traffic rights. The adequacy of the existing international regulatory regime to govern aerospace transport, and specifically matters related to the allocation of liability and

insurance, is the focus of the third article in this section. The section concludes with an overview of regulatory challenges to suborbital flights in the light of different approaches and theories that have been proposed to address the delimitation of the boundary between outer space and airspace.

Part Three opens with a contribution outlining the successful integration of commercial space activities into the US' national airspace system by the Federal Aviation Administration. The second article addresses the regulation of aerospace vehicles and what appropriate and integrated "rules of the road" (or rather "rules of the air") should apply.

Part Four of the book begins with two contributions addressing how existing ICAO standards and recommended practices (SARPs) on the design and operation of airports are applicable to emerging aerospace transportation systems, especially as much of the ground infrastructure are similar and can potentially be shared. Annex 14 to the Chicago Convention is instrumental in this regard. This section then concludes with the perspective from the United Kingdom (UK), with discussions on how the UK has been trying to attract commercial operators and what approach is optimal in balancing the divergent industry, public and government interests involved in the operation of transportation systems that operate partly in airspace and partly in outer space.

Part Five lays out the efforts of the US FAA's Office of Commercial Space Transportation in encouraging the development of commercial orbital and suborbital transportation. This is followed by a contribution which illustrates the regulatory framework across the Atlantic which centres around the European Aviation Safety Agency (EASA). The European perspective is continued with an article outlining the development of Remotely Piloted Aircraft Systems (RPAS), the regulatory approach of which

is currently undergoing discussion at ICAO and which may serve a paradigm shift beyond the traditional separation between air and space law. This section concludes with a contribution highlighting the Chinese perspective on the age-old matter of the delimitation between airspace and outer space, and the important matter of the right of passage through airspace which will no doubt be pertinent to emerging modes of aerospace transportation.

The book concludes with brief summaries of the discussions that took place during the two-day event, which serve to highlight the great interest, concerns and prospect for future discourse that the development aerospace transportation attracts.

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