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Background

Introduction

Every civilized nation has some form of rules, regulations, policies, and laws that regulate economic activities and social behaviour. The scope and process for the creation of these guidelines varies widely among nations, depending upon many factors that derive from the form of government and cultures that produce those rules. As a society grows more open and more complex, more rules and regulations may become necessary to maintain order and protect people from harm that may result from the unrestricted activities of others. Those harms can be physical, health related, economic, environmental, or any number of potentially damaging outcomes from a governmental entity, an organization, or an individual doing or failing to do something that threatens the well-being of others. As the technology of unmanned aircraft systems has evolved and more potential users seek to deploy them for recreational, commercial, scientific, or public safety purposes, national and local governments have attempted to address the challenges presented by the integration of remotely piloted aircraft into national civil airspaces, particularly the perception of increased risk of harm to persons or property, by developing regulations that address the risk management and policy issues resulting from the use of these devices.

Since there is no settled overarching international law, treaty, or body of community-based standards that governs unmanned aerial systems (although several such efforts are underway), the developer, manufacturer, distributor, and end user must be wary of the potential for inadvertent violations of existing law, or of having a formerly permitted activity become illegal or proscribed as a result of a change in the rules. Methodologies for understanding the existing rules and participating in the process of developing new or modified rules should be key elements in the business plan for any individual or entity seeking to participate in the unmanned systems arena. Likewise, government regulators can benefit from comprehensive and adaptable criteria for the development of new technologies and the safe integration of those technologies into complex airspace systems.

Setting the Stage for Integration of Remotely Piloted Aircraft into Non-segregated Airspace

Like the oceans, the world's airspace is a public resource, owned by no one. Territorial waters adjacent to continents, islands, and land masses are controlled by the nations that claim sovereignty over the land contiguous to the oceans. International treaties such as the United Nations Conference on the Law of the Sea (UNCLOS) and United Nations Convention on the Law of the Sea (LCOS) establish the criteria for recognition and structure of national territorial waters, setting limits on the extent of those waters and economic zones. There are dozens of such treaties, conventions and instruments dealing with every conceivable aspect of human management of the world's oceans. Disputes often arise about the interpretation of treaty language and there is a forum to resolve those disputes. "Peaceful settlement of international disputes occupies an important place in international law in general and the law of the sea is no exception" (Tanaka 2012). The same can be said for the treaties and conventions that deal with international airspace, specifically the Convention on International Civil Aviation (also known as the Chicago Convention of 1944), which created the International Civil Aviation Organization (ICAO). The similarity between the legal regimes of international and domestic airspace and the high seas (and coastal waters) bears examination, for many aviation regulations are derived from ancient maritime common law.

The Law of the Sea and the Law of the Air

Perhaps the greatest challenge to lawmakers and regulators charged with maintaining an acceptable level of safety in their respective national airspace systems is how to integrate unmanned aircraft into existing aeronautical environments where manned aircraft have been navigating with ever increasing levels of safety for decades. The law of the sea evolved over centuries of commercial shipping activities, and is one of the oldest branches of public international law (Tanaka 2012). The law of the airways has a relatively shorter life, but it has progressed and expanded at a far greater pace than the law of the sea. What makes the laws of the sea and the air similar enough to warrant comparison, and perhaps guidance for aviation professionals and regulators, is that both bodies of law, policy, and regulation deal with access to and the safety of a vast common community resource, to wit: the oceans and the airspace above the Earth and the high seas. While it seems unlikely that two vessels navigating the vastness of the world's oceans could ever collide, they do, far more often than may commonly be known. The European Maritime Safety Agency Annual Overview of Marine Casualties and Incidents 2018 reported an average of 3315 occurrences per year for the four years ending in 2017. In 2017 more than 1500 cargo ships were involved in accidents that resulted in 25 fatalities. Casualties numbered 1018 persons, half related to issues of a navigational nature, such as contacts, grounding/stranding, and collisions. The same observation could be made about the skies. The skies are immense, seemingly limitless, yet airplanes collide, often with catastrophic results. Thus, in both realms, the sea and the sky,

regulations and “rules of the road” are necessary to minimize the risk of such events. The aviation rules for airplanes occupying the same airspace in close proximity to one another generally follow the rules at sea (for example, “... when aircraft of the same category are converging at approximately the same altitude [except head-on, or nearly so], the aircraft to the other’s right has the right-of-way”; similarly, “... when two power-driven vessels are meeting on reciprocal or nearly reciprocal courses so as to involve risk of collision each shall alter her course to starboard so that each shall pass on the port side of the other”).

