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Unmanned Aerial Vehicles Era. Legal regulatory challenges EU and Ukraine.

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Abstract: The ongoing war in Ukraine has significantly accelerated the development and deployment of unmanned aerial vehicles (UAVs), illustrating how urgent military needs can drive rapid technological innovation. This war has sparked a technical revolution, driven by the imperative to reduce human casualties by replacing soldiers in high-risk tasks with robotic alternatives. At the same time, the implications of these advancements are extending far beyond the battlefield. As UAV technology evolves, it is increasingly adopted by the civil sector, raising questions about how soon drone-based delivery systems might replace human couriers or when personal aerial mobility devices.

Globally, nations are observing the strategic advantages of UAVs and responding with increased investment and innovation, leading to rapid growth in both military and civilian drone markets. However, this swift expansion presents significant regulatory challenges. Existing airspace governance frameworks are ill-equipped to manage the rising volume and complexity of UAV operations.

This thesis explores the current legal frameworks and regulatory practices governing UAVs in the European Union and Ukraine. It argues that governments must urgently address the societal and security implications of UAV integration by adopting flexible, forward-looking regulations. Such measures are essential to balance innovation with public safety, ensuring that technological progress serves the broader interests of society.

Keywords: Unmanned Aerial Vehicles (UAVs), Drone Regulation, UAV Legislation in Ukraine, Civil Drone Usage, Legal Framework for UAVs

Abstrakt auf Deutsch: Der andauernde Krieg in der Ukraine hat die Entwicklung und den Einsatz unbemannter Luftfahrzeuge (UAVs) erheblich beschleunigt und zeigt eindrucksvoll, wie dringende militärische Erfordernisse technologische Innovationen vorantreiben können. Dieser Krieg hat eine technische Revolution ausgelöst, angetrieben durch das Bestreben, menschliche Verluste zu minimieren, indem Soldaten bei gefährlichen Aufgaben durch robotische Systeme ersetzt werden. Gleichzeitig reichen die Auswirkungen dieser Entwicklungen weit über das Schlachtfeld hinaus. Mit dem Fortschritt der UAV-Technologie wird ihr Einsatz im zivilen Sektor zunehmend vorangetrieben – mit Fragen danach, wann drohnenbasierte Liefersysteme menschliche Kuriere ersetzen könnten oder wann persönliche Fluggeräte Realität werden könnten.

Weltweit erkennen Staaten die strategischen Vorteile von UAVs und reagieren mit verstärkten Investitionen und Innovationsanstrengungen, was zu einem rasanten Wachstum sowohl im militärischen als auch im zivilen Drohnensektor führt. Diese schnelle Ausbreitung

stellt jedoch erhebliche regulatorische Herausforderungen dar. Die bestehenden luftrechtlichen Regelwerke sind unzureichend darauf vorbereitet, die steigende Anzahl und Komplexität von UAV-Einsätzen zu bewältigen.

Diese Masterarbeit untersucht die aktuellen rechtlichen Rahmenbedingungen und regulatorischen Praktiken im Umgang mit UAVs in der Europäischen Union und der Ukraine. Sie vertritt die These, dass Regierungen dringend die gesellschaftlichen und sicherheitspolitischen Auswirkungen der UAV-Integration berücksichtigen und durch flexible, vorausschauende Regelungen begleiten müssen. Solche Maßnahmen sind entscheidend, um Innovation mit öffentlicher Sicherheit in Einklang zu bringen und sicherzustellen, dass technologischer Fortschritt dem Gemeinwohl dient.

Schlüsselwörter: Unbemannte Luftfahrzeuge (UAVs), Drohnenregulierung, UAV-Gesetzgebung in der Ukraine, zivile Drohnennutzung, rechtlicher Rahmen für UAVs

List of Abbreviations

BVLOS - beyond visual line of sight

CIS - common information services

DPIA - Data Protection Impact Assessment

DPO - data protection officer

EASA - European Union Aviation Safety Agency

FAA - Federal Aviation Administration

GDPR – General Data Protection Regulation

ICAO - International Civil Aviation Organization

TFEU - Treaty on the Functioning of the European Union

UAS - Unmanned Aircraft Systems

UAVs or drones - Unmanned Aerial Vehicles meaning any aircraft operating or designed to operate autonomously or to be piloted remotely without a pilot on board

VLOS - visual line of sight

FPV - First-Person View

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1.Chapter I. Introduction.

1.1. Subject Matter of the Master Thesis.

I do not intend to focus on the war in Ukraine or the implications of martial law. However, I have been inspired to explore the topic of drones regulations, as I reside in Kyiv during what is currently the largest war in Europe since World War II. Living in these circumstances, I have witnessed firsthand the rapid development and deployment of drone technologies in real combat conditions and in the everyday life of civil population. As a result, some facts and examples referenced in this work will inevitably be linked to the military context and its influence on technological advancement.

Throughout our history wars have repeatedly catalyzed significant technological advancements, driven by the urgent need for better weapons, communication, and logistics. For example, during the World War I the development of the first modern tanks was a direct result of the trench warfare that dominated on the batterfield[1]. During these times the rapid advancements in aviation were also noted, namely the development of fighter aircraft, bombers, and strategic reconnaissance planes. Aerial dogfights and the need for better bombing techniques led to improvements in airplane designs, engines, and weaponry[2]. The use of poison gas spurred the development of protective gear, such as gas masks, and drove advancements in chemical engineering and gas detection technologies[3]. The development of radar was a key technological advance during World War II, used to detect enemy aircraft and ships. This technology later played a significant role in both civilian aviation and meteorology[4]. The need for faster aircraft in 1940ies led to the development of jet engines, first used in military planes and later adapted for commercial aviation[5]. The development of nuclear weapons and atomic energy was one of the most profound technological outcomes of World War II. The Manhattan Project led to the creation of the first atomic bomb, while advancements in nuclear reactors paved the way for future energy

[1] Spencer C Tucker, *Instruments of War: Weapons and Technologies That Have Changed History* (ABC-CLIO 2015) 166–169.
[2] Spencer C Tucker, *Instruments of War: Weapons and Technologies That Have Changed History* (ABC-CLIO 2015) 172–174.
[3] Spencer C Tucker, *Instruments of War: Weapons and Technologies That Have Changed History* (ABC-CLIO 2015) 178–179.
[4] Spencer C Tucker, *Instruments of War: Weapons and Technologies That Have Changed History* (ABC-CLIO 2015) 244–246.
[5] Spencer C Tucker, *Instruments of War: Weapons and Technologies That Have Changed History* (ABC-CLIO 2015) 263–264.

development[6]. The Cold War rivalry between the U.S. and the Soviet Union led to significant advancements in rocket technology and space exploration as well as of satellite technology, including reconnaissance satellites, GPS, and communications satellites. The Gulf War saw the use of advanced satellite communications, surveillance drones, and electronic warfare technologies. The ability to control information on the battlefield became a key component of military strategy and laid the groundwork for future cybersecurity and networked systems[7]. Undoubtedly, this list could be further expanded, vividly depicting how warfare has historically served as a powerful catalyst for innovation and new technical solutions which later found broader applications in civilian life. A remarkably similar narrative is currently unfolding with drone technology.

The earliest instances of Unmanned Aircraft Systems (UAS), commonly referred to as drones, trace back to a variety of primarily military uses. The term "drones" is derived from the name of the male worker bee, symbolizing the potential for scalability of these units. One of the initial uncrewed aircraft to be designed and flown was the Aerial Target, a radio-controlled monoplane developed by de Havilland in 1917. During the Cold War, drones were frequently utilized for aerial target practice by Surface-to-Air Systems and Fighter Aircraft. The advancement of command-and-control technologies, along with satellite communication and navigation in the 1980s, enabled the deployment of larger platforms for reconnaissance missions. This was followed by the introduction of armed drones, such as the Predator UAS, for use in combat. Military applications of drones were primarily governed by the laws of armed conflict and regulations surrounding arms trade and exports[8].

