Ruwantissa Abeyratne

Aviation in the Digital Age

Legal and Regulatory Aspects

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Preface

At the time of writing, news media reported that Google had teamed up with AirAsia to establish "AirAsia Google Cloud Academy" which will be managed by AirAsia's venture arm, RedBeat Ventures, and will offer courses including digital marketing, software engineering, and tech infrastructure design all of which will be accredited by Google. One does not need any further evidence that aviation has entered the digital world. Also at the time of writing, the Convention on International Civil Aviation (Chicago Convention) which was signed in December 1944 and entered into force in April 1947 was 72 years in application. Having been conceived in the twentieth century and being still considered as relevant in the twenty-first century is no mean feat. At the same time, one has to consider the words of Antoine de Saint-Exupery who said: "to grasp the world of today we are using a language made for the world of yesterday. . . ." Aviation has entered the world of digital technologies, transcending the earlier world of information and communication technologies (ICT), where digital technologies bring with them a whole new vocabulary of data, algorithms, and machine learning. Jamie Susskind in his book *Future Politics* says: "In the digital lifeworld, technology will permeate our world, inseparable from our daily experience and embedded in physical structures and objects that we never regarded previously as 'technology'. Our lives will play out in a teeming network of connected people and 'smart' things with little meaningful distinction between human and machine, online and offline, virtual and physical. . . ." Susskind says convincingly that three factors will dominate our world: increasingly capable systems, increasingly integrated technology, and increasingly quantified society. There is no room for doubt that aviation is in the throes of these three factors.

The Chicago Convention—as the fundamental constitution of international civil aviation—talks of concepts such as sovereignty, admissibility of persons into countries, documents carried on board aircraft, registration of aircraft, accident investigation, and search and rescue—just to name a few, all of which may have to be associated and viewed one way or other through the prism of systems, technology, and a quantified and connected society. Just one example of the intrinsic link between aviation and the digital world is Blockchain—a relatively new

technological initiative in the business process—which promises "smart contracts" and is shaping modern business management in how businesses are managed and how value is created within enterprises, bringing to bear a distinct correlation between aviation and Blockchain. Inasmuch as the internet moves information and transmits the flow of data, Blockchain moves value which could assist industries in aviation to transact business faster and improve tracking of passengers and freight while eliminating transaction costs. The networks based on Blockchain serve products and services better, making it a better tool for molding the air transport product and enabling airports to become "smart airports." Blockchain could well be the platform in various areas of aviation and is insulated from deleterious hacking, thereby offering security and immutability.

IT helps airlines and airports to improve their competitiveness by both improving their efficiency and reducing their operating costs. For the most part, airlines now achieve these objectives by migrating their services to Cloud Computing, which Eric Griffith defines in PCMag as "storing and accessing data and programs over the Internet instead of a computer's hard drive. The cloud is just a metaphor for the Internet. It goes back to the days of flowcharts and presentations that would represent the gigantic server-farm infrastructure of the Internet as nothing but a puffy, white cumulus cloud, accepting connections and doling out information as it floats." Cloud—which is a buzzword for optimizing services through the IT network—helps airlines in both their connectivity and the improvement of their services to the passengers and other clients they serve.

Airports, in a similar vein, use IT applications such as Cloud Computing, Big Data, and the Internet of Things for connectivity and making efficient their information flows. Airports are also tremendously benefitted by the use of IT—in particular Artificial Intelligence (AI)—in developing deep learning algorithms for risk-based assessment of threats posed by potentially dangerous goods and substances. Kevin Riordan, Head of Airports and Checkpoint Solutions at Smiths Detection says: "[T]he application of deep learning algorithms for automated threat detection requires the availability of a considerable image database, categorized in threats and unsuspicious images. Deep learning algorithms scan this information to learn which objects are potentially harmful and which are benign."

One must also not forget that in this chain of the aviation industry, there is also the air navigation services industry which provides air traffic control. This industry now relies heavily on information and communications technology for efficient and timely communications integration and management and quick decision-making.

At the core of the approach by both airlines and airports in their reliance on IT is their relentless focus on the passenger, which is reflected in New Experience in Travel Technologies (NEXIT)—a joint program developed by the two global associations representing the air transport industry and the airport industry—namely the International Air Transport Association (IATA) and Airports Council International (ACI). This program is a direct response by these two associations to the steadily rising passenger numbers. Sarah Samuel, Head of Airport IT for Asia-Pacific at Amadeus says: ". . .the programme highlights the need for airports to focus on how

the latest in digital technology can create a seamless flow through the airport and help to integrate systems and services."

Of major importance to this (IT) megatrend in aviation is the statement by Angela Gittens, Director General of ACI, which effectively binds all the elements in the equation when she says: "We (ACI) take an evidence and data-based approach to provide a voice for the world's airports in the formulation of regulation, policies, standards and practices." The keywords here are "regulation, policies, standards, and practices." In other words, the data-based approach adopted by all three industries—airlines, airports, and air traffic control services—must inevitably be accompanied by laws and regulations.

The corollary to any human practice or endeavor is the ominous possibility of things going wrong, and this potential risk must be taken into account when considering the promulgation of regulations or the adoption of standards and recommended practices. Harvard Business Review cites three possible concerns where humans would not comprehend how a machine reached a conclusion. They are: hidden biases cultivated by the machine through the learning process; since machines are mostly neural networks that work with statistical data, it would be difficult to think that the solutions given by a machine would work in every case, particularly where there are variables and random circumstances; and when a machine error occurs, it would be difficult to correct the error for the first concern cited—that humans may not understand how the machine came to its conclusion.

Max Tegmark, Professor of Physics at the Massachusetts Institute of Technology in his *book Life 3.0: Being Human in the Age of Artificial Intelligence* offers the following principles: the goal of AI should be to create not undirected intelligence but creative and beneficial intelligence; investments in AI should be accompanied by funding for research on ensuring its beneficial use, including thorny questions in computer science, economics, law, ethics, and social studies; there should be healthy and constructive exchange between AI researchers and policymakers; a culture of cooperation, trust, and transparency should be fostered among researchers and developers of AI; and teams developing AI systems should actively cooperate to avoid corner-cutting on safety standards.

Against this scenario, it would be advisable to evaluate the most prudent approach to the use of AI. While AI is proving to be an asset to human progress, with such innovations as Amazon's Alexa and Google's self-driving cars, it could be several decades before AI attains complete fruition, as discussed above, as a total replacement of biological intelligence. Thomas W. Malone in his book *Superminds* suggests using AI in combination with human intelligence where a collective intelligence could better serve humanity. Malone suggests hypoconnectivity between the 7.2 billion people of the world as the most important tool for the twenty-first century, where the optimal use of information technology could be a supplement to human intelligence in connecting the world.

The fact that airlines, airports, and air traffic management are using information and communications technology in the advancement of their activities and in coping with the exponential rise in demand for air transport leaves no room for doubt that they are on the right track. However, they must not disregard the fact that law and

regulation are key elements in managing data flows and ensuring that whatever the buzzwords might be in modern technology and science, and however much they would facilitate the functioning of a rapidly changing world, they must be properly regulated.

Under these circumstances and in the face of a rapidly changing world, should we have a new look at the Chicago Convention and the interpretation of its key provisions in the context of rapidly developing technological changes? Or should we stick to the original intent of the forefathers of the treaty? Originalism has been the last refuge of interpreters of the Convention who try to go back to what the framers of the treaty may have intended international civil aviation to be at its incipient stages. Of direct analogy is the ongoing debate as to whether the United States Constitution, which is nearly 350 years old, should be interpreted and applied according to the will of the drafters of the Constitution or whether it should be applied to accord with modern exigencies of society. Jurists in the USA are divided. The originalists argue that "a jurisprudence seriously aimed at the explication of original intention would produce defensible principles of government that would not be tainted by ideological predilection. This belief in a jurisprudence of original intention also reflects deeply rooted commitment to the idea of democracy." On the other hand, progressive jurists of the last century were of the view: "We current justices read the Constitution in the only way we can: as twentieth century Americans. We look to the history of the time of framing and to the intervening history of interpretation. But the ultimate question must be: what do the words of the text mean in our time? For the genius of the Constitution rests not in any static meaning it might have had in a world that is dead and gone, but in the adaptability of its great principles to cope with current problems and current needs."

This last statement (made in the last century) resonates all the more in the current century in the context of the interpretation of the Chicago Convention. This is not to say that the treaty itself is outdated. Rather, what is true is that it has to be seen as the instrument of vision it is and its ability to adapt and cope with "current problems and current needs." For this to be achieved within the parameters of a meaningful discussion, firstly, the current issues, problems, and needs of the world as represented by the digital age we are in must be discussed. It is only then that the applicable provisions of the Chicago Convention would appear relevant. This is precisely what this book will endeavor to do, with a view to evaluating whether originalism has any value in the application of the Convention to aviation in the digital age.

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February 2020

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Aerospace and Its Limits

1.1 Introduction

In the current digital age and in the future, activities in outer space will have a critical bearing on air space and the operation of aircraft. Now more than ever before, it becomes necessary to discuss demarcation of air space and outer space for purposes of establishing jurisdiction in the determination of acts performed in both strata. Digital applications in outer space would have an increasing bearing on commercial aircraft.