A Brief History of Aviation Regulations

Although the first powered flight with a pilot on board is attributed to the Wright Brothers (specifically with Orville, the daring one, at the controls) at 10:35 a.m. on 17 December 1903 near Kitty Hawk, North Carolina, the first aviation regulations did not appear for another eight years when Great Britain passed the Aerial Navigation Act of 1911. The British followed that law with a second Aerial Navigation Act of 1913, which transferred the control of aviation activities to the Secretary of State for War. In 1916 the British Air Board was created, which greatly influenced the post-World War I control of civil aviation in Great Britain (Chaplin 2011).

Although the United States did not initiate the first efforts to create aviation safety regulations, the US system of regulations, whether aviation related or not, bears closer examination because the US is historically viewed as a leader in the evolution of aviation regulations world-wide. Regulations, and the supporting standards and guidance materials that help people and organizations comply with them, have been a core component of the legal system in the United States for nearly 150 years. Every federal regulatory agency promulgates rules that are intended to carry out the agency’s legislative mandates. State and local regulatory agencies or commissions act in much the same way.

Lawmakers in most countries generally do not have the luxury of time, expertise, or the resources to define and monitor every element of the particular industry or activity that they undertake to regulate through the enactment of laws that are national in scope. The agencies that the US Congress creates and funds, for example, are delegated the legislative powers that Congress has been granted by Article, Section 1 of the US Constitution. Those delegated powers are implemented through the rule-making process. The oldest federal regulatory agency that still exists in the US is the Office of the Comptroller of the Currency, which was created in 1863 to charter and regulate the nation’s banks. The modern era of federal regulation really began with the creation of the Interstate Commerce Commission (ICC) in 1887, which was directed to protect the public from excessive and discriminatory railroad rates. The regulation was economic in nature, by the setting of rates and by regulating how railroad services were to be provided. The ICC’s administrative model was that of an independent, bipartisan commission that used an adjudicatory approach to arrive at decisions on contested matters. This structure was adopted by several subsequently created agencies, such as the Federal Trade Commission (FTC), the Water Power Commission (later the Federal Power Commission), and the Federal Radio Commission (which became

the Federal Communications Commission). Congress created several other agencies early in the 20th century to regulate commercial and financial systems – including the Federal Reserve Board, the Tariff Commission, the Packers and Stockyards Administration, and the Commodities Exchange Authority, all established before 1922. The Food and Drug Administration was created in 1931 to ensure that certain foods and drugs were fit for human consumption.

Many other federal regulatory agencies were created in the 1930s as part of President Franklin D. Roosevelt’s “New Deal” programs. These included the Federal Home Loan Bank Board (1932), the Federal Deposit Insurance Corporation (FDIC) (1933), the Commodity Credit Corporation (1933), the Farm Credit Administration (1933), the Securities and Exchange Commission (SEC) (1934), and the National Labor Relations Board (1935). The jurisdictions of both the Federal Communications Commission (FCC) and the Interstate Commerce Commission were also expanded to regulate other methods of communications (e.g. telephone and telegraph) as well as other transportation modes (trucking, pipelines, and common carriers such as bus lines and telephones). The ICC was dissolved in 1995, and its remaining powers were reassigned to the Surface Transportation Board.

The United States’ first attempt to regulate commercial aviation arose out of the US Post Office’s commencement of airmail operations in 1918. The first published aviation regulations were released in 1926 by the Aeronautics Branch of the Department of Commerce, and were known as “Air Commerce Regulations.” They consisted of six chapters spanning 45 pages of text, and covered the areas of Licensing, Marking, and Operation of Aircraft, Licensing of Pilots and Mechanics, Air Traffic Rules, and were rounded out by a miscellaneous section. Aviation is indeed one of the oldest regulated industries or activities in the US. Presently the Federal Aviation Regulations (FARs) fill four volumes of the Code of Federal Regulations, consisting of over 460 sections filling more than 3600 pages, and totaling around 8400 regulations, counting major subparts and sections.

International Civil Aviation Regulations

Outside of the US, aviation regulations vary from country to country, as can be expected. Some countries have aviation rules and regulations similar to the US, but few, if any, are as comprehensive and voluminous. In Europe, for example, each individual country (Member State) has its own set of regulations, developed and enforced by their domestic civil aviation authorities (CAAs). An additional layer of safety rules falls under the regulatory and administrative jurisdiction of the European Aviation Safety Agency (EASA), an agency of the European Union (EU), established in 2002 and consisting of 31 Member States (27 European Union states plus Switzerland, Norway, Iceland, and Liechtenstein observer states). EASA’s role is to provide advice to the European Union for drafting new legislation, implementing and monitoring safety rules, including inspections in the Member States, type certification of aircraft and components, as well as the approval of organizations involved in the design, manufacture, and maintenance of aeronautical products, authorization of third-country (non-EU) operators, safety analysis, and research.