In the mid-20th century, as groups of enthusiasts worldwide began to build and fly scale models of airplanes and helicopters, there emerged a growing need for regulations governing civil, non-military uses of unmanned aerial systems. For a long time, the primary civil use of smaller UAS was model flying and aerobatics, which were mainly recreational activities. During this period, specific regulations were established to govern these activities,

[6] Spencer C Tucker, *Instruments of War: Weapons and Technologies That Have Changed History* (ABC-CLIO 2015) 285–287.
[7] Spencer C Tucker, *Instruments of War: Weapons and Technologies That Have Changed History* (ABC-CLIO 2015) 323–324.
[8] Christian Janke and Maarten Uijt de Haag, ‘Progress and Challenges with the Implementation of European Drone Regulation – Status Quo and Outlook’ (paper presented at 2022 International Conference on Unmanned Aircraft Systems (ICUAS), Dubrovnik, Croatia, 21–24 June 2022) IEEE https://doi.org/10.1109/ICUAS54217.2022.9836165

and model flying was restricted to certain flight areas. Enthusiasts were often organized into model flight associations, and the rules were focused on leisure and sport[9].

Unmanned aircraft or Unmanned Aircraft System (UAS), most often named as Unmanned Aerial Vehicles (UAVs or drones), meaning any aircraft operating or designed to operate autonomously or to be piloted remotely without a pilot on board[10] have become an integral part of various sectors, revolutionizing industries such as agriculture, logistics, constructions, security and surveillance and many others.

Drones were once primarily associated with recreation and toys. Indeed, in their early stages during the 2010s, these technologies were widely used for entertainment purposes. However, over the past 10 years, the capabilities and potential of unmanned aerial vehicles have expanded far beyond these initial associations. As a relatively young technology, drones began entering mass usage.

Over the past decade, drones have found applications almost in all sectors of economy. Each year brings significant advancements, as the potential for innovation in this field remains vast. Notably, the war in Ukraine has significantly accelerated the evolution of UAV technologies, with major advancements occurring within just the past three years.

I vividly recall the moment drones were first "introduced" to the broader public in Ukraine. In March 2022, the first kamikaze drones, equipped with explosives, struck Kyiv. It was an unexpected and shocking development, the civilian population was caught unawares, while the military lacked sufficient capability to effectively respond to the drone incursions. At that time, the drones were relatively loud and slow. One notable incident occurred when a middle-aged woman in Kyiv successfully neutralized a drone that flew too close to her balcony by throwing a jar of homemade tomatoes at it. She became a local celebrity overnight[11].

Since then, drone technologies have evolved at an extraordinary pace. Today, UAVs are capable of performing a wide range of military tasks. This not only reduces the cost of

[9] Christian Janke and Maarten Uijt de Haag, 'Progress and Challenges with the Implementation of European Drone Regulation – Status Quo and Outlook' (paper presented at 2022 International Conference on Unmanned Aircraft Systems (ICUAS), Dubrovnik, Croatia, 21–24 June 2022) IEEE https://doi.org/10.1109/ICUAS54217.2022.9836165

[10] Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency [2018] OJ L212/1, art 3(30)

[11] Ishveena Singh, ''They Were Tomatoes': Ukrainian Woman Who Took Down Spy Drone with a Can' (*DroneDJ*, 8 March 2022) https://dronedj.com/2022/03/08/ukrainian-woman-russian-drone-cucumbers-tomatoes/ accessed 21 May 2025.

combat missions but also enables remote operations that minimize the need for direct human involvement, making warfare both more efficient and more detached.

The use of drones in modern warfare has become a transformative element, with a wide range of applications both in military and civilian contexts. Unmanned aerial vehicles are now used for diverse purposes, such as surveing the territory, identifying and detecting the military equipment and accumulation of manpower in certain locations, transporting goods, evacuating the injured, as well as performing mining and demining operations and attacking the targets. Drones not only offer critical advantages on the battlefield but also help reduce the risks to human life by taking on tasks that were once carried out by soldiers.

Electronic warfare has become an essential element of modern conflict, particularly in countering the growing use of unmanned aerial vehicles. As drone technology rapidly evolves, so too does electronic warfare, progressing in parallel as both an offensive and defensive tool. Techniques such as signal jamming, GPS spoofing, and radio frequency interference are now commonly used to detect, disrupt, or disable UAVs in real time. This technological arms race, between increasingly sophisticated drones and equally advanced electronic warfare systems, continues to shape the dynamics, tempo, and outcomes of contemporary warfare[12].

This technological gap highlights a key dimension of modern drone warfare: the balance between affordability and resilience. As both UAV and electronic warfare technologies continue to evolve, the strategic value of even small-scale drones in high-intensity combat zones becomes increasingly apparent. In many cases, the ability to conduct precise, remote operations at a fraction of the cost of traditional weapons systems is redefining the economics and tactics of the battlefield[13].

In Ukraine, drone production has evolved into a widespread grassroots movement, where innovation is taking place in garages across the country. Ordinary people are creating impressive drones, often referred to as "masterpieces," that are perfectly suited for the unique demands of frontline combat. This phenomenon is reminiscent of the early days of Apple, when Steve Jobs and Steve Wozniak began building their groundbreaking

[12] Daly Jess, ‘How Ukraine Defends Against Russia’s Invisible Onslaught of Electronic Warfare’ (United24 Media, 20 March 2025) https://united24media.com/war-in-ukraine/how-ukraine-defends-against-russias-invisible-onslaught-of-electronic-warfare-6868 accessed 24 May 2025.
[13] Baghai Christian, ‘How Ukraine’s Underground Drone Makers Are Changing the Face of War’ (Medium, 30 December 2023) https://christianbaghai.medium.com/how-ukraines-underground-drone-makers-are-changing-the-face-of-war-7eb27f28f31b accessed 24 May 2025.

technology in a garage. Several domestic manufacturers are now at the forefront of developing First-Person View (FPV) drones, including notable names such as Grím[14], Shark[15], Shershni (Wild Hornets)[16]. These companies are not only innovating rapidly but also scaling production to meet the increasing demands of the battlefield.

The spirit of ingenuity and resourcefulness in Ukraine has given rise to a thriving community of makers and engineers, developing drones that are not only efficient and effective but also tailored to the specific needs of modern warfare in our country. These homemade drones have proven to be invaluable, capable of performing a range of tasks from reconnaissance to precision strikes, often at a fraction of the cost of commercially available military drones[17].

Much like the early days of the tech industry, where small, passionate teams could develop products that would change the world, Ukraine's drone revolution demonstrates the power of grassroots innovation and the profound impact it can have on modern warfare.

For military applications, the capabilities of these drones are expanding significantly. Some models, such as the Vampire drone, are engineered to carry payloads of up to 15 kg, to heights of 400 meters with a flight range of 10 km, far surpassing the capacity of standard tactical drones. These heavy-lift drones are used for a variety of defense operations, ranging from direct strikes to advanced reconnaissance missions. Their ability to deliver high-quality video footage from challenging environments provides critical real-time intelligence to ground forces, enhancing situational awareness and decision-making on the front lines[18].