Patricia Lewis, Research Director at the Royal Institute of International Affairs—otherwise known as Chatham House—in her essay "Create a Global Code of Conduct for Outer Space" sagely suggests that: "A cross-regional group of like-minded countries (for example Algeria, Canada, Chile, France, India, Kazakhstan, Malaysia, Nigeria, Sweden, the UAE and the UK) should link up with UN bodies, including the Office for Outer Space Affairs (UNOOSA), COPUOS and ITU, and key private-sector companies to kick-start a new process for a global code of conduct to establish norms and regulate behaviour in space".

The problem is that there is no internationally recognized definition, scope or parameters of "outer space".

The Outer Space Treaty of 1967—the principal international treaty governing matters in "outer space"—does not contain any definition, nor does any other treaty enlighten us on the matter. The Treaty merely provides, in Article 1 that the exploration and use of outer space, including the Moon and other celestial bodies, is required to be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and must be the province of all mankind. The treaty goes on to say that outer space, including the Moon and other celestial bodies, is free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and that there will be free access to all areas of celestial bodies. Freedom

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of scientific investigation in outer space, including the Moon and other celestial bodies is encouraged, and States are expected to facilitate and encourage international cooperation in such investigation.

There is just one snag: without knowing what "outer space" is, how can one even conceive of the implementation of this and other provisions of the Outer Space Treaty? Although the "spacialist" approach to this question calls for a demarcated boundary between air space and outer space, any attempt by its proponents has been thwarted by the perceived reluctance of States to tie themselves to a globally accepted principle that would define parameters of outer space linked to their sovereignty. This reluctance would of course be for geopolitical reasons. Adam Ward, Deputy Director of Chatham House correctly points out in his essay "Adapt or Die": "The concept of the 'rules-based international order' refers today in its most general sense to arrangements put into place to allow for cooperative efforts in addressing geopolitical, economic and other global challenges, and to arbitrate disputes".

Air law clearly dictates that each State has complete and exclusive sovereignty over the air space above its territory. "territory" is defined as the land areas and territorial waters adjacent to the State concerned. The term "territorial waters" is defined at maritime law as a 12 nautical mile radius around the land area of a State. The issue now is to decipher when air space ends and outer space begins. There are several theories that have been put forward on this issue. The first is the "functionalist theory" which states that a single regime should apply throughout a flight and be calculated based on the delimitation or definition of the air space/outer space regime founded on the purpose and activities for which an object is designed in air space or outer space. Then there is what is called the "arbitrarist" approach where some have recommended that the demarcation between air space and outer space should be decided by drawing an arbitrary line between air space and outer space.

The Bogota Declaration of 1976 was signed by 8 States traversed by the Equator (Brazil, Colombia, Congo, Ecuador, Indonesia, Kenya, Uganda and Zaire which is now the Democratic Republic of Congo) which provides inter alia that the geostationary synchronous orbit (GSO) is a physical fact linked to the reality of planet Earth because its existence depends exclusively on its relation to gravitational phenomena generated by the earth. Therefore, GSO would not be considered as being conducted in outer space. This means that the States signatories to the Bogota Declaration claim sovereignty on GSO carried out over their territories on the following principles: The sovereign rights put forward by the equatorial countries are directed towards rendering tangible benefits to their respective people and for the universal community, which is completely different from the present reality when the orbit is used to the greater benefit of the most developed countries. The segments of the orbit corresponding to the open sea beyond the national jurisdiction of states will be considered as common heritage of mankind. Consequently, the competent international agencies should regulate its use and exploitation for the benefit of mankind.

The Bogota Declaration goes contrary to an approach suggested by some that outer space should begin at the lowest point of orbital flight. This approach suggests

that sovereignty should extend to the lowest height at which an object requires to enter into orbit and circle the Earth. That point has been variously put between 70 km and 160 km.

The signatories do not object to the free orbital transit of satellites approved and authorized by the International Telecommunications Convention, when these satellites pass through their outer space in their gravitational flight outside their geostationary orbit; the devices to be placed permanently on the segment of a geostationary orbit of an equatorial state requires previous and expressed authorization on the part of the concerned state; and the operation of the device should conform with the national law of that territorial country over which it is placed. The said authorization is different from the co-ordination requested in cases of interference among satellite systems, which are specified in the regulations for radiocommunications. The authorization refers in very clear terms to the countries' right to allow the operation of fixed radiocommunications stations within their territory.

Another theory called the "Usque ad Infinitum" theory posits that sovereignty of a State should extend beyond any altitudinal bounds. This has been criticized as being both arbitrary and ambivalent. The "national security and effective control" theory on the other hand suggests that state sovereignty should extend as far out as the subjacent state could exercise effective control. This is based on the argument that state sovereignty extends to any point in outer space if activities conducted therein affect state security or human welfare.

Finally, there is the "aerodynamic lift" theory which recommends that outer space should begin at the point at which an aircraft cannot operate with aerodynamic lift. It is known that with increasing altitude the density of air, as well as the upward pressure of air, decrease and ultimately come to a point where in the complete absence of air, an aircraft would not be able to fly. This is the point, according to the aerodynamic lift theory, where outer space should begin.

All the above mentioned theories have been rejected due to various perceived inadequacies and flaws. For example, the aerodynamic lift theory has been rejected on the ground that the absence of air cannot be clearly identified with an altitudinal limit and that there could be areas in outer space where pockets of air may be found. The Usque ad Infinitum theory has been debunked for obvious reasons. The Bogota Declaration applies only to eight Equatorial States.

We seem to be back to the current "do nothing" approach that many have suggested, which seemingly prevails.

1.2 Jurisdictional Issues

At the time of writing it was reported that It has been reported that The National Aeronautics and Space Administration (NASA) is investigating an alleged crime—the first reported from the International Space Station (ISS)—by one of the personnel on board who accessed the bank account of her estranged spouse while on mission in ISS. ISS is defined as "a co-operative programme between Europe, the United States,

Russia, Canada, and Japan for the joint development, operation and utilisation of a permanently inhabited Space Station in low Earth orbit. The legal framework defines the rights and obligations of each of the countries and their jurisdiction and control with respect to their Space Station elements".

ISS is driven by a legal framework within the purview of what is called The International Space Station Intergovernmental Agreement, otherwise known as 'the IGA'. IGA was signed on 29 January 1998 by the fifteen governments involved in the Space Station project. Article 1 of this treaty provides that it is based on "a long term international co-operative frame-work on the basis of genuine partnership, for the detailed design, development, operation, and utilisation of a permanently inhabited civil Space Station for peaceful purposes, in accordance with international law".

Article 5 of IGA allows the Space Station Partners States to extend their national jurisdiction in ISS, stating that "'each partner must retain jurisdiction and control over the elements it registers and over personnel in or on the Space Station who are its nationals'". This incontrovertibly vests jurisdiction on The United States of which the astronaut concerned is a citizen.

The IGA is implemented through four Memoranda of Understandings (MoUs) between NASA and each co-operating Space Agency: European Space Agency (ESA), Canadian Space Agency (CSA), Russian Federal Space Agency (Roscosmos), and Japan Aerospace Exploration Agency (JAXA). Canada has promulgated its own legislation called Civil International Space Station Agreement Implementation Act of 1999. However, the author could not find evidence of any such legislation or instrument of ratification by the United States in addition to IGA and the four MoUs.

It is assumed that such instruments exist or that the aforementioned documents would suffice under United States law if the authorities pursue action against the astronaut. Clearly, the person suspected of the offence is not an astronaut by definition.

Liability of an astronaut is based on the accepted legal premise that astronauts, by virtue of the Outer Space Treaty of 1967 are designated as "envoys of mankind in outer space", casting on them the responsibility of adhering to applicable treaty provisions on behalf of their States. The Treaty provision is a reproduction verbatim of Paragraph 9 of United Nations General Assembly Resolution XVIII of 1962. Although initially, the world's "envoys of mankind" seemingly created some apprehension in the international community as to whether such phraseology connoted diplomatic immunity to astronauts, academics have cleared up this ambivalence by concluding that it was only a figure of speech which has not been repeated in any United Nation's documentation yet. The perceived inadequacy of definitive identification at international law of an astronaut and her conduct in outer space leaves one with the realization that IGA and its legal regal regime has decidedly and effectively precluded any room for doubt by the use of "personnel" instead of "astronaut" in Article 5 of the IGA.

The above facts leave one with a dichotomy: If astronauts are defined as "envoys of mankind in outer space", what is "outer space"? In an earlier article in this journal

I grappled with the numerous theories that have been propounded in the absence of a definition of outer space. Confusion is worse confounded by the fact that the ISS is orbiting the earth at an altitude of about 400 km which puts it right inside the thermosphere which is the layer of the Earth's atmosphere directly above the mesosphere and directly below the exosphere. Therefore, it may be argued that ISS is not in outer space, in which case the person faced with criminal charges in the context of this article could not be called an astronaut by definition.

Therefore, it is arguable that this is not a crime in space. The fact that a separate legal regime in the form of IGA exists to address legal issues concerning IGA is evidence enough. For outer space a separate regime under the Article VIII of the Outer Space Treaty of 1967 exists which provides that a State party to the Treaty on whose registry an object launched into outer space is carried must retain jurisdiction and control over such object, and over any personnel thereof, while in outer space or on a celestial body.