The European Organization for the Safety of Air Navigation, known as “EUROCONTROL,” is the entity that provides harmonized air navigation services across European skies, and is separate from EASA. In 2011 the European Union established another organization, the European Network of Civil Aviation Safety Investigation Authorities (ENCASIA), via Regulation No. 996/2010, whose “... mission is to further improve the quality of air safety investigations and to strengthen the independence of the national investigating authorities.” This organization makes safety recommendations to EASA, but does not create regulations. Thus, each member state has the option to create and maintain its own aviation safety organization with attendant powers to investigate accidents and impose sanctions on violators of their domestic regulations.

The 1944 Chicago Convention on International Civil Aviation (which created the International Civil Aviation Organization, ICAO) generally and comprehensively sets forth international standards and recommended practices for aviation (as provided in Article 37). Consistent with Article 26 of the Convention, Annex 13 deals with aircraft accident and incident investigation. The Annex states that investigation of serious accidents and incidents is to be conducted by the State where the accident or incident occurs, or where the State of Registry when the location of the accident or serious incident cannot definitely be established as being in the territory of any State. In addition, a State may delegate the task of conducting the investigation to another State or request its assistance. By virtue of this Annex, EASA should be invited to participate in a safety investigation “... in order to contribute, within the scope of its competence, to its efficiency and to ensure the safety of aircraft design, without affecting the independent status of the investigation. National civil aviation authorities should be similarly invited to participate in safety investigations.”

The foregoing structure is similar to the United States’ system, where all aviation regulations and air navigation services fall under the purview of one agency, the Federal Aviation Administration (FAA), a subdivision of the US Department of Transportation (DOT). However, investigations of aviation accidents are solely vested in another agency, the National Transportation Safety Board (NTSB), an independent agency of the United States Government, and, unlike the FAA, is not a sub-agency of the Department of Transportation. The NTSB has no regulatory or enforcement powers. In addition to investigating transportation accidents, the NTSB also provides administrative, quasi-judicial review process for FAA enforcement actions by Administrative Law Judges (ALJs), who preside over a wide variety of FAA enforcement matters. In summary, the major difference between the European and American systems is that each EU Member State creates its own aviation regulations, and commits to harmonizing their domestic regulations with EASA and EU aviation safety standards, as well as remaining in compliance with the International Civil Aviation Organization’s requirements. In contrast, there is only one overarching set of aviation regulations in the US, and the individual states generally have little or no power to create their own regulations. The legal and policy tug-of-war between state, local, and federal government regulatory power over aviation activities is controversial, falling under the broad theme of “preemption,” but that is a discussion for another book. Some state and local governments have enacted legislation that impact low-level (generally below 400 ft AGL) unmanned aircraft operations, and the extent to which they can do so without running afoul of federal law, and the FAA’s declared policy, has yet to

be definitively decided in US courts. There is no such gray area between EU Member State regulations and the rules of the road established and agreed upon by the members of EUROCONTROL and EASA.

Another major distinction between EASA and NTSB is that the former is only chartered to oversee aviation safety, whereas the NTSB also has more or less exclusive jurisdiction over other non-aviation transportation sectors, such as railway, highway, marine, and pipeline. NTSB investigators will respond anywhere in the world to aviation accidents involving products manufactured in the US. The NTSB “Go Teams” only respond to accidents that occur on US territory or in international waters. Elsewhere, the lead investigator is by default the government in whose territory the accident occurs, often assisted by a US “accredited representative” from the NTSB’s staff of “investigators in charge” (IICs) if a US carrier or US manufactured airplane is involved.

Virtually every member of the United Nations (currently numbering 193 Member States and 2 non-member observer states) has its own version of domestic aviation regulations, which for the most part is patterned after the Chicago Convention articles and annexes. As noted above, the Chicago Convention established the International Civil Aviation Organization as a means to secure international cooperation and the highest possible degree of uniformity in regulations and standards, procedures, and organization regarding civil aviation matters. The Convention produced the foundation for a set of rules and regulations regarding air navigation as a whole, with the intent to enhance safety in flying by laying the groundwork for the application of a common air navigation system throughout the world.