This surge in local manufacturing also reflects a larger trend of decentralization and rapid prototyping, where small teams or startups, often working in improvised settings, are producing highly effective combat tools at record speed. The fusion of civilian technology, military need, and grassroots innovation has created an ecosystem where UAVs are no

[14] Kozatskyi Sania, 'Ukrainian Kamikaze Drone "Grim" Passed Flight Tests' *Militarnyi* (3 October 2021) https://militarnyi.com/uk/news/ukrayinskyj-dron-kamikadze-grim-projshov-lotni-vyprobuvannya/?utm accessed 25 May 2025.
[15] Zoria Yuri, 'Ukrainian Drone Maker Ukrspecsystems Expands Internationally with Polish Representation Deal' (Euromaidan Press, 3 September 2024) https://euromaidanpress.com/2024/09/03/ukrainian-drone-maker-ukrspecsystems-expands-internationally-with-polish-representation-deal/ accessed 25 May 2025.
[16] Wild Hornets, 'FPV Drones. Ukrainian UAV Manufacturer, Wild Hornets' https://wildhornets.com/en/ accessed 25 May 2025.
[17] Baghai Christian, 'How Ukraine's Underground Drone Makers Are Changing the Face of War' (Medium, 27 February 2024) https://christianbaghai.medium.com/how-ukraines-underground-drone-makers-are-changing-the-face-of-war-7eb27f28f31b accessed 24 May 2025.
[18] Struck Julia, 'Ukrainians Deploy Heavy Vampire Drones to Transport Robot Dogs to Frontlines' (Kyiv Post, 25 September 2024) https://www.kyivpost.com accessed 23 May 2025

longer just support instruments, they have become central assets in Ukraine's defense strategy[19].

In the broader scope of modern military operations, drones are part of a technological revolution that has transformed how combat is conducted. Command centers have adapted to this shift, often resembling advanced gaming environments where operators use joysticks, gaming chairs, and multiple screens to control the drones. This technological approach represents a new way of engaging with warfare, where strategy and decision-making are increasingly facilitated by cutting-edge tools.

While practical implementation and innovation have surged ahead, especially in the defense sector, the legal framework has struggled to keep pace. The most advanced and structured regulations currently exist within the military domain, where Ukrainian defense standards are increasingly aligned with NATO and EU practices, ensuring effective and secure integration of drone technologies into combat operations.

However, when it comes to civilian applications, regulatory oversight remains limited and underdeveloped in Ukraine. There is a lack of clear legislation governing aspects such as certification, airspace coordination, privacy, and safety, which creates legal uncertainty for both developers and users. In Ukraine, UAVs weighing less than 20 kg are not subject to mandatory registration, whereas in the European Union, the registration threshold is significantly lower at 250 grams; this disparity raises considerable security concerns for Ukraine, as the higher threshold may allow for unregulated commercial drone use and increased potential for misuse. Compounding the issue is the grassroots nature of much of Ukraine's drone innovation, many UAVs are assembled by volunteers or enthusiasts working in home garages or small workshops. While this bottom-up approach has driven remarkable ingenuity and adaptability, it also highlights the urgent need for formal legal structures to support, standardize, and scale these efforts responsibly[20].

When talking about the European Union, considerable efforts have been made in recent years to regulate drones, with significant strides toward creating a comprehensive

[19] Kesteloo Haye, 'Ukraine's Kitchen-Top Drone Revolution: Citizens Join the Fight Against Russian Invasion' (DroneXL, 16 October 2024) https://dronexl.co/2024/10/16/ukraines-drone-revolution-citizens-join-fight-against-russian-invasion/ accessed 24 May 2025.

[20] Drap'yatyi Bogdan, 'Проблемні питання правового регулювання застосування безпілотних літальних апаратів в Україні та шляхи їх вирішення [Problematic Issues of Legal Regulation of the Use of Unmanned Aerial Vehicles in Ukraine and Ways to Solve Them]' (Censor.NET, 18 April 2023) https://censor.net/ua/blogs/3412889/problemn_pitannya_pravovogo_regulyuvannya_zastosuvannya_bezplotnih_ltalnih_aparatv_v_ukran_ta_shlyahi accessed 24 May 2025.

legal framework. The EU has adopted solid legislation aimed at ensuring the safety, security, and integration of drones into European airspace, addressing key concerns such as privacy, air traffic management, and safety standards. However, despite these advancements, numerous challenges remain, with several aspects of drone usage still lacking clear regulatory oversight. These unresolved issues include concerns related to the scope of operational limits and the evolving technology of drones and misuse of drones, highlighting the need for further refinement and adaptation of EU drone regulations. Moreover, each EU member state has its own set of peculiar regulations and interpretations of drone laws, which adds complexity to the enforcement and uniformity of drone regulations across the region[21].

1.2. Objectives of the Master Thesis.

The primary objective of this master's thesis is to analyze the current state of legislation governing Unmanned Aerial Vehicles, with a particular focus on the European Union and Ukraine. This research aims to examine UAV-related legal frameworks, policy developments, and legislative acts that have shaped current regulatory approaches. By providing context through some historical insights, the thesis will highlight how the rapid pace of technological advancement in UAV development has increasingly outstripped the capacity of existing legal systems to adapt. The ultimate goal is to demonstrate that technological progress in the UAV sector often overlaps and outpaces legislative efforts, thereby emphasizing the urgent need for more flexible, forward-looking regulatory models that can respond to ongoing innovation while ensuring safety, accountability, and public trust.

[21] Janke Christian and Uijt de Haag Maarten, 'Progress and Challenges with the Implementation of European Drone Regulation – Status Quo and Outlook' (paper presented at 2022 International Conference on Unmanned Aircraft Systems (ICUAS), Dubrovnik, Croatia, 21–24 June 2022) IEEE https://doi.org/10.1109/ICUAS54217.2022.9836165

2. Chapter II. Current system of legal regulations for UAVs, practices in EU and Ukraine.

2.1. Chicago Convention on International Civil Aviation and UAVs.

Interesting is that to grasp the principles of drone usage we have to go back to very distant 1944 when in Chicago a Convention on International Civil Aviation was signed by 52 states[22]. The Convention entered into force on 4 April 1947. According to the Convention the International Civil Aviation Organization (ICAO) was created and in October 1947 the ICAO became a specialized agency of the United Nations linked to Economic and Social Council[23]. The Convention on International Civil Aviation set forth the purpose of ICAO by stating in its preamble that the future development of international civil aviation can greatly help to create and preserve friendship and understanding among the nations and peoples of the world, yet its abuse can become a threat to the general security and it is desirable to avoid friction and to promote that co-operation between nations and peoples upon which the peace of the world depends. The undersigned governments have agreed on certain principles and arrangements in order that international civil aviation may be developed in a safe and orderly manner and that international air transport services may be established on the basis of equality of opportunity and operated soundly and economically.

As of the present day, the Convention on International Civil Aviation, commonly known as the Chicago Convention, remains in force and continues to serve as the cornerstone of international civil aviation law. The Convention has undergone several amendments since its initial adoption in 1944, with the current and authoritative version being the Ninth Edition. As of the present it enjoys widespread international support, with 193 member states[24] committed to its principles and regulatory framework, reflecting a near-universal consensus on its importance to global aviation governance. Ukraine ratified the Convention in 1992[25], thereby aligning its civil aviation standards with the global framework established by the ICAO. The European Union, while not a contracting party in its own right, actively supports and implements the Convention's provisions through its member states

[22] Ruwantissa I R Abeyratne, *Convention on International Civil Aviation: A Commentary* (Springer International Publishing 2014) preface v.
[23] Convention on International Civil Aviation (opened for signature 7 December 1944, entered into force 4 April 1947) 15 UNTS 295 https://www.icao.int/publications/pages/doc7300.aspx
[24] https://www.icao.int/about-icao/pages/member-states.aspx/?utm accessed 27 May 2025
[25] Convention on International Civil Aviation 1944 (signed 7 December 1944, entered into force for Ukraine 9 August 1994) https://zakon.rada.gov.ua/laws/show/995_038#Text accessed 22 June 2025.

and has incorporated many of its standards and recommended practices into EU aviation law through various regulations and agreements.