As a side note, it must be noted that the first "space tourist" Denis Tito was called a space tourist for purposes of public reference by the media. He was called a "guest cosmonaut" by the Russians and an amateur astronaut by the Americans. The interpretation of Article VIII could well result in ambivalence and confusion. The "object" and "personnel" referred to in the Treaty provision do not adequately cover persons who are not "personnel" such as passengers in a spacecraft. Of course, as some maintain, the quasi jurisdiction of the State of registry of the spacecraft can apply both in the instance of conduct in the spacecraft as well as outside the spacecraft on the basis that the astronaut concerned would be deemed to belong to the spacecraft at all times in outer space. Logically, therefore, such jurisdiction could be imputed to passengers, visitors and guests by linking them to the spacecraft in which they travelled. This far reaching generalization would then cover the conduct of an astronaut or other persons while walking on the moon, Mars or other celestial body, as well as such persons who go on space walks outside the spacecraft in which they travelled.

Another provision which sheds some light on past attempts by the international community to identify liability and jurisdictional issues relating to astronauts is Article 12 of the Moon Treaty of 1979 which provides that States Parties must retain jurisdiction and control over their personnel, space vehicles, equipment facilities, stations and installations on the moon.

It is presumed that the legal link between the personnel and the spacecraft they travel in under the circumstances are imputed to the State of registry of the said craft. If this were not the case, and such a link cannot be established, the provision itself becomes meaningless and destitute of effect.

All this is obviated under IGA.

Progress in the digital world would impact the space tourist who begins her space flight in the air, takes off from a spaceport and traverses airspace before leaving airspace. We are now at a time 50 years after the astronauts of Apollo 11 landed on the moon. On 16 July 1969, Apollo 11 took to the heavens carrying astronauts Neil Armstrong, Edwin "Buzz" Aldrin and Michael Collins. This was just 66 years after the Wright Brothers demonstrated that humans could use aerodynamic lift to fly

heavier than air aircraft. While Collins was orbiting, Armstrong and Aldrin walked on the Moon for 21 h creating history and demonstrating for the first time that humankind could have physical access to a celestial body. Fifty years on, we are on the cusp of sending humans to Mars with the ultimate hope of colonizing it.

By any modern standards of human endeavor and research, space transportation stands preeminent in the wonderment it offers. What began as exploration of outer space in the 1950s and 1960s is now opening out as full-blown tourism in space. Added to this is the startling possibility of the existence of life in outer space which makes us not only think but wonder in amazement. Stephen Hawking—the preeminent theoretical physicist—has stated that in a universe with 100 billion galaxies, each containing hundreds of millions of stars, it is unlikely that life forms are present only on Earth.

Against this bewildering backdrop, we continue to use and explore outer space, take pictures, calculate trajectories of planets and determine who owns the moon and what the purpose of outer space exploration is. An added dimension would be the use of aerospace in terrestrial transportation where an aerospace plane will take off as an aircraft, go into orbit, enter the atmosphere using the Earth's orbit into its destination, cutting the travel time significantly. It is said that by using this method, air travel time can be reduced drastically. For instance, a journey by air between Los Angeles and Sydney, which would now take 16 h by conventional air travel, could take 2 h or less. None of these technological feats would be possible without the advancement of information technology and computerized knowledge-sharing.

The prospect of space tourism looms ahead, making our minds soar with dreams of flights into the heavens. All this brings to bear the question as to how we should handle outer space given the dimensions envisioned. How would we handle space tourism?

Narrowly defined, the word "tourism" means travel for recreation or instruction, often in organized groups. The tourism industry primarily provides the tourist with travel to the destination and thereafter provides accommodation usually in a commercial establishment that provides lodging, food, and other services to the public. Therefore, tourism is essentially associated with the transport and hospitality industries, where the hotel business features as an important industry which caters to people traveling for business or pleasure. When these factors are translated into exigencies of a viable space tourism industry, many considerations emerge, particularly from an extra-terrestrial perspective. The main issues are whether a commercially viable and sufficiently evolved space transportation program could be a reality in the near future and whether the infrastructure needed for establishing accommodation for a sustained tourism industry in the inhospitable terrain of outer space could be put into place. Some have suggested that space tourism is indeed a realistic goal in the near future particularly if a space program were calculated to create permanent settlements. The residents of such outposts would have to "live off the land," obtaining necessities such as oxygen and water from the harsh environment of outer space. For example, it has been suggested that on the Moon, pioneers could obtain oxygen by heating lunar soil. In 1998 the Lunar Prospector discovered evidence of significant deposits of ice—a valuable resource for settlers—mixed

with soil at the lunar poles. It is also thought that on Mars, oxygen could be extracted from the atmosphere and water could come from buried deposits of ice.

Space tourism, which would have been merely a dream and a cinematographic fantasy at best is fast becoming neither a fantasy nor just a nickname for conventional manned space flights. It is now considered a viable economic activity based on public demand. Dennis Tito and Mark Shuttleworth, both of whom traveled as tourists in space have already obviated any doubts regarding the immense possibilities of this activity. Space tourism is a term broadly applied to the concept of travel beyond Earth's atmosphere by paying customers. It can be defined to include not only the vehicles that take public passengers into space, but also from the perspective of the "destination" paradigm. As such, the industry can be envisioned to include earth-based attractions that simulate the space experience such as space theme parks, space training camps, virtual reality facilities, multimedia interactive games, and telerobotic moon rovers controlled from earth. Also included are parabolic flight, vertical suborbital flights, orbital flights lasting up to 3 days, or weeklong stays at a floating space hotel, including participatory educational, research and entertainment experiences as well as space sports competitions (i.e. space Olympics).

To see the unseen and know the unknown has been the genesis and heritage of human aspiration from early times, resulting in human migration and travel over centuries. The arcane desire to conquer the invincible is an endemic human trait. Space tourism has the added dimension of making space tourists ambassadors of planet Earth to other celestial territories while at the same time giving them the thrill of crossing the frontiers of the Earth's atmosphere into uncharted territory that is outer space. It is believed that the sensation of weightlessness and the defeat of the force of gravity are the most alluring to the space tourist. Recent advancements in space technology have enabled the world community to develop safe, reliable and affordable transportation systems for space travel within the next decade or so. The National Aerospace Laboratory of Japan, in a market survey on space tourism, has revealed that the price of a return ticket to low Earth orbit should be reduced to between US $ 10,000 to US$ 20,000 per person. A market of one million passengers per year from the world's two largest markets—North America and Europe—would, at US$ 10,000 per return ticket, yield revenues of US$ 10 billion a year. This would make space travel by the ordinary or "average" citizen of the world a common occurrence. It is reported that Enzo Paci, Chief Statistician of the World Tourism Organization, conducted a study in which he concluded that short pleasure voyages to outer space by tourists will become a reality in 2004 or 2005. However, in 2019, we are still waiting for a commercial product that would make this prognosis a reality although we are almost there.

Taken from a socio-legal perspective, space tourism brings to bear unique considerations, from the status of the space tourist to the conduct expected of such a person and the various liability regimes that might be required to address the "package deal" concerning the contract of carriage to outer space and amenities provided by the service provider. Additionally, real concerns of liability, insurance coverage and risk management would have to be allayed before a sustained space tourism programme takes to the heavens.

Amidst all its glamour and glitter, space transportation brings to bear two major considerations. The first is that the development of this mode of transportation should essentially be subject to good governance. The second is that any development of space transportation should not endanger and encroach upon the rights of sovereign States and their citizens.

1.3 Aerospace and Cyberspace

The Economist of February 24th of 2018 in its obituary of John Perry Barlow described him as "Internet Utopian". The Economist went on: "He saw what other people had not yet seen, that this was a new space – one to which he quickly applied an existing term, cyberspace, and his own metaphor, the electronic frontier".

This got me thinking: who has sovereignty over cyberspace? In the sense of airspace and outer space, as well as the sea, sovereignty can be reasonably determined. In the context of air space, The Chicago Convention says that every State has sovereignty over the air space above its land and territorial waters. Of course, to what extent air space applies vertically above that land and water has not been determined, arguably because States do not want to constrain themselves on the control they could have above their land and water. As to sovereignty over the sea, The United Nations Convention on the Law of the Sea (UNCLOS) says it extends to 12 nautical miles beyond the State's land boundaries. The Jury is out on at what point outer space starts, again on the assumption that air space ends at the threshold height when the Atmosphere ends (speculatively about 100 km above ground).

But what about cyberspace which transcends State boundaries? Could a State, in which a person buys an item from E-Bay, claim sovereignty over the transaction and therefore apply its jurisdiction to the contract? What about the country in which the server was? Wolff Heintschel von Heinegg in his article: Legal Implications of Territorial Sovereignty in Cyberspace states: "The principle of territorial sovereignty applies to cyberspace and it protects the cyber infrastructure located within a State's territory. States are prohibited to interfere with the cyber infrastructure located in the territory of another State. This certainly holds true if the conduct is attributable and if it inflicts (severe) damage on the integrity or functionality of foreign cyber infrastructure. Moreover, States have the obligation not to allow knowingly their territory to be used for acts that violate the territorial sovereignty of another State. . ."

This is all well and good for interference with cyberspace infrastructure and where tangible territorial sovereignty principles as described above, can be applied. Author Michael Hanlon envisions the consequences of a cyber attack: "at first, it would be no more than a nuisance. No burning skyscrapers, no underground explosions, just a million electronic irritations up and down the land. Thousands of government web pages suddenly vanish. . . the disruption continues: thousands of popular websites, from eBay to YouTube, start malfunctioning or are replaced by malicious parodies. Tens of millions of pounds are wiped off the share price of companies like Amazon as fears grow that the whole Internet credit card payment

network is now vulnerable and insecure... eventually, reports start to flood in that hundreds of thousands of personal bank accounts have been raided overnight".