ICAO works in close cooperation with other members of the United Nations family, such as the World Meteorological Organization, the International Telecommunication Union, the Universal Postal Union, the World Health Organization, the International Maritime Organization and the Arctic Council. Aviation-related non-governmental organizations (NGOs) also participating in ICAO’s efforts include the International Air Transport Association, the Airports Council International, the International Federation of Air Line Pilots’ Associations, and the International Council of Aircraft Owner and Pilot Associations.

A comprehensive analysis of the aviation regulatory schemes in each and every country that publishes some form of regulation is beyond the scope of this book. However, since ICAO Member States contract to follow ICAO’s rules and supplementary material, and to publish for all to see any exceptions taken to any ICAO Article, Annex, Regional Supplementary Procedure (“SUPPS”) or Procedures for Air Navigations Services (PANS), the beginning point must be the aforementioned ICAO rules and procedures themselves, with particular focus on those provisions related to safe integration and management of domestic and international airspace.

The Chicago Convention and the International Civil Aviation Organization

The Aeronautical Commission of the Peace Conference of 1919 (otherwise known as the Versailles Treaty) created an international agreement (the Convention for the Regulation of Aerial Navigation) that recognized that the airspace above the high seas was not as “free”

as the oceans beneath. The contracting States to that Convention agreed that the States had exclusive jurisdiction over the airspace above the land and territorial waters of the States, but agreed to allow, in times of peace, innocent passage of civil aircraft of other States through their sovereign airspace, so long as the other provisions of the Convention were observed. States still retained the right to create prohibited areas in the interests of military needs or national security. During the years leading up to World War II and throughout that conflict the United States initiated studies and later consulted with its major allies regarding further harmonization of the rules of international airspace, building upon the 1919 Convention. Anticipating the pending termination of the hostilities and desiring to re-establish international transport by air, the US government invited 55 states and civil aviation authorities to attend a meeting to discuss these issues and to promote cooperation and “create and preserve friendship and understanding among the nations and peoples of the world,” and in November 1944, an International Civil Aviation Conference was held in Chicago. Fifty-four nations (they are referred to as “States” in the Convention) attended this conference, and 52 of those nations signed the new *Convention on International Civil Aviation*. The convention created a specialized agency, the International Civil Aviation Organization (ICAO), to oversee the terms of the Convention, and as a means to secure international cooperation and the highest possible degree of uniformity in regulations and standards, procedures, and organization regarding civil aviation matters. The Chicago Conference laid the foundation for a set of rules and regulations regarding air navigation as a whole, which was intended to enhance safety in flying and construct the groundwork for the application of a common air navigation system throughout the world.

ICAO’s many objectives are set forth in the 96 Articles of the Chicago Convention and the 18 annexes thereto. Numerous published supplements (Standards and Recommended Practices, or SARPS) and Procedures for Air Navigation Services (PANS) (which are under continual review and revision) set forth additional standards and guidelines for Contracting States. These Contracting States may take exception to any element of the annexes, and those exceptions are also published. Contracting States are also responsible for developing their own aeronautical information publications (AIPs), which provide more detailed information to ICAO and other States about air traffic, airspace, airports, nav aids (navigational aids), special use of airspace, weather, and other relevant data that are available for use by aircrews arriving into or transiting through the State’s airspace. The AIPs also contain information about the State’s exceptions to the annexes and any significant differences between the rules and regulations of the State and ICAO’s rules.

The annexes cover personnel licensing (Annex 1), rules of the air (Annex 2), meteorological services for international air navigation (Annex 3), aeronautical charts (Annex 4), units of measurement to be used in air and ground operations (Annex 5), operation of aircraft (Annex 6), aircraft nationality and registration marks (Annex 7), airworthiness of aircraft (Annex 8), facilitation of border crossing (Annex 9), aeronautical communications (Annex 10), air traffic services (Annex 11), search and rescue (Annex 12), aircraft accident investigation (Annex 13), aerodromes (Annex 14), aeronautical information services (Annex 15), environmental protection (Annex 16), security-safeguarding international civil aviation against acts of unlawful interference (Annex 17), and the safe transportation of dangerous goods by air (Annex 18). The only reference to unmanned aircraft in the Convention is in Article 8, which states that:

No aircraft capable of being flown without a pilot shall be flown without a pilot over the territory of a contracting State without special authorization by that State and in accordance with the terms of such authorization. Each contracting State undertakes to ensure that the flight of such aircraft without a pilot in regions open to civil aircraft shall be so controlled as to obviate danger to civil aircraft.