The main reason for initiating and signing of the Convention was prompt development of aircraft industry, which was facilitated by the Word War II as well as establish a framework for international civil aviation that promotes peace, cooperation, and mutual understanding among nations. The Preamble of the Convention articulates this goal by stating that aviation should "build friendship and understanding among the peoples of the world". Moreover, the Convention was compiled and adopted during the last year of the big world war as a post war instrument what found exact reflections in the text[26]. For instance, Articles 92 and 93 regulate admission of other States to the Convention and state that the Convention shall be open to adherence by members of the United Nations and States associated with them, and States which remained neutral during the present world conflict. Adherence is effected by a notification to the Government of the United States of America and is considered to be effected as from the thirtieth day from the receipt of such notification. States other than those may also be accepted if approve by any general international organization set up by the nations of the world to preserve peace, be admitted to participation in this Convention by means of a four-fifths vote of the Assembly and on such conditions as the Assembly may prescribe: provided that in each case the assent of any State invaded or attacked during the present war by the State seeking admission shall be necessary. Article 64 of the Chicago Convention provides that the ICAO may enter into arrangements with any general organization set up by the nations of the world to preserve peace. Article 65 of the Convention provides that ICAO may enter into agreement with international bodies for maintenance of common service and facilitation of its work. Based on aforementioned Articles ICAO entered into agreement with the United Nations and at the first ICAO Assembly in May 1947, Resolution A1-2 was unanimously adopted by the 32 Contracting States present at the 3rd Plenary Meeting. This resolution approved the relationship agreement with the United Nations (UN) officially making ICAO a specialized agency of the UN. Under this agreement, both organizations commit to cooperate as necessary to fulfill provisions of the Chicago Convention and the UN Charter.[27] According to Article II of the mentioned agreement with UN ICAO transmits to the General Assembly of UN applications on adherence of all member states other than those provided in Articles 91 and 92 (a) of the

[26] Ruwantissa I R Abeyratne, *Convention on International Civil Aviation: A Commentary* (Springer International Publishing 2014) 3-5.
[27] International Civil Aviation Organization, 'ICAO and the United Nations' (ICAO, 3 October 1947) https://www.icao.int/about-icao/History/Pages/icao-and-the-united-nations.aspx accessed 28 May 2025.

Chicago Convention. The Assembly is empowered to recommend the rejection of such application. At the same time Article 92 is unequivocal that member State of the United Nations should deposit their instruments of ratification or adherence to the United States. ICAO is not influencing such deposit, and the United States transmit their advice to the ICAO on the fact[28].

Article 35 explicitly restricts military cargo from the list of possible goods to be accepted by stating that no munitions of war or implements of war may be carried in or above the territory of a State in aircraft engaged in international navigation, except by permission of such State. And lastly, Chapter XIX “War” which contains only one Article 89, with its only chapter though is fully devoted to the topic of functioning in conditions of war, laying down that in case of war, the provisions of this Convention shall not affect the freedom of action of any of the contracting States affected, whether as belligerents or as neutrals. The same principle shall apply in the case of any contracting State which declares a state of national emergency and notifies the fact to the Council (meaning the specially acting body of the ICAO). This provision carries significant implications, as it effectively suspends the protections normally granted to civil aircraft, thereby permitting states, in times of war or national emergency, to intervene in civil aviation operations in ways that would otherwise be restricted under international law[29].

Back then it became very clear that in war and in peace times the world must unite to preserve peace and guard air security[30]. Unfortunately, the growing hostile moods and events that reign during last years in the world add sense to these clauses.

The situation back then very much resembles me the modern times when rapid development of drone technologies is basically caused by the need to fight in the Ukrainian war that erupted in 2022.

The Convention in Articles 1-3 defines that the contracting States recognize that every State has complete and exclusive sovereignty over the airspace above its territory. The territory of a State is deemed to be the land areas and territorial waters adjacent thereto under the sovereignty, suzerainty, protection or mandate of such State. The Convention

[28] Ruwantissa I R Abeyratne, *Convention on International Civil Aviation: A Commentary* (Springer International Publishing 2014) 685-686.
[29] Ruwantissa I R Abeyratne, *Convention on International Civil Aviation: A Commentary* (Springer International Publishing 2014) 677-678.
[30] Ruwantissa I R Abeyratne, *Convention on International Civil Aviation: A Commentary* (Springer International Publishing 2014) 7-9.

applies only to civil aircraft, and shall not be applicable to state aircraft, which is the aircraft used in military, customs and police services. No state aircraft of a contracting State shall fly over the territory of another State or land thereon without authorization by special agreement or otherwise. Tthis exemption reflects the recognition that military operations are governed by different legal frameworks and considerations, distinct from those applicable to civil aviation. However, understanding that military/civil cooperation and coordination is of high importance to establish and maintain long-term peace and stability the ICAO encouraged States to apply the principles of the Convention to military aircraft, to the extent that such application is practicable and does not interfere with national security interests.It was important that States developed an integrated and cohesive civil-military coordination strategy with a road map indiacting short and long term objectives[31].

Curious is that the Convention laid down the basic principles of civil aircraft usage in international space that are preserved in the modern regulations further on till today.

It's remarkable that Article 8 of the Convention dwells on the pilotless aircraft, which itself sounds unbelievable remembering that the text goes back to the middle of the previous century. Still, this is explained by the fact that back then when the drone technologies were not yet known, this regulation was targeted at the usage of air balloons[32], which have been used in military operations for surveillance since 1794 and actively employed in World War II as a defense against low-flying aircraft[33]. While the Chicago Convention was established in 1944, its principles continue to apply to modern unmanned aerial systems[34]. The Article sets forth 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. This principle is completely preserved in the core modern legislative acts regulating UAV usage, namely: Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency as well as in

[31] Ruwantissa I R Abeyratne, *Convention on International Civil Aviation: A Commentary* (Springer International Publishing 2014) 63.
[32] Ruwantissa I R Abeyratne, *Convention on International Civil Aviation: A Commentary* (Springer International Publishing 2014) 116.
[33] Spencer C Tucker, *Instruments of War: Weapons and Technologies That Have Changed History* (ABC-CLIO 2015) 81-83.
[34] Ruwantissa I R Abeyratne, *Convention on International Civil Aviation: A Commentary* (Springer International Publishing 2014) 116-118.

Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft and Commission Delegated Regulation (EU) 2019/945 of 12 March 2019 on unmanned aircraft systems and on third-country operators of unmanned aircraft systems.

Articles 11 and 12 of the Chicago Convention establish the hierarchy of the air regulations stating that the laws and regulations of a contracting State relating to the admission or departure from its territory of aircraft engaged in international air navigation, or to the operation and navigation of such aircraft while within its territory, shall be applied to the aircraft of all contracting States without distinction as to nationality, and shall be complied with by such aircraft upon entering or departing from or while within the territory of that State. At that each contracting State undertakes to adopt measures to insure that every aircraft flying over or maneuvering within its territory and that every aircraft carrying its nationality mark, wherever such aircraft may be, shall comply with the rules and regulations relating to the flight and maneuver of aircraft there in force. Each contracting State undertakes to keep its own regulations in these respects uniform, to the greatest possible extent, with those established from time to time under this Convention. Over the high seas, the rules in force shall be those established under this Convention[35].

An aircraft is deemed to possess the nationality of the State in which it is registered. This foundational rule affirms the exclusive connection between an aircraft and its State of registration, thereby ensuring clarity in jurisdiction and responsibility. The Convention on International Civil Aviation expressly prohibits dual registration, reinforcing the principle that an aircraft may be registered in one State only. Furthermore, every aircraft engaged in international air navigation is required to display its proper nationality and registration marks, thereby facilitating identification and compliance with international regulatory standards.[36].