James D. Zirin, writing to the Washington Times said: "It is an irony of the digital age that technology has aided the security forces in detecting and thwarting terrorist operations and has helped terrorists do their evil".

In taking action against cyber crimes, then US President Bill Clinton, in a 1999 speech to the National Academy of Sciences said: "open borders and revolutions in technology have spread the message and the gifts of freedom, but have also given new opportunities to freedom's enemies... we must be ready... ready if our adversaries try to use computers to disable power grids, banking, communications and transportation networks, police, fire, and health services—or military assets".

What about the consequences of the use of cyberspace as mentioned above regarding contracts? If an arms deal goes through cyber space where the buyer transacted on his computer from his hotel room in Montreal where the server was in Minnesota, and the seller was in Amsterdam? Cyber contracts are commonly called "click wrap" agreements and are formed over the Internet in their entirety. The essence of a "click wrap" agreement is that when an offeree visits the web site of a person who has advertised his goods for sale at a given price and agrees to buy those goods, indicating his assent to be bound by the terms of the offeror—or person who offers to sell goods on the Internet—a contract is concluded. There is no paper exchange, nor is there the need for the signature of either parties to the contract.

Arguably, one of the key indicators that cyber contracts should be construed as possessing special characteristics in the context of performance the need to resolve issues of jurisdiction. Given the worldwide web and its global application, the most compelling question in this regard would pertain to the trans-boundary applicability of an Internet contract. If an offer originated from a computer based in the vendor's office in Virginia, or as in the case of an e-ticket sale, an invitation to treat is issued in Virginia and is responded to by the buyer in Paris, the question at issue would be whether the seller "pushed "his message to Paris or whether the buyer "pulled" the message from Virginia. In such an instance could the vendor claim that it is unjust to apply French law merely because a computer in Paris "pulled "or received his message? In the 1996 case of United States v. Thomas, concerning criminal liability of the defendant for having posted pornographic pictures on his computer, the defendant claimed that he had not "pushed "pornographic pictures into Tennessee from his server in Los Angeles and therefore should not be subjected to Tennessee's laws. The defendant Thomas claimed that rather, it was the other way around and that a computer in Tennessee "pulled "the pornographic pictures. The Thomas case clearly brought to bear the compelling need for courts to determine whether a buyer or recipient of a message "drags" a message and therefore whether the jurisdiction in which that recipient is placed is appropriate for a dispute to be adjudicated on.

In determining jurisdiction in an e-commerce case, the most fundamental issue that arises for consideration is whether any jurisdiction in which either the buyer or seller transacted the business concerned can rule the entire internet. In the case of Minnesota v. Granite Gate Resorts, Inc. The court of Appeal of Minnesota ruled that the laws of Minnesota were applicable to an online gambling business located in Las

Vegas that operated through a server in Belize. The Minnesota case is somewhat consistent with some cases and at the same time distinguishable from other decisions in various jurisdictions of the United States and Canada (such as those discussed below) which are inclined to follow the approach that every jurisdiction cannot impose its advertising, gambling and consumer protection laws to the entire internet.

The most convenient analogy to an e-transaction comes from the two jurisdictions of Canada and the United States. Would an offeror in Canada, who offers $500 over the Internet for a round trip between Toronto and Miami, be able to enforce an auction agreement against a United States airline at its home base in Florida? In a case decided in 1952 in Canada where the plaintiff brought a case to the Ontario High Court against an American radio broadcasting station which was broadcasting from across the border, allegedly libellous statements which could be heard over the air waves in Canada, the defendant radio station brought up a motion of dismissal, alleging that the Ontario Court in Canada had no jurisdiction to hear a case against a party to the action which was an enterprise based in the United States. The Court disagreed and held: "A person may utter all the defamatory words he wishes without incurring any civil liability unless they are heard and understood by a third person. I think it a "startling proposition" to say that one may, while standing south of the border or cruising in an aeroplane south of the border, through the medium of modern sound amplification, utter defamatory matter which is heard in a Province in Canada north of the border, and not be said to have published a slander in the Province in which it is heard and understood".

The principle of universal application of jurisdiction has been invoked in other instances, where courts have accepted jurisdiction on the basis of sales made to customers through the defendant's web site, or based on soliciting donations, or based on subscribers signed up by the defendant for services delivered over the Internet, or for having follow on contacts, negotiations, and other dealings in addition to, and often as a result of the initial Internet based communication. The common thread which runs through the fabric of judicial thinking in this regard is that parties who avail themselves of technology in order to do business in a distant place should not then be able to escape that place's legal jurisdiction.

Cyberspace, aerospace and airspace are intrinsically linked. For example, in commercial space transportation, the aerospace vehicle would traverse airspace before entering outer space. In this instance, all indications are that States would have sovereignty in providing air traffic services which come within their sovereignty. At the 13th Air Navigation Conference of ICAO held in 2018 the United States presented to the Conference the view that: "Every day, air navigation service providers (ANSPs) work to safely and efficiently manage a diverse mix of operations in the global airspace. Commercial space launch and re-entry operations are becoming an increasingly more significant part of this mix. Traditionally, ANSPs restrict other airspace users' access to volumes of airspace assigned to a space launch or re-entry to ensure that these other users are kept safely away from the potential hazards. Until recently, the United States Federal Aviation Administration (FAA) applied a target level of safety that evolved from the space industry to size these airspace restrictions. Having evolved at different times and under different

circumstances, this space industry target level of safety differs from the aviation industry target level of safety in terms of terminology, numeric value, and relative stringency. Simply imposing the target level of safety of one industry on another would have significant consequences. As such, integration of aviation and space operations goes beyond techniques to manage the airspace, to include the integration of their different safety standards. To address this challenge, the FAA has developed an intermediate solution in the form of an acceptable level of risk approach that applies safety principles from both industries. This paper describes that approach, and its application to space launch and re-entry operations. In the United States, the commercial aviation and commercial space industries originated and evolved under different circumstances. While some commonality exists across the industries in the approaches used by regulators and safety professionals to ensure public safety, the target levels of safety used in the two industries are not directly comparable. As commercial launches and re-entries are becoming more frequent, more complex, and more global in nature, Air Navigation Service Providers (ANSPs) and civil aviation authorities (CAAs) must consider this difference as they take steps to integrate commercial launch and re-entry operations into the global airspace system".[1]

However, in the digital world of the Internet, sovereignty, according to some parts ways with the typical Westphalian concept (mentioned at the start of Chap. 3) which followed the thinking of Thomas Hobbes in his book *Leviathan* that the State holds absolute sovereignty in a juridical sense based on territoriality. Instead, it is believed that sovereignty in cyberspace should be determined on "freedom of action".[2] There are instances where in the past, The United States has recognized freedom of action in the maritime and outer space contexts and it follows that arguably, there may not be any inconsistence in the application of this concept to sovereignty and cyberspace.[3] Be that as it may, it is clear that within a geographic territory, a State could

[1]Integrating Public Safety Standards for Commercial Space and Aviation, *AN-Conf/13-WP/205 26/9/18* (Information Paper), at 1.

[2]Krasner (1999), p. 93. It is noteworthy that from a political sense, sovereignty has been viewed under four headings: *International legal sovereignty*, which involves mutual recognition by other states with formal juridical independence (you can be recognized as a government, yet have no control over your territory); *Westphalian sovereignty*, which excludes external actors from the authority structures in a territory (e.g. colonial systems) and independent exclusivity of political institutions; *Domestic sovereignty*, which indicates the ability of public authorities to exercise effective control within their territory; and *Interdependence sovereignty*, which includes the ability of public authorities to regulate the flow of information, ideas, goods, people, capital, etc., into and out of their borders (the most relevant to cyberspace). See Ayers (2016), pp. 67–68.

[3]Ayers cites that "freedom of action as it applies to the oceans is older than the Westphalian model: In 1609, Grotius articulated the principle of *Mare Liberum* (Freedom of the Seas); In the 1780s, early American political leaders e.g. Adams, Franklin championed the view that the seas ought to be free in war as well as in peace; In 1917, President Wilson asserted the right of every nation to have free access to "the open paths of the world's commerce"; In 1941, the Atlantic Charter set forth the affirmation that "peace should enable all men to traverse the high seas and oceans without hindrance". Ayers, *Ibid*, at 73.

exercise sovereignty over activities involving cyberspace".[4] This is subject to the overall principle, as enunciated in the 1928 dictum of the Permanent Court of International Justice, that unless an activity is prohibited by law, a States would be free to indulge in that activity irrespective of a territorial basis.[5]

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[4]See for example The United States *Computer Fraud and Abuse Act* at Appendix C.

[5]The Lotus Case, A.K.A *THE CASE OF THE S.S. "LOTUS"*, 1927. 7 Septembre. ssier E. c. X. lble XII: 2. For the English text see *France* v. *Turkey*, File E. c. Docket XI, Judgment No. 9, 7 September 1927.