ICAO's rules apply to international airspace, which is typically defined as the airspace over the high seas more than 12 miles from the sovereign territory of a State (country), as well as some domestic airspace by virtue of incorporation into a contracting State's own regulatory scheme. The rules just apply to the 193 Member States, so any nation that declines to become an ICAO member is not entitled to the protection of ICAO's rules. However, ICAO is a voluntary organization and there are no provisions for enforcement of the regulations or standards such as those found in the US Federal Aviation Regulations or similar regulatory provisions enacted by the Member States. As a practical matter, a nation that elects to not be an ICAO Member State will find that no foreign air carriers will be allowed to land in that nation's airports, except in an emergency, and that nation's airlines, if any, will not be permitted to operate in the airspace of a Member Nation.

However, even a Member State may find itself isolated and ostracized for a blatant violation of ICAO rules, such as what happened to Belarus in May of 2021 after its leadership engineered the diversion and forced landing of a commercial airline's aircraft in Belarus to detain a political dissident journalist (basically a hijack). The airline (Ryanair) was operating a scheduled flight on an approved international route over Belarus, not intended to land in that country. Belarus military aircraft forced the airliner to land in Belarus and the dissident was taken off the aircraft and placed into custody. In response, the European Union banned Belavia, the national airline of Belarus, from EU airspace, effectively shutting the airline down indefinitely. Other EU Member States and non-EU nations also ceased flights in and out of Belarus, and the US Department of Transportation (at the request of the State Department) issued a final order blocking most travel between the United States and Belarus. All EU nations are ICAO Member States. Article 6 of the Convention gives Contracting States the authority to revoke permission of another State's aircraft to operate over the territory of the Contracting State, so this action by the EU was wholly consistent with the Convention, as well as ICAO's rule.

As a founding member of ICAO and a nation that has a substantial interest in preserving harmony in international commercial aviation, the United States enforces ICAO's rules against US operators to the extent that the ICAO rule has been incorporated into the FARs and does not conflict with domestic regulations. Other ICAO Member States do the same. In 2012 ICAO created a Remotely Piloted Aircraft Systems (RPAS) Panel, designed to deliver standards for unmanned aircraft to ICAO's governing council in 2018. The panel's focus was and is on the development of standards and recommended practices (SARPs) for adoption by the ICAO Council regarding airworthiness, operations, and licensing of remote pilots. The first edition of the "Manual on Remotely Piloted Aircraft Systems" was released in 2015. Also in 2015, ICAO established the Unmanned Aircraft Systems Advisory Group (UAS-AG) to support the Secretariat in

developing guidance material and expedite the development of provisions to be used by Member States to regulate unmanned aircraft systems. The Advisory Group has continued to respond to ICAO's Requests for Information (RFI) in 2017, 2018, and 2019 by holding industry symposia to showcase submissions by interested parties responding to the RFIs. The last scheduled symposium, "Drone Enable/2021" was held virtually in April 2021. The 2020 Rio de Janeiro Symposium was canceled due to the Covid-19 pandemic.

The following chapter will offer a brief look at regulatory efforts around the world that focus on integration of drones into domestic airspace. The European Union is developing its version of unmanned aircraft systems traffic management, called "U-space," and the US is engaged in a parallel effort labeled "UTM," while also participating in the European effort with the intent to harmonize these two major projects. Most other non-EU nations have thus far not taken the deep dive into the integration technology that is ongoing in the US and Europe, but those two undertakings will presumably provide a template for other nations to adopt. The overall picture of global airspace integration efforts intended to merge UAS operations with manned aviation at low levels, as well as higher controlled and uncontrolled airspace, divides the strategies into three broad categories: Unmanned Aircraft Systems Traffic Management (UTM) in the US, "U-space" in the European Union, and an FIMS-based (Flight Information Management Systems) data exchange gateway that connects UTM participants with a nation's air traffic management system, Australia being a good example. Air traffic management (ATM) is the broad descriptor of air traffic control services in all categories airspace.

The details of those strategies are discussed in Chapters 2, 3, and 4.

Conclusion

Aviation regulations have been in place for over a century. They have evolved into a complex and interconnected web of overlapping regulations, acceptable means of compliance, guidance materials, and standards. The introduction of unmanned aircraft into national airspaces around the world may properly be characterized as the greatest technical innovation in aviation since the development and implementation of gas turbine engines for commercial aircraft. This phenomenon has also been the most disruptive to airspace safety, something that cannot be said for jet engines. The next chapter takes us to UAS airspace integration efforts in the European Union, which have been responsive to this disruptive technology.

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