The Convention further outlines essential principles of cooperation between States to promote the seamless operation of international air navigation. It sets forth requirements for various critical aspects of aviation, including aircraft radio equipment, certificates of airworthiness, meteorological services, and other air navigation facilities. These measures are designed to ensure interoperability and safety across borders. The Convention also mandates the standardisation of communication systems, procedures, codes, markings,

[35] Ruwantissa I R Abeyratne, *Convention on International Civil Aviation: A Commentary* (Springer International Publishing 2014) 179-184.
[36] Convention on International Civil Aviation (adopted 7 December 1944, entered into force 4 April 1947) 15 UNTS 295 (Chicago Convention), arts 17–19

signals, and lighting. Additionally, it requires States to publish aeronautical maps and charts, contributing to the harmonisation of operational practices and the enhancement of global aviation safety[37]. While the Convention does not specify the exact standards for such air navigating facilities, it entrusts the ICAO with the responsibility to establish international standards and recommended practices. These standards are detailed in various ICAO Annexes, which contracting States are encouraged to adopt. The principle of non-discrimination is enshrined in the Convention, which ensures that the facilities provided by States are accessible to international civil aviation without unjustifiable discrimination. This principle is crucial for maintaining a level playing field among States and promoting the growth of international air transport.[38]

The Convention also enshrines key principles of mutual cooperation among States concerning security, the response to aircraft in distress, and the procedures for the search and investigation of aircraft accidents. These principles are essential to ensuring consistent and effective action in critical situations, fostering a collaborative approach to aviation safety. Furthermore, Article 36 of the Convention grants each contracting State the authority to regulate or prohibit the use of photographic equipment on aircraft flying over its territory, thereby balancing national security concerns with the right to freedom of air navigation.

In addition, Article 37 establishes the ICAO's right to adopt international standards, recommended practices, and procedures in a wide range of aviation-related matters:

(a) communications systems and air navigation aids, including ground marking,
(b) characteristics of airports and landing areas,
(c) rules of the air and air traffic control practices,
(d) licensing of operating and mechanical personnel,
(e) airworthiness of aircraft,
(f) registration and identification of aircraft,
(g) collection and exchange of meteorological information,
(h) log books,
(i) aeronautical maps and charts,
(j) customs and immigration procedures,

[37] Convention on International Civil Aviation (adopted 7 December 1944, entered into force 4 April 1947) 15 UNTS 295 (Chicago Convention), art 28
[38] Ruwantissa I R Abeyratne, *Convention on International Civil Aviation: A Commentary* (Springer International Publishing 2014) 343-346.

(k) aircraft in distress and investigation of accidents[39].

2.2. ICAO and the Unmanned Aviation.

ICAO actively develops the stream on unmanned aviation and advanced air mobility nowadays. In June 2020 ICAO published a model regulatory framework for unmanned aircraft systems that operate outside of the Instrument Flight Rules International arena[40]. At request of its Member States ICAO made research into the best practices of the regulations of the member states, inter alia Vanuatu, New Zealand, Australia, Canada and the United States, identified commonalities and best solutions that would be consistent with the ICAO aviation framework and that could be implemented by a broad range of States and compiled a unified version of model regulation and the advisory circulars. These model regulations were limited to the certification and safe operations of UAS and did not address sanctions against violations or discretionary topics specific to national consideration such as, privacy or insurance. The model regulations were not intended to be prescriptive for the member states but offered the model language for States to facilitate the establishment of UAS regulations. It was recognized that each member State might have specific national legislative requirements and thus the regulations might not be the same for all States, and therefore the model regulations could be used to some extent appropriate to meet specific needs as each state decides. Important is that ICAO explicitly stated that the model regulations did not supersede or replace applicable Annexes to the Chicago Convention. The ICAO Model UAS regulations are accompanied by Advisory Circulars (AC) and guidance material. The ACs and guidance material serve as a template for ICAO member States to implement or to supplement their existing UAS regulations. These regulations and ACs have been created to serve as a living document, internationally harmonized material based on the latest developments of this the industry.

The outcomes of this activity are ICAO Model UAS Regulations titled Parts 101, 102 and 149 that provide a structured and harmonized framework for the safe and efficient integration of unmanned aircraft systems (UAS) into national airspace, especially in countries where UAS legislation is still developing[41].

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[39] Ruwantissa I R Abeyratne, *Convention on International Civil Aviation: A Commentary* (Springer International Publishing 2014) 415.

[40] International Civil Aviation Organization, ICAO Model UAS Regulations (ICAO, 2022) https://www.icao.int/safety/UA/Pages/ICAO-Model-UAS-Regulations.aspx accessed 22 June 2025.

[41] International Civil Aviation Organization, *Model UAS Regulations: Parts 101, 102 and 149* (ICAO 2022) https://www.icao.int/safety/UA/Pages/Model-UAS-Regulations.aspx

As another unifying initiative, the International Civil Aviation Organization (ICAO) published the Unmanned Aviation Bulletin 2018–2020, which compiles notable practices in the use of unmanned aerial vehicles across various regions, as well as an overview of regulatory approaches adopted by different states.

According to the International Emergency Drone Organization, as cited in ICAO Bulletin 2020/1, the global deployment of unmanned aircraft has steadily increased in support of emergency and rescue operations. These include missions conducted during the COVID-19 pandemic, as well as in response to urban and forest fires, floods, and earthquakes. Unmanned aircraft systems have proven instrumental in assisting first responders, such as firefighters, police officers, paramedics, and medical personnel, by providing operational flexibility and enhanced safety in complex and high-risk environments.

In a similar vein, the Japan UAS Industrial Development Association reported that Japan Airlines conducted two beyond visual line-of-sight (BVLOS) flights using an 80 kg unmanned aircraft to explore the establishment of new logistics networks across remote islands. During these operations, the aircraft successfully transported 20 kg of fresh fish from Kamigoto Airport to Saiki City, covering a distance of 35 kilometres. This example underscores the growing potential of UAS not only in emergency response but also in commercial logistics, especially in geographically isolated regions.[42]

With reference to the official webpage of the French government, as cited in ICAO Bulletin 2019/1, France introduced a new legal framework governing unmanned aircraft operations through the adoption of Law No. 2016-1428 of 24 October 2016, aimed at strengthening the safety of civil unmanned aircraft. This framework was supplemented by two implementing decrees that provide further regulatory precision.

Under this regime, remote pilots operating unmanned aircraft weighing 800 grams or more are required to undergo mandatory training.[2] In addition, such aircraft must be electronically registered and recorded in a dedicated unmanned aircraft registry maintained by the French Civil Aviation Authority. Remote pilots must be able to present a current copy of the registration certificate, either in digital or printed form, upon request during

[42] International Civil Aviation Organization, *Unmanned Aviation Bulletin 2020/1* (ICAO 2020) https://www.icao.int/safety/UA/Pages/Unmanned-Aviation-Bulletin.aspx

inspections. These measures reflect a broader trend toward formalising UAS governance through risk-based, traceable, and accountable frameworks at the national level.[43]

As published in ICAO Bulletin 2018/1, one of China's largest online retailers, JD.com, announced plans to expand services to rural areas by constructing 185 drone airports in southwest China. The initiative aimed to enable the delivery of agricultural products from the Sichuan province to any location in China within 24 hours, while reducing logistics costs by up to 70%. This development exemplifies how unmanned aircraft systems (UAS) are being leveraged to overcome geographic and infrastructural barriers, particularly in remote regions.

In Europe, growing concerns over the safety, privacy, and security implications of drone operations have prompted stricter regulatory measures. According to Reuters, drones that pose a significant risk, such as those capable of causing injury upon impact or threatening data protection and environmental safety, must be registered. A drone is classified as "dangerous" if it possesses a kinetic energy of more than 80 joules, a determination based on its mass and maximum speed.

The United Kingdom has similarly observed a sharp rise in safety concerns. In 2016, proximity incidents between drones and manned aircraft more than doubled, increasing from 40 in 2015 to 94 in the following year. In response, the UK government proposed a series of measures aimed at ensuring drones are operated safely and legally. These included mandatory registration for drone owners to improve traceability and accountability, and potential restrictions such as banning all drones from flying above 400 feet or near airports.[44]

In response to the rapid evolution of unmanned aviation technologies, ICAO continues to play a central role in fostering international cooperation and in developing harmonised regulatory frameworks. Its efforts aim to guide the safe, secure, and coordinated integration of UAVs into national and international airspace systems, ensuring that innovation proceeds without compromising aviation safety or public interest.