Chapter 2
International Aviation and Megatrends

2.1 Introduction

There are several megatrends which bring to bear the realization that we live in a digital world. This is turn affects the direction aviation is taking. A megatrend is a global direction towards which a large transformative force drives the entire world. It is not sectarian, affecting merely a part of the world; region; or country. Megatrends affect our existential life and connect everything: data; processes; humans; and geo-political instability. Thus, megatrends represent an important shift in the progress of a society. The megatrends are: the global economic shift from the West to the East; increasing urbanization; demographic changes; innovative technology; climate change; and global connectivity.

Megatrends are driven by what are called "Drivers" such as: globalization; competition; digitalization; decreasing lifestyle satisfaction; terrorism; entrepreneurial mindset; geo political challenges; emergence of alternative lifestyles; increasing energy demands; wearables (smartphones et al.); drones; augmented and virtual reality; blockchain and cryptocurrencies; 3D printing; biotechnology; robotics; cyber deceit; and sustainability (which is the key driver of innovation). These Drivers are often misquoted and wrongly regarded as Megatrends, which they are not.

The drivers of megatrends are influencers promoting global transformative forces that change the course of society. Taking the megatrends in the order mentioned above, the drivers of the Global Economic Shift from West to East are geo politics; global income inequality; volatility and weakness of the global economy; the changing industry supply chain; shift to a knowledge-based economy; privatization; data transparency; and the changing nature of work and the future of work. In terms of Rapid Urbanization, the drivers are global ageing; growth of the middle class in Asia; consumption; population evolution; growth of mega cities; shifting ethnic identities and innovations in medical technology. Demography is influenced by

R. Abeyratne, *Aviation in the Digital Age*,
https://doi.org/10.1007/978-3-030-48218-3_2

changing patterns in employment; focus on technology; social values; geo-political instability; strength of governance; and increasing influence of alternative regional and global institutions.

Megatrends must be approached in the same manner as one's treatment of a system because one megatrend affects the other in the overall result. This approach would essentially require systemic leadership which in turn calls for system initiatives. These system initiatives should be constructed on the premise that a contextual understanding on how a complex system interacts is required to achieve sustainable change in a positive manner that affects our existential lives.

Megatrends directly impact the work of the International Civil Aviation Organization (ICAO)[1]—the specialized agency of the United Nations addressing international civil aviation—in which the Council of ICAO has adopted five Strategic Objectives: *Safety* (the enhancement of global safety); *Air Navigation Capacity and Efficiency* (increase the capacity and improve the efficiency of the global civil aviation system); *Security & Facilitation*: (enhance global civil aviation security and facilitation); *Economic Development of Air Transport*: (foster the development of a sound and economically-viable civil aviation system); and *Environmental Protection*: (minimize the adverse environmental effects of civil aviation activities). These Strategic Objectives are driven towards ICAO's vision which is to achieve the sustainable growth of the global civil aviation system. Each of these megatrends are directly impacted by the drivers of megatrends and the megatrends themselves.

Air transport evolves rapidly and grows exponentially. Inevitably, challenges faced by the industry change almost every decade. These changes are influenced by megatrends and their drivers and leaders must adapt their business strategies. There have been numerous changes over the past three decades. Over the past 30 years the airline industry has seen several changes, such as the advent of low-cost carriers (LCCs) who obtained sizeable market shares, and natural disasters such as volcanoes and the spread of infectious diseases. The next 30 years are likely to be more turbulent, calling for new approaches in leadership and entrepreneurship.

There is one incontrovertible fact: the future of the world, as affected by megatrends, would be integrally connected with the world of business. The world of business would be of service only to innovative leaders who find new solutions to existing problems. One example of innovation in business practice is the paradigm shift from adapting global products to the needs of local markets to innovating locally to suit the demands of global markets. Another lies in branding unbranded

[1]The International Civil Aviation Organization (ICAO) is the specialized agency of the United Nations handling issues of international civil aviation. ICAO was established by the Convention on International Civil Aviation, signed at Chicago on 7 December 1944 (Chicago Convention). The overarching objectives of ICAO, as contained in Article 44 of the Convention is to develop the principles and techniques of international air navigation and to foster the planning and development of international air transport to meet the needs of the peoples for safe, regular, efficient and economical air transport. ICAO has 193 member States, who become members of ICAO by ratifying or otherwise issuing notice of adherence to the Chicago Convention.

products and markets. Yet another innovative business practice is disruptive innovation.

A good example of disruptive innovation is a measure—the third wave—that caters to the new demography of millennials who are known as the "gypsy tribe" because of their prolific travel habits. The millennials are highly tech savvy 25–35-year-olds who seek the best possible and easiest way to their point to point destinations. The approach taken by the Boeing Dreamliner in creating an aircraft that is best suited to meet this need and therefore able to capture this market is a case in point. Another point is that millennials are integrally linked to innovative technology. This is where more than one megatrend converges as a system. The first step for airlines seeking to cash in on disruptive innovation with the millennial market would be to be up there with apps and connecting tools that could boast of having the internet of things involved in the product they offer this new market. The third wave could disrupt every competitor unless they step up to the millennials. One of the key strategies in the internet of everything is forming partnerships with the "connectors". For instance, an airline which wins the new market of millennials would have to be in partnership with the providers of up to date inflight entertainment systems.

This discussion brings to bear the compelling need for airlines to think systemically so that all the dots are connected in the internet of everything. The interconnection of all elements that makes the air transport product attractive to the millennial would require looking at parallel scenarios; being flexible in the context of being able to adapt to changing trends; a certain amount of risk taking; and the seeking of new partnerships.

2.2 The Global Economy

Although in 2017 the global economy showed the best growth performance in six years, amidst contrasts in various regions of the world: from growth acceleration to concern and anxiety wrought by political dissent and fragmentation, as well as polarization and tension between the major economies, the global economy slumped in 2018, slowing trade and business confidence. The global economy in 2018 was expected to grow at 3.2%, matching 2017s growth rate, and well above 2016s 2.5%. The emergent truth in 2017 was that socio-political forces had a deep influence on the global economy centrifugally, resonating from core trade and economic philosophy to the outside world. These forces were key drivers of the shift that is occurring from the West to the East. Markets and economies withstood these forces with robust flexibility, obviating political disorder as an influencing factor to overall growth. The

International Monetary Fund has forecast a modest 3.7% worldwide growth for 2019.[2]

A key deviation and economic setback that flowed into 2018 and continued into 2019 was Brexit in the United Kingdom which not only brought to bear the possibility of an economic disadvantage both to The United Kingdom and the other members of the European Union, but also threatened to create a power imbalance in Europe. Although the United Kingdom government went on the assumption that the referendum result was sufficient to trigger Article 50[3] of the Lisbon Treaty[4] The Supreme Court of the UK disagreed, stating that parliamentary authority must be obtained by the Prime Minister to trigger the provision, after which formal notice of Brexit to the EU could be given. On 8 February 2017, this requirement was complied with through an absolute majority in Parliament. The next step was to obtain assent of the second limb of the bicameral process in the UK—The House of Lords—which was accomplished subsequently. Article 50 notification was received by the EU, in March 2017 and there will be a two-year period from that year until formal exit of the UK takes place.

During the two-year period, and at the time of writing, exit terms were being discussed in the United Kingdom Parliament after a deal struck between the Prime Minister and Europe had been rejected by the House. For her part, initially, the Prime Minister of UK submitted 12 Principles that indicate a framework for negotiation with the EU. The 12 principles were discussed during the interim two-year period with a view to a meaningful agreement being reached between the parties that would obviate ambivalence regarding the positions of the parties. In the meanwhile, the UK airlines would have to await results of the negotiations which could pose difficulties in their planning for the future.

From an air transport perspective, a major effect that Brexit would have will be on the US-EU Open Skies Agreement[5] which would no longer apply to such carriers when the UK separates from the EU. The "Community Carrier" status of the British

[2]Global economy in 2019: Growth beginning to fray, *The News International*, Monday 18 February 2019. See https://www.thenews.com.pk/latest/404996-global-economy-in-2019-growth-beginning-to-fray.

[3]Article 50 provides *inter alia* that any Member State may decide to withdraw from the Union in accordance with its own constitutional requirements; a Member State which decides to withdraw must notify the European Council of its intention. In the light of the guidelines provided by the European Council, the Union is required to negotiate and conclude an agreement with that State, setting out the arrangements for its withdrawal, taking account of the framework for its future relationship with the Union. That agreement must be negotiated in accordance with Article 218 (3) of the Treaty on the Functioning of the European Union. It will l be concluded on behalf of the Union by the Council, acting by a qualified majority, after obtaining the consent of the European Parliament.

[4]*The Treaty of Lisbon* was signed by the EU Members on 13 December 2007 and entered into force in December 2009.

[5]The EU-US Air Transport Agreement signed on 25 and 30 April 2007, the main purpose of which is to establish a Trans-Atlantic open aviation area, was provisionally applied from 30 March 2008 for all EU Member States, and Amended by a Protocol, signed and provisionally applied on 24 June

carriers could be removed. Should this happen, The UK may have to revert to the *status quo ante* existing prior to the UK joining the EU. It is reported that the EU is the single largest air transport market for the UK carriers, involving 49% of passenger traffic and 54% of scheduled carriage of UK carriers being within the EU.[6] These figures could change with Brexit where the UK would have to negotiate separate bilateral air services agreements with the rest of the EU member States. It would follow that under the new circumstances, unless granted within the Brexit negotiations, the UK carriers will lose their inherent right to market access on an intra-Europe basis between cities within the same EU Member State (e.g. Paris/Nice) or between two cities in two different EU member States (e.g. Lisbon/Rome).