[43] International Civil Aviation Organization, *Unmanned Aviation Bulletin 2019/1* (ICAO 2019) https://www.icao.int/safety/UA/Pages/Unmanned-Aviation-Bulletin.aspx
[44] International Civil Aviation Organization, *Unmanned Aviation Bulletin 2018/1* (ICAO 2018) https://www.icao.int/safety/UA/Pages/Unmanned-Aviation-Bulletin.aspx

2.3. Single European Sky and UAVs.

The Single European Sky (SES) is an ambitious EU initiative aimed at reforming the fragmented airspace structure in Europe, enhancing the efficiency, safety, and sustainability of air traffic management. It seeks to unify airspace boundaries across EU Member States to function as a single coordinated airspace, rather than as a patchwork of national systems[45]. When dwelling on the UAV EU regulations it is important to outline that in EU the Single European Sky concept was established by Regulation (EC) No 551/2004 of the European Parliament and of the Council of 10 March 2004 on the organisation and use of the airspace in the single European sky (hereinafter - Regulation (EC) No 551/2004). This Regulation formed part of the first legislative package aimed at restructuring the airspace of the European Union as a functionally integrated block, irrespective of national boundaries, for the purpose of enhancing air traffic management (ATM) efficiency, safety, and environmental sustainability.

A key component of the European Union's regulatory architecture for airspace management is found in Article 1 of Regulation (EC) No 551/2004, which established the legal foundation for the design and management of a unified European airspace framework. The Regulation was designed to apply to airspace within the ICAO European and Africa–Indian Ocean regions where Member States were responsible for the provision of air traffic services (ATS), in accordance with related service provision legislation. Additionally, Member States were permitted to apply the Regulation to airspace under their responsibility in other ICAO regions, provided that they notify the European Commission and the other Member States accordingly[46].

Regulation (EC) No 551/2004 mandated the establishment of common procedures and standards concerning airspace classification, route structure, and air navigation service provision, under a coordinated framework led by the Commission and national authorities. One of its most significant contributions is the facilitation of Functional Airspace Blocks (FABs), which transcend national borders to allow for more flexible and performance-based airspace management. Moreover, the Regulation promoted the interoperability of systems

[45] Council Regulation (EC) No 551/2004 of the European Parliament and of the Council of 10 March 2004 on the organisation and use of the airspace in the single European sky [2004] OJ L96/20, recitals 1-3.
[46] Council Regulation (EC) No 551/2004 of the European Parliament and of the Council of 10 March 2004 on the organisation and use of the airspace in the single European sky [2004] OJ L96/20, art 1.

and reinforced the need for coordinated civil–military airspace usage, a vital consideration for both safety and efficiency[47].

Importantly, the Regulation serves as a cornerstone in the legal development of SES and underpins several subsequent legislative instruments, including those governing the integration of unmanned aircraft systems (UAS) and the establishment of U-space - the EU's framework for the safe and scalable integration of drones[48]. As such, Regulation (EC) No 551/2004 not only reflects the EU's commitment to modernising air traffic management but also plays a pivotal role in enabling the cross-border operation of both manned and unmanned aircraft, thereby contributing to the broader goals of EU aviation law harmonisation[49].

The SES framework is underpinned by a series of regulations and directives designed to harmonize air traffic management across EU member states. Central to this structure is the role of the Network Manager (NM), an entity responsible for coordinating air traffic flows and ensuring the efficient use of airspace. The European Commission, in collaboration with EUROCONTROL, provides oversight and strategic direction. Despite these efforts, the legal and organizational landscape remained complex. Variations in national regulations, differing levels of technological advancement among member states, and challenges in harmonizing operational procedures have led to a fragmented air traffic management system. This fragmentation complicates crisis response efforts, as coordination among diverse entities with varying capabilities and protocols becomes increasingly difficult. To depict as an example the following situations led to significant gaps in inter-state communications and constituted serious challenges for SES management: the war in the Balkans in 1999, when airspace and airports in Croatia, Bosnia, FRY (Federal Republic of Yugoslavia), FYROM (Former Yugoslav Republic of Macedonia) and Albania were completely closed to air traffic, the terrorist attacks of September 11, 2001, in the US, the eruption of Iceland's Eyjafjallajökull volcano in April 2010, which led to widespread airspace closures across Europe, labor strikes by air traffic controllers in various EU countries[50].

[47] Council Regulation (EC) No 551/2004 of the European Parliament and of the Council of 10 March 2004 on the organisation and use of the airspace in the single European sky [2004] OJ L96/20, arts 4–7.
[48] Bassi Eleonora, 'From Here to 2023: Civil Drones Operations and the Setting of New Legal Rules for the European Single Sky' (2020) 100 *Journal of Intelligent & Robotic Systems* 493 https://doi.org/10.1007/s10846-020-01185-1 accessed 29 May 2025.
[49] Council Regulation (EC) No 551/2004 of the European Parliament and of the Council of 10 March 2004 on the organisation and use of the airspace in the single European sky [2004] OJ L96/20, art 5.
[50] Markiewicz Marek T, 'The Legal and Organizational Aspects of Crisis Management in the Single European Sky' (2023) 9(2) Safety & Defense 54 https://doi.org/10.37105/sd.202.

Marek Telesfor Markiewicz, in his 2023 article in *Safety & Defense*, offered a range of solutions to strengthen the SES system:

(a) Revise legislation and grant the NM binding decision-making powers during crises would enable it to direct coordinated responses, mitigating the patchwork of national approaches that currently prevail;

(b) Develop in EU a common legal framework for crisis management in air traffic, including clear definitions, activation thresholds, and pre-agreed operational procedures;

(c) Introduce regular joint exercises involving the NM, ANSPs, and national aviation authorities;

(d) Enhance Investment in Cybersecurity and Infrastructure and ivil-Military Coordination.

Part of the issues have been considered in the Regulation (EU) 2024/2803 of the European Parliament and of the Council of 23 October 2024 On the implementation of the Single European Sky (hereinafter - Regulation (EU) 2024/2803) which repealed the Regulation (EC) No 551/2004. As stated in Article 1 of this Regulation, it lays down rules for the creation and effective functioning of the Single European Sky in order to reinforce air traffic safety standards, to contribute to the sustainable development of the air transport system and to improve the overall performance of air traffic management and air navigation services for general air traffic in Europe, with a view to meeting the requirements of all airspace users.

The Regulation establishes rules and incentives for air navigation service providers to modernise technologies, alleviate congestion, and enhance service quality, introduces specific targets for climate and environmental performance for air navigation service providers. Airlines are encouraged to adopt more sustainable practices through a fair charging system. EUROCONTROL has been appointed by the European Commission as the network manager, which is expected to work with stakeholders on the coordinated deployment of network infrastructure in Europe. As the next step the Commission plans to carry out the work to adopt the necessary implementing acts, in accordance with the Regulation as the full potential of the new regulation will depend on implementing measures

that the Commission will now develop, to be adopted subject to Member States' agreement[51].

The Single European Sky initiative envisions a coherent, pan-European airspace network, underpinned by progressively integrated systems of airspace design, network management, and air traffic management. These systems are to be governed by principles of safety, efficiency, interoperability, and technological modernisation, aiming to serve the interests of airspace users, citizens, and the environment. Importantly, the Regulation underpinning the SES framework explicitly excludes military operations and training from its scope. However, it requires that coordination with military authorities be ensured, so that the potential impact of civil regulatory measures on military activities is properly assessed and addressed[52].

The geographical scope of application of the SES Regulation is primarily limited to airspace within the ICAO European region, where EU Member States are responsible for the provision of air traffic services. Nonetheless, Member States are permitted to extend the application of the Regulation to other ICAO regions, provided that they notify the European Commission and the other Member States in advance[53].

A significant advancement under the SES framework is the integration of unmanned aircraft systems (UAS) through the development of a dedicated U-space environment. As highlighted in Recital 32 of the Regulation, the effective traffic management of unmanned aircraft necessitates the availability of Common Information Services (CIS). These services are crucial for the safe, efficient, and scalable integration of drones into controlled airspace, alongside manned aviation.

Under Article 2(22) of the Regulation, the term "common information service" is defined as a service responsible for the dissemination of static and dynamic data essential to the functioning of U-space services. These services support the management of drone operations and enable situational awareness, flight authorisation, and conflict resolution. Pursuant to Article 12, where CIS are provided, the disseminated data must meet integrity and quality standards sufficient to ensure the safe and secure management of unmanned

[51] European Commission, 'Single European Sky Regulation enters into force, aiming for a more efficient and sustainable airspace' (2 December 2024) https://transport.ec.europa.eu/news-events/news/single-european-sky-regulation-enters-force-aiming-more-efficient-and-sustainable-airspace-2024-12-02_en accessed 29 May 2025.

[52] European Commission, 'Single European Sky' (European Commission, 2025) https://transport.ec.europa.eu/transport-modes/air/single-european-sky_en accessed 29 May 2025.

[53] Regulation (EU) 2024/2803 of the European Parliament and of the Council of 23 October 2024 on the implementation of the Single European Sky (recast) [2024] OJ L2803/1, art 1.

aircraft traffic. Furthermore, the framework is designed to enable the shared use of airspace by both manned and unmanned aircraft, reflecting the EU's commitment to integrated, non-discriminatory airspace access.

To safeguard equity and transparency, the Regulation stipulates that all data necessary for UAS operations in U-space must be made available on a non-discriminatory basis. This is without prejudice to considerations of national security, public order, or defence policy. Air navigation service providers, CIS providers, and U-space service providers are required to use such data strictly for operational purposes. Regarding cost recovery, access to CIS data is to be priced based only on the additional costs incurred in making the data available, and where not already covered under Article 30 the cost of data generation, unless such costs are otherwise subsidised by the Member State through public resources.

These provisions are of particular importance, as they demonstrate how the Single European Sky framework has progressively adapted to the rapid emergence of unmanned aerial vehicles. In response to evolving technological and operational realities, the SES regime has begun to incorporate drone-specific regulatory measures, particularly in relation to cross-border UAV operations. This development is reflected in the adoption of Commission Delegated Regulation (EU) 2019/945 and Commission Implementing Regulation (EU) 2019/947, which establish a harmonised framework for the manufacture, operation, and cross-border deployment of UAVs within the European Union[54]. These instruments will be examined in detail below.

2.3.1. Regulatory framework for the U-space. Regulation EU 2021/664.

One of the most significant points of convergence between SES and UAV regulation is the development of U-space - a concept introduced under SES to designate a low-altitude, controlled airspace where drones can operate safely and efficiently, often alongside manned aircraft. Recognizing the need for a harmonized regulatory framework to facilitate the safe integration of drones into the European airspace, the European Union adopted Regulation EU 2021/664 on a regulatory framework for the U-space, effective from January 26, 2023[55] (hereinafter - Regulation EU 2021/664). This legal instrument constitutes a critical

[54] Bassi Eleonora, 'From Here to 2023: Civil Drones Operations and the Setting of New Legal Rules for the European Single Sky' (2020) 100 *Journal of Intelligent & Robotic Systems* 493 https://doi.org/10.1007/s10846-020-01185-1

[55] Commission Implementing Regulation (EU) 2021/664 of 22 April 2021 on a regulatory framework for the U-space [2021] OJ L139/67

component of the broader EU drone strategy and complements existing aviation safety rules[56].

Regulation EU 2021/664 was adopted pursuant to the European Union's legislative competence in the area of air transport, as conferred by Article 100(2) of the Treaty on the Functioning of the European Union (TFEU). This Regulation constitutes a delegated act enacted within the broader legal framework established by Regulation EU 2018/1139[57] which is commonly referred to as the Basic Regulation, which will be discussed in detail below. The Basic Regulation empowers the European Commission to adopt implementing and delegated rules necessary to ensure a high and uniform level of civil aviation safety across Member States. It is complemented by related legal instruments, notably:

- Commission Implementing Regulation EU 2019/947[58], which lays down the rules for drone operations and pilot competency;
- Commission Delegated Regulation EU 2019/945[59], which covers drone product requirements;
- Regulation EU 2021/665[60] and 2021/666[61], addressing certification and air traffic management respectively.

The concept of "U-space" represents a pivotal development in the European Union's regulatory approach to the integration of unmanned aircraft systems into the airspace. It refers to a set of digital and automated services designed to enable the safe, secure, and efficient operation of drones, particularly in airspace below 120 metres above ground level.

[56] European Commission, 'Drones: Commission Adopts New Rules and Conditions for Safe, Secure and Green Drone Operations' (22 April 2021) Directorate-General for Mobility and Transport https://transport.ec.europa.eu/news-events/news/drones-commission-adopts-new-rules-and-conditions-safe-secure-and-green-drone-operations-2021-04-22_en accessed 30 May 2025.

[57] Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and amending Regulations (EC) No 2111/2005, (EC) No 1008/2008, (EU) No 996/2010, (EU) No 376/2014 and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations (EC) No 552/2004 and (EC) No 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) No 3922/91 [2018] OJ L212/1

[58] Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft [2019] OJ L152/45

[59] Commission Delegated Regulation (EU) 2019/945 of 12 March 2019 on unmanned aircraft systems and on third-country operators of unmanned aircraft systems [2019] OJ L152/1

[60] Commission Implementing Regulation (EU) 2021/665 of 22 April 2021 amending Implementing Regulation (EU) 2017/373 as regards requirements for providers of air traffic management/air navigation services and other air traffic management network functions in the U-space airspace designated in controlled airspace [2021] OJ L139/108

[61] Commission Implementing Regulation (EU) 2021/666 of 22 April 2021 amending Implementing Regulation (EU) 923/2012 as regards requirements for manned aviation operating in U-space airspace [2021] OJ L139/114

The framework is intended to support a rapidly growing drone sector while ensuring that such operations do not compromise the safety of manned aviation or the broader airspace environment[62].

Under Article 1 of the Regulation EU 2021/664, which establishes the regulatory framework for the U-space, certain low-risk operations are exempt from compliance with U-space airspace requirements. For instance, this exemption applies to operations involving unmanned aircraft with a maximum take-off mass of less than 250 grams, conducted within visual line of sight (VLOS). Such operations are deemed to present minimal risk to public safety, aviation, or privacy, and are therefore subject to lighter regulatory oversight.

Although military operations are not covered by this regulation, it is considered that military and State aircraft authorities play a key role in the coordination mechanism outlined in Article 18(f) of Regulation (EU) 2021/664, ensuring safety and security throughout the U-space airspace lifecycle, from initial risk assessment to implementation and monitoring. Their involvement is essential for managing both ground and air risks. For instance, short-notice off-airfield landings by military or State aircraft may require rapid adjustments or deactivation of parts of the U-space. In such cases, air traffic control should promptly reconfigure U-space airspace in line with Article 4 of the same Regulation[63].

Before the adoption of Regulation EU 2021/664, the legal landscape governing drone operations across the European Union was fragmented and inconsistent, with Member States applying divergent national rules. This lack of harmonisation created regulatory uncertainty, safety concerns, and barriers to the development of a unified European drone market. The U-space Regulation directly addresses these shortcomings by introducing a coherent, Union-wide framework based on a risk-based and performance-oriented approach.

The Regulation pursues several key objectives that reflect both the complexity of modern drone operations and the strategic interests of the EU. These objectives include:

[62] Lovells Hogan, 'Rising to New Challenges – The EU's Legal Framework for Widespread Commercial Drone Operations' (1 April 2022) https://www.hoganlovells.com/en/publications/rising-to-new-challenges-the-eus-legal-framework-for-widespread-commercial-drone-operations accessed 31 May 2025.