An IATA Study,[7] released in October 2018 states that in the context of the new US-UK relationship after Brexit both the United Kingdom and the United states have shown some willingness to replicate the current EU-US agreement where in any reference to the EU the acronym "EU" will be replaced by "UK". However, consequences for the UK will be different, for example in the ownership and control requirement in the bilateral air services agreement between the US and the UK. The IATA study states that "[T]his would mean that UK carriers operating a transatlantic route would need to be "substantially owned and effectively controlled" in the UK specifically, not across the EU as a whole, even if an EU-UK agreement on reciprocal ownership were in place. Airlines would therefore have to choose between concentrating ownership and operating licences in the EU to allow operation under the EU-US agreement or make substantial (and potentially costly) changes to ownership structure to consolidate ownership in the UK".[8]

As for intra-European air traffic The European Commission expects significant challenges and disruptions from a hard Brexit without a compromise deal between the UK and the EU. Accordingly, as this article was written, the EU was preparing contingency plans that would mitigate the consequences of a hard Brexit. The contingency plan aims at maintaining basic services that would cater to the travelling public of member countries of Europe without a guarantee of the status quo ante that would have existed before Brexit. The European Commission, which is formally charged with the issue of market access within the EU has stated: "UK carriers will be allowed to make a technical stop in the EU or fly over the EU, though they will lose their current right to operate freely within the EU—between member countries

2010. Norway and Iceland accession to the Air Transport Agreement as amended by the Protocol is provisionally applied from 21 June 2011.

[6]EUROCONTROL, which is the European Organisation for Safety of Air Navigation and is made up of 39-member States of the European Community, forecasts that there will be 16.9 million aircraft movements in Europe in 2030, which is approximately 2% more than the movements in 2009. The number of flights concerned is estimated between 13.1 and 20.9 million flights during 2030.

[7]A study of the effects of the United Kingdom leaving the European Union on airlines flying to and from the UK, R-038-001-001 Final at https://www.iata.org/policy/consumer-pax-rights/Documents/iata-brexit-study.pdf.

[8]*Id.* 28.

and domestically in member countries. Their traffic rights to the EU will be restricted to third and fourth freedom; in other words, they will be allowed to operate between any point in the UK and any point in the EU. In addition, their capacity will be restricted. According to the proposed regulation, the total seasonal capacity to be provided by UK air carriers for routes between the UK and each member state must not exceed the total number of frequencies operated by those carriers on those routes during respectively the IATA winter and summer seasons of the year of 2018."[9] This would mean that the number of frequencies to be operated by UK carriers would be "frozen" at pre-Brexit levels and the pre-existing flexibility given to UK carriers in the area of cooperative marketing arrangements, leasing of aircraft, change of gauge would have to be renegotiated.[10]

2.3 Scope of Air Transport

ICAO recorded that in 2015 3.5 billion passengers were carried.[11] The Report goes on to say that the key driver of future air transport growth will be sustained world economic and trade growth as well as declining airline costs and ticket prices. ICAO said that in 2017 an unprecedented 4.1 billion passengers were carried by the aviation industry on scheduled services This indicated a 7.1% increase over 2016. The number of departures rose to approximately 37 million globally, and world passenger traffic, expressed in terms of total scheduled revenue passenger-kilometres (RPKs), posted an increase of 7.6% with approximately 7.7 trillion RPKs performed. This growth is a slight improvement from the 7.4% achieved in 2016.[12]

As for air cargo, the same Report records that cargo traffic recorded an annual growth of +1.7% in 2015 in terms of freight tonne kilometres reflecting a substantial decline as compared to +4.7% increase in 2014. The outlook for 2042 is an overall 4.5% growth rate. Boeing, in its World Air Cargo Forecast 2016–2017 says: "world air cargo traffic has struggled to maintain sustained growth since the end of the global economic downturn in 2008 and 2009. After bouncing back in 2010, then stagnating in 2011 and 2012, air cargo began growing again in mid-2013, even growing 4.8% in 2014, an year in which US $ 6.4 trillion worth of goods were carried by air. Growth accelerated in the first quarter of 2015, but, then traffic

[9]No-deal Brexit could hit UK-EU flights, says Whitehall, The Guardian at https://www.theguardian.com/politics/2018/sep/24/uk-eu-flights-would-cease-immediately-in-event-of-no-deal-brexit.

[10]Cathy Buyck, EU Reveals 'Basic Connectivity' No-deal Brexit Air Traffic Plan, - *AIN Online*, December 19, 2018. See https://www.ainonline.com/aviation-news/air-transport/2018-12-19/eu-reveals-basic-connectivity-no-deal-brexit-air-traffic-plan.

[11]ICAO World Civil Aviation Report: 2016, at 22.

[12]Uniting Aviation, at https://www.unitingaviation.com/strategic-objective/economic-development/continued-passenger-traffic-growth-robust-air-cargo-demand-2017/.

volumes remained flat for the rest of that year. Air cargo traffic gathered some strength after a weak first quarter of 2016 and is projected to return to trend growth by 2018. Despite the weak growth of the past decade, more than one-half of air cargo is still carried on freighters".[13]

The Air Transport Action Group—an arm of The International Air Transport Association (IATA)—in its report states that the global aviation industry's total economic impact—encompassing direct, indirect, induced and tourism related—reached US $ 2.7 trillion, which amounts to 3.5% of the world's gross domestic product.[14] The same report states that the air transport industry in 2014 supported 62.7 million jobs globally, while 9.9 million of this total were jobs directly ascribed to the airline industry.

It has been predicted that by the year 2020, air travel would have doubled compared to today's figures. ICAO expects that global passenger traffic will grow at 4.6% annually to 2032.[15] A global market forecast by *Airbus Industrie* states that between 2009 and 2028 there will be a demand for 24,951 passenger and freighter aircraft worth USD 3.1 trillion, and that, by 2028 there will be 32,000 aircraft in service compared with 15,750 in 2009.[16] In January 2015, ongoing projects for airport construction amounted to the value of US $543 billion globally. These facts and figures incontrovertibly spell out the future of air transport and the inevitable fact that liberalization of air transport and the use of more efficient operating systems for air navigation, airport operations and marketing are compelling needs to meet demand.

Air transport and tourism are intrinsically linked, and it is estimated that over 54% of tourists travel by air. Air transport offers a unique connectivity for tourists to get to their destination, which is why it is the largest single transportation mode for tourists. Travel & tourism's direct contribution to global GDP is expected to grow at an average of 3.9% per year over the next ten years. The World Travel and Tourism Council (WTTC) has said that by 2027, Travel & Tourism is expected to support more than 380 million jobs globally, which equates to 1 in 9 of all jobs in the world and the sector is expected to contribute around 23% of total global net job creation over the next decade. Meanwhile, total travel & tourism GDP is expected to account for 11.4% of global GDP and global visitor exports are expected to account for 7.1% of total global exports.

The World Tourism Organization (UNWTO) in its 2016 Annual Report states that 2016 was a memorable year for tourism, as international tourist arrivals

[13]Boeing World Air Cargo Forecast 2016–2017. http://www.boeing.com/commercial/market/cargo-forecast/.

[14]Aviation Benefits: Contributing to Global Economic Prosperity, Uniting Aviation: Bringing Air Transport Partners Together, http://www.unitingaviation.com/strategic-objective/economic-development/aviation-benefits-for-a-better-future/.

[15]*Outlook to 2042, ICAO World Civil Aviation Report* 2016, supra, note 11 at 44. In 2015 3.5 billion passengers were carried by air worldwide.

[16]John Leahy, Chief Operating Officer, Airbus Industrie, *Airbus Market Forecast 2010-2029*, https://www.scribd.com/document/66638952/Airbus-Global-Market-Forecast-2010-2029.

continued their upward trajectory in their seventh straight year of above-average growth despite many challenges, reaching 1.2 billion. Fast forward to 2019 UNWTO says that there were 1.4 billion international tourist arrivals (+6%), in 2018 showing a robust trend which added to the strong figures of 2017 and second only to the large numbers shown in 2010. For 2019 UNWTO's forecast is a 3–4% increase, in line with the historical growth trend and exponential increase that is portended.[17]

Despite this sanguine vision, air transport faces certain restrictions. It is the only mode of transport which can operate commercially subject to the permission or authorization from the country to which aircraft offering air transport services fly; foreign direct investment in air carriers is often restricted by States; and the majority of ownership and effective control of an airline should be with nationals of the state in which the airline is established. The symbiosis of air transport and tourism and their exponential growth calls for liberalization of air transport as a trading process.

Against this scenario, megatrends, in their own way, affect air transport where managers have to deduce who their clients and customers would be in the next 20 years and what routes the millennials would prefer.

Two goals must be accomplished if the air transport industry were to be recognized as a major contributor to the world economy and trading process and assisted accordingly. The first is to treat air transport as a trading tool and not as a luxury. A liberalized trading process must be applied in the context of air transport. It is incontrovertible that liberalization of air transport is a global trend that is irreversible and has been on-going since the eighties. In the liberalization process, fluctuations of global economic factors and their effect on the role and national approaches to market access continues to be the most critical element in air services agreements between States. These factors remain integral to substantive regulatory liberalization should a State decide to radically alter its stance toward opening the skies. In considering liberalization of market access, States invariably face two basic issues: the extent of liberalization, *i.e*. how open the market access should be in terms of the grant of traffic rights; and the approach to liberalization, *i.e.* whether liberalization should be national, bilateral, regional, plurilateral, or multilateral and the pace with which liberalization should be pursued.

2.4 Innovative Technology

There are two key factors of leadership that could effectively deal with megatrends: insight leadership; and systems leadership. These leadership styles are not mutually exclusive but are symbiotic. The glue that binds these two approaches is innovative

[17]International Tourist Arrivals Reach 1.4 billion Two Years Ahead of Forecasts: UNWTO: Geneva, 21 January 2019. See http://www2.unwto.org/press-release/2019-01-21/international-tourist-arrivals-reach-14-billion-two-years-ahead-forecasts. See also generally Tourism Towards 2030: Global Overview, UNWTO: Madrid at https://www.globalwellnesssummit.com/wp-content/uploads/Industry-Research/Global/2011_UNWTO_Tourism_Towards_2030.pdf.

technology, multiple data sources and analytics. Insights are essential to product development in the age of megatrends. Systems leadership is based on an abdication of tired business practices and in place embracing of the global changes that are taking place as a system. Keyed into this approach is digitalization, disruptive innovation (creating new markets for existing products) and sensitivity to rapidly evolving customer expectation. In the air transport industry, leadership would depend significantly on innovative technology: in particular on artificial intelligence.

AI systems are proliferating rapidly. They are made available by companies through the *Cloud*. The significance of AI to air transport lies in the fact that issues in air transport inevitably attenuate both qualitative and quantitative data. In the realm of accident investigation as well as breaches of aviation security, traditional approaches often cannot be used or modelled and therefore the Big Data and Deep Learning could be of considerable assistance. The human factor in air transport has been seen to optimize the challenge in emergency situations which renders traditional mathematical programming destitute of effect.

It is estimated that there are currently more than 1700 AI start-ups with over $14.6 billion in total funding from 70 different countries. Revenues from AI applications are expected to reach $47 billion by 2020, from $8.0 billion in 2016.[18] There is growing concern that the jobs of 63 million aviation workers could be at risk when AI ultimately replaces human resources in aviation.[19]

SITA[20] has recorded that both airlines and airports are attracted to AI and the technologies that come with it in the context of service quality and customer service. Heavy investment has been planned until 2020 by airports on research and development (45% of all airports), whereas 52% of global airlines are currently using AI technology and programmes. Airlines are particularly interested in using AI to minimize disruption of service to their customers and enhance their warning systems.[21]

Artificial intelligence has been applied to air traffic control with some success and AI has been developed at The Lincoln Laboratory which has automated basic air

[18] Artificial Intelligence in Aviation. What is it and when is it Coming? *ICAO Now*, 17 August 2006, at https://www.icaonow.com.br/single-post/2017/04/16/Artificial-Intelligence-in-Aviation-What-is-it-and-when-is-it-coming-English-Practice.

[19] *Ibid.* Identified as at risk are physical jobs that are repetitive in nature and data collecting and processing jobs.

Less at risk further down the line are: physical unpredictable jobs and Jobs that require application of expertise. Jobs that are most difficult to replace are Jobs that involve emotional interaction with people. A separate study has concluded that the computer/digital revolution favours more skilled over less skilled workers and it reduces employment and constrains wage growth. See Tyson and Spence (2017), p. 171.

[20] SITA is a multinational information technology company providing information technology and telecommunication services to the air transport industry. The company provides its services to over 430 members and 2800 customers worldwide which is around 90% of the world's airline business.

It is the world's leading specialist in air transport communications and information technology.

[21] Air Transport Sector Turning to Artificial Intelligence, *CXOtoday.com*. Sep 26, 2017. See http://www.cxotoday.com/story/air-transport-sector-turning-to-artificial-intelligence/.

traffic functions. However, it has been recognized that general planning with AI does not easily rest with air traffic control. An article published in the *Lincoln Laboratory Journal* says: "One difficulty in applying this method to ATC problems is that in ATC there exist no particular end states that need to be achieved. That is, in general many possible future situations are acceptable. Another difficulty is that the use of logical assertions does not capture the continuous behavior of physical systems such as aircraft in flight. and it also introduces a number of artificial logical problems to the system".[22]

In other words, considering the large number of decisions to be taken and actions to be carried out in the process of providing air traffic control for the safe navigation of aircraft which involve the consideration of numerous factors such as: the presence of other aircraft in the vicinity; severe weather conditions; simultaneous communications between multiple controller in different segments of airspace; the impossibility of directing an aircraft to climb further than the maximum altitude already reached; and the coordination of timing with the speed of ascent or descent, these factors could all be beyond the cognitive capacity of AI.

There are two fundamental principles applicable to both insight leadership and systems leadership regarding the use of AI. The application of AI to air transport should be based on the highest values of human rights and must not intrude on the contemporary aspirations of people living in the twenty-first century. The World Conference on Human Rights held in Vienna in 1993 recognized and affirmed that all human rights derive from the dignity and worth inherent in the human person, and that the human person is the central subject of human rights and fundamental freedoms, and consequently should be the principal beneficiary and should participate actively in the realization of these rights and freedoms.

The Conference also reaffirmed the solemn commitment of all States to fulfil their obligations to promote universal respect for, and observance and protection of, all human rights and fundamental freedoms for all in accordance with the Charter of the United Nations, other instruments relating to human rights, and international law, stating that the universal nature of these rights and freedoms is beyond question.

The second moral principle is that AI should result in optimal benefit to humankind. This benefit should be measurable both in scientific and economic terms. This would largely hinge on governance and the way AI is applied to assist the consumer whilst not eroding rights of privacy, life and liberty. There should also be a clear legal and regulatory regime that would identify responsibility and accountability of those applying AI to air transport. As a follow-up to responsibility and accountability should be the sensitivity of AI to a clear retrospective understanding in the way AI worked when something went wrong with the AI application used. Until these various issued become clearer AI should be used as a mathematical and scientific tool that provides extended intelligence to humankind.

With these principles in mind, AI could affect air transport in areas such as passenger experience, flight operations, security on board aircraft as well as overall

[22] https://www.ll.mit.edu/mission/aviation/aviationresearch.html.

safety. One of the key areas would be the way in which passenger data is used and stored with more efficiency and protection. Protection of aircraft on runways as well as in vertical separation and accident prevention would be key areas where AI would assist air transport. Furthermore, an entire passenger journey could be made more efficient from the check in through security (with biometric identification) and thereafter the journey to the gate where beacons could guide the passenger through various venues that he needs to visit prior to boarding as well as with flight information display systems.

Innovative Technology is driven by expanding human intelligence; robotics and automation; virtual and augmented reality; cybersecurity; new technical designs; and internet of things. *Climate Change* is driven by regulations on emissions; alternative fuels and renewable energy sources; carbon trading; extreme weather; water and food supply; rising sea levels. *Global Connectivity* is driven by competition; trade practices; travel patterns of new markets; airline policies as set by various governing bodies; rising population; technological progress; increased productivity; and globalization.

Innovative technology as a megatrend has, as its root the extension of human intelligence to create digital intelligence s a mental, physical and social extension of themselves. An example of this is our association with the internet as well as the internet of things which digitally links inanimate objects enabling them to talk to one another. Artificial intelligence and big data are two other drivers, along with 3D printing which uses digitally transmitted parameters to create physical objects. Innovative technology enables us to conduct business more effectively, facilitate globalization and enhance social discourse. Digitalization also enables sustainability of the business and social world. However, the issue is whether the new innovations that monitor worker performance in terms of speed of productivity at the assembly line, or the distance travelled by a worker to report to duty, could affect corporate social responsibility that is expected to ensure the worker gets a fair deal from the employer. Another issue is whether there could be confirmation bias that could mislead the company into discontinuing the services of a worker who is subjected to confirmation bias and whose only source of income that supports his school going children is his wage.

Innovative technology also comes with its challengers both to businesses as well as their consumers. A survey carried out by *Pricewarterhousecoopers* (PwC) reflected that 60% of CEOs were concerned that the exponential advancement of innovative technology would affect their companies' growth. As for the consumer, digital technology acts as a prompt to expect personalised solutions to his problems.

The march of innovative technology into business is an incontrovertible fact. There is also no room for doubt that innovative technology has ensured connectivity and networking through billions of devices. This has been accomplished through cloud computing and miniaturising of communications chips and sensors. The internet of things could add trillions of dollars to the global GDP within the next few years. It ensures enhanced customer service and satisfaction as revenue. Cloud computing, when used in business practices offer a more managed enterprise governance model. Of importance to this discussion is artificial intelligence (AI).

The term "artificial intelligence" has been challenged as connoting emotional intelligence that humans possess. Scientists cannot even imagine a time where computers would acquire emotional intelligence. IBM advocates terms such as "cognitive computing" or "augmented intelligence" to describe what is popularly known as AI for this reason. In this context, AI forms two broad categories: knowledge-based intelligence delivered by knowledge-based systems (KBS) and computational intelligence which involve neural networks fuzzy systems and evolutionary computing. The former is applied based on the reliance placed by information provided by a human (such as rules and algorithms) while the latter delivers through networks of computational systems. Air transport involves the use of qualitative and quantitative data but is primarily governed by human involvement, whether in maintenance, air traffic control or flight deck management. This factor makes it difficult to entirely rely upon mathematical computations or non-emotive reasoning in air transport.

Blockchain is a technology which can affect air transport in many ways. Although Blockchain came into being with bitcoin as a cryptocurrency, its utility as a multilayered records system could be of immense use to air transport in the future. One of the examples is Dubai which plans to use Blockchain in its digital passports.[23] Blockchain is a form of de-centralized database that could benefit the value chain that applies to aviation in the context of aircraft manufacturers, airlines, travel agents, airports, ground handlers, and other industry suppliers who are symbiotically dependant on each other for products and services to serve their customers. IATA makes the valid observation that air transport is heading towards doing business in the digital space because the commercial aviation industry relies more on exposing their products and services and reaching a wide spread distribution network which the industry is well known to which in turn go towards more efficient management of business risks. IATA says: "[T]he inherently robust security properties (e.g. integrity, immutability) of the Blockchain technology make it very suitable as the underlying technology for digital identity management solutions".[24]

There is a danger inherent in innovative technology, where the use of innovative technology—in particular artificial intelligence—in the workplace could also have questionable consequences, for instance, the wrist band that Amazon has introduced to be worn by line workers which tracks the hand movements of the workers and goads them to work faster could be the modern and more humanitarian equivalent of the measures used by slave owners in forcing slaves to work faster. Firms can use AI to sift through not just employees' professional communications but their social-media profiles, too.

Artificial intelligence can result in confirmation bias when AI, which is essentially data driven, could establish patterns that enables it to discriminate against a particular group of people or race.

[23]CoinDesk at https://www.coindesk.com/dubai-plans-gate-less-airport-security-using-blockchain-tech.

[24]*Blockchain in Aviation: Exploring the Fundamentals, Use Cases and Industry Initiatives*, White Paper, IATA: October 2018, at 14.

The Economist offers three ways out of this dilemma: anonymity; transparency; and entitlement of employees to access to their data and information. The first—anonymity—is where managers do not receive individual details but instead aggregate information. This is counter intuitive as it is difficult to evaluate how performance and competency can be assessed this way. The second—transparency—which provides information to employees as to what data is gathered, is also not helpful as the employee may not have a choice as to the type of his information that is collected. The third—access to information gathered—may only make matters worse for the employee, making him anxious and unproductive.

The purposes of AI are recognized as the ultimate promotion of the well-being of all sentient creatures. Therefore, the development of AI should promote the autonomy of all human beings and control, in a responsible way, as well as the autonomy of computer systems. It should promote justice and seek to eliminate all types of discrimination, notably those linked to gender, age, mental / physical abilities, sexual orientation, ethnic / social origins and religious beliefs. AI's development should offer guarantees respecting personal privacy and allowing people who use it to access their personal data as well as the kinds of information that any algorithm might use. It should also promote critical thinking and protect us from propaganda and manipulation and promote informed participation in public life, cooperation and democratic debate. The various players in the development of AI should assume their responsibility by working against the risks arising from their technological innovations.

According to some, AI might well have the opposite effect on the well being of sentient creatures. Bill Gates, the founder of Microsoft opines that super intelligent systems will become "strong enough to be a concern".[25] Stephen Hawking is more vocal, stating that AI could be both a miraculous and catastrophic "biggest event in human history but also potentially the last unless we learn how to avoid the risks".[26] Nick Bostrom—a recognized AI Guru from Oxford University—warns that AI could quickly turn dark and dispose of humans. Elon Musk, founder of SPACEX calls AI "our biggest existential threat"[27] which would be tantamount to "summoning the demon". Others are more sanguine: Michio Kaku—a theoretical physicist and author—says that even if robots get out of control, we could "put a chip in their

[25] Artificial intelligence will become strong enough to be a concern, says Bill Gates, *The Guardian*, 29 January 2015 at https://www.theguardian.com/technology/2015/jan/29/artificial-intelligence-strong-concern-bill-gates.

[26] Sanya Burgess, Stephen Hawking: AI could be 'worst event in the history of our civilisation', *The National,* 7 November 2017 at https://www.thenational.ae/business/technology/stephen-hawking-ai-could-be-worst-event-in-the-history-of-our-civilisation-1.673585.

[27] Elon Musk: artificial intelligence is our biggest existential threat, The Guardian, 27 October 2017, at https://www.theguardian.com/technology/2014/oct/27/elon-musk-artificial-intelligence-ai-biggest-existential-threat.

brain to shut them off".[28] Sam Altman—a renowned computer programmer—says that AI could be programmed to work towards benevolent ends only. Inventor Ray Kurzweil—Director of Engineering at Google—is of the view that the world is under a moral imperative to use AI for benevolent purposes, such as the use of AI to find cures for diseases while ensuring that "we control the peril".[29]

The problem is that AI merely mimics human biology to solve problems that cannot be solved by classical mathematics. It only mimics human biology. We do not even have a definition of "natural intelligence" to distinguish it from artificial intelligence. Robots learn, and are capable of even learning by themselves, which is called singularity. We humans must learn under supervision and that is why we have to initially go to school. As humans we have feelings that are integrally associated with sensations such as remorse; guilt; recrimination; gratitude and sadness. We practice integrity, which is doing the right thing even when no one is looking. This is our limbic system of the brain in action. We rescue others in distress even without thinking or waiting for algorithms to kick in.

MIT uses the word "extended intelligence" instead of "artificial intelligence" and IBM's Watson is considered not a replacement for human intelligence but a tool that would augment human intelligence.

One cannot conclude a discussion on innovative technology without alluding to the ominous threat of cyber terrorism. Cyber Terrorism defines our times. It has brought seismic changes to the way we approach terrorism. This is because global and national reliance placed on cyberspace for the development and sustenance of human interaction will continue to grow in the years to come and with that continued development will come ominous threats and daunting challenges from cyber terrorism. Cyber terrorism has the advantage of anonymity, which in turn enables the hacker to obviate checkpoints or any physical evidence being traceable to him. It is a low budget form of terrorism where the only costs entailed in interfering with the computer programs of a State's activities and stability would be those pertaining to the right computer equipment. The most intractable challenge posed by cyber terrorism is that the digital environment that we live in, which enables us to create and share knowledge also provides ample opportunity for the commission of a cyber crime since that environment breeds motivated offenders who can develop covert capabilities that could exploit the vulnerability of the cyber environment. The opportunities the cyber environment offers for subterfuge is another challenge to be overcome. However, the most ominous challenge is the lack of sentinels to guard against crimes committed against the digital world.

[28]David Rivers, AI Warning: Robots Will Need "Chipping" to Stop Murderous Thoughts, *Daily Star*, 22nd February 2018, at https://www.dailystar.co.uk/news/world-news/683829/michio-kaku-robots-artificial-intelligence-murderous-thoughts-reddit-science.

[29]Ray Kurzweil, Don't Fear Artificial Intelligence, *TIME*, December 19, 2014 at http://time.com/3641921/dont-fear-artificial-intelligence/.

2.5 Rapid Urbanization

One of the signal effects of the globalization shift and increased. global competition is migration to cities. In the past 40 years the rate in global migration has tripled, concentrating on urban areas. Half the world is living in cities and the East dominates population spread and growth. In 1950, the western world had 20% of the global population. Now it has only 10%. If China were to be divided into countries along the lines of the European Union in terms of population spread, it would have 99 countries. However, China has to be vigilant and guard against a possible collapse in the future of its "growth targets" in its massive growth impetus that sees what some call "phantom cities and towns" being developed and make sure its managed growth can accommodate this initiative.

Urbanization is the result of economic development and industrialization which impel humans to migrate from rural areas to cities. Authors Peng, Chen and Yen, in their paper Urbanization and its Consequences say: "Demographically, the term urbanization denotes the redistribution of populations from rural to urban settlements over time. However, it is important to acknowledge that the criteria for defining what is urban may vary from country to country, which cautions us against a strict comparison of urbanization cross-nationally. The fundamental difference between urban and rural is that urban populations live in larger, denser, and more heterogeneous cities as opposed to small, sparser, and less differentiated rural places".[30]

At the core of urbanization lies the natural human instinct to better living standards according to a hierarchy of needs. Abraham Maslow, a distinguished philosopher opined that we all live within a hierarchy of needs. The primary need is to be able to breath, have food and drink and shelter. The secondary need is to be safe and secure and be free of personal danger and evil. Some of us take these needs for granted while others consider it futile even to dream of or aspire to these fundamental human needs.

Sustainable development of cities and communities is one of the Sustainable Development Goals of The United Nations. The United Nations has recorded that in 1995 there was a palpable growth and increase in urbanization across the Americas, most of Europe, parts of western Asia and Australia. Continentally, south America was the most prolific in urbanization (except for Guyana). The Report says: "More than 80 percent of the population lived in towns and cities in Venezuela, Uruguay, Chile and Argentina. Levels of urban development were low throughout most of Africa, South and East Asia. Less than one person in three in sub-Saharan Africa was an urban dweller. The figure was below 20 percent in Ethiopia, Malawi, Uganda, Burkina Faso, Rwanda and Burundi. An estimated 40 percent of China's 1.2 billion people and 29 percent of India's 0.96 billion lived in cities and towns. The Himalayan kingdom of Bhutan was reckoned to be the world's most rural sovereign state, with only six percent of its population living in urban places".[31]

[30]Peng et al. (2006a), p. 2.

[31]Peng et al. (2006b), p. 7.