[63] European Union Aviation Safety Agency, Acceptable Means of Compliance and Guidance Material to Implementing Regulation (EU) 2021/664 – Issue 1 (20 December 2022) https://www.easa.europa.eu/en/document-library/acceptable-means-of-compliance-and-guidance-materials/amc-and-gm-implementing accessed 31 May 2025.

- Enabling complex drone operations, particularly in urban areas and other congested environments where traditional aviation rules may be inadequate;
- Ensuring the safe coexistence of manned and unmanned aircraft in shared airspace;
- Facilitating cross-border drone operations within the EU Single Market, thereby eliminating regulatory inconsistencies between Member States;
- Providing legal certainty for UAS operators and U-space service providers, including common standards for data-sharing, safety, and airspace access;
- Promoting technological innovation and competitiveness within the EU drone ecosystem, supporting industry growth and the uptake of advanced digital technologies.

According to Article 2 of the Regulation EU 2021/664, U-space airspace is defined as a UAS geographical zone designated by Member States, in which drone operations are permitted only when supported by U-space services. These services include traffic information, strategic deconfliction, and airspace authorisation mechanisms, which are critical for managing high-density drone operations safely and efficiently.

The U-space Regulation grants Member States the authority to designate specific volumes of airspace as U-space airspace, within which drone operations are permitted only with prior authorization and in accordance with the applicable U-space services. Member States are required to perform an airspace risk assessment in these designated areas using the defined criteria laid out in Annex I of the Regulation. Based on this assessment, Member States must determine several critical elements, including:

- UAS capabilities and performance requirements, ensuring that unmanned aircraft systems (UAS) operating within the designated airspace meet the required safety, operational, and performance standards;
- U-space services performance requirements, ensuring that the services provided to manage UAS traffic and airspace usage are consistent with safety and operational standards;
- The applicable operational conditions and airspace constraints, which may include restrictions on altitude, operational hours, or specific no-fly zones, based on the overall risk assessment of the area (Article 3)[64].

[64] European Union Aviation Safety Agency, Acceptable Means of Compliance and Guidance Material to Implementing Regulation (EU) 2021/664 – Issue 1 (20 December 2022)

The Regulation EU 2021/664 also introduces a significant regulatory concept - the U-space Service Providers (USSPs). USSPs are certified legal entities responsible for delivering U-space services to UAS operators. These services are essential for the management and safe operation of drones within U-space airspace, and as such, only entities that have been certified by national competent authorities or the European Union Aviation Safety Agency (EASA) can operate as U-space Service Providers[65].

In accordance with Articles 3 and 7, U-space service providers are required to establish coordinated arrangements with air traffic service providers (ATSPs) to ensure the safe and efficient management of UAS operations. These arrangements include the exchange of relevant operational data and information to facilitate seamless coordination between manned and unmanned aviation. The integration of U-space services with existing air traffic management systems is crucial for ensuring both safety and operational efficiency in airspace used by both drones and traditional aircraft.

U-space service providers are also mandated to deliver mandatory services, which include but are not limited to:

- Network identification,
- Geo-awareness,
- Traffic information, and
- UAS flight authorization.

Among the obliagtions of USSPs Article 7 of the Regulation imposes specific duties designed to ensure safety, data integrity, and operational interoperability across the U-space ecosystem[66].

USSPs are required, first and foremost, to exchange relevant information with one another necessary for the safe and efficient provision of U-space services. This collaborative duty ensures that all operators and service providers maintain consistent situational awareness and can respond appropriately to real-time developments in the airspace. In

https://www.easa.europa.eu/en/document-library/acceptable-means-of-compliance-and-guidance-materials/amc-and-gm-implementing accessed 31 May 2025

[65] European Union Aviation Safety Agency, 'EASA Certifies ANRA Technologies as First U-space Service Provider' (30 October 2024) https://www.easa.europa.eu/en/newsroom-and-events/press-releases/easa-certifies-anra-technologies-first-u-space-service-provider accessed 31 May 2025.

[66] European Union Aviation Safety Agency, Acceptable Means of Compliance and Guidance Material to Implementing Regulation (EU) 2021/664 – Issue 1 (20 December 2022) https://www.easa.europa.eu/en/document-library/acceptable-means-of-compliance-and-guidance-materials/amc-and-gm-implementing accessed 31 May 2025.

addition, all USSPs must adhere to a common, secure, interoperable, and open communication protocol, which forms the technical foundation for seamless data sharing and integration across different platforms and systems.

Furthermore, Article 7(c) stipulates that any information exchanged between USSPs must comply with specific requirements relating to data quality, latency, and protection, as set out in Annex III of the Regulation. This ensures that the information used for navigation, traffic deconfliction, and other U-space functions is both reliable and timely. Equally, USSPs are under a legal obligation to guarantee access to and the protection of exchanged information, ensuring that sensitive operational data is adequately safeguarded against misuse or cyber threats.

While the Regulation sets out a series of mandatory services, such as network identification, traffic information, and strategic deconfliction, it also allows USSPs to offer optional services. These may include, for example, weather updates, which can enhance situational awareness for drone operators, or conformance monitoring, which assists in ensuring that UAS remain within approved flight parameters. Such optional services contribute to the overall safety and efficiency of drone operations, particularly in high-density or high-risk environments.

To further facilitate coordination and data interoperability within U-space, the Regulation provides for the designation of Common Information Service Providers (CISPs). CISPs play a pivotal role in enabling the exchange of static and dynamic information between USSPs, air traffic service providers (ATSPs), and other relevant stakeholders. This centralised information architecture is essential for ensuring a unified and harmonised operational picture, particularly in complex or congested airspace[67].

The effective integration of UAS into European airspace requires the active coordination and compliance of all relevant stakeholders with a range of regulatory and operational standards. Among the key requirements are adherence to safety management systems, cybersecurity protocols, and data protection legislation, including the General Data Protection Regulation (GDPR). In addition, stakeholders must be prepared to coordinate with law enforcement authorities in cases involving emergencies, public safety threats, or

[67] ENAIRE, 'U-Space and ENAIRE's Role' (ENAIRE, 2025) https://www.enaire.es/services/drones/everything_you_need_to_know_to_fligh_your_drone/uspace_and_enaires_role accessed 31 May 2025.

unlawful activities, ensuring that drone operations do not compromise security or infringe upon individual rights.

At the national level, aviation authorities bear responsibility for the supervision, enforcement, and certification of UAS operators, USSPs, and other entities within their jurisdiction. These authorities are tasked with implementing the U-space framework, approving designated airspace, and overseeing compliance with both EU and national legislation. At the supranational level, the EASA performs a critical role in harmonising standards, coordinating oversight practices, and ensuring regulatory consistency across EU Member States. In May 2025 the EASA issued the first-ever USSP certificate (to ANRA Technologies), setting out a replicable, harmonised path to certification and signalling EASA's central role in ensuring consistent standards for safety, cybersecurity, data protection, and interoperability across EU Member States[68].

Within the broader context of the Single European Sky initiative, the concept of Functional Airspace Blocks (FABs) plays an important role in fostering cross-border cooperation. FABs allow Member States to jointly manage segments of airspace based on operational requirements rather than national boundaries. This philosophy is equally applicable to UAS operations, particularly those falling within the specific or certified categories, where risk levels and complexity necessitate coordinated airspace management[69].

Despite significant progress in the integration of unmanned aerial vehicles into European airspace, full integration remains a work in progress. The European Union has made notable strides with the development of U-space, a set of services designed to safely and efficiently manage drone traffic. However, several challenges continue to hinder the seamless incorporation of UAVs into the existing aviation ecosystem. One of the foremost barriers is the persistent variation in national approaches to airspace restrictions and U-space implementation. While the EU strives for a harmonized aviation framework, Member States have adopted differing timelines, technologies, and regulatory interpretations. These

[68] European Union Aviation Safety Agency (EASA), 'EASA Certifies ANRA Technologies as First U-space Service Provider' (EASA, 15 May 2025) https://www.easa.europa.eu/en/newsroom-and-events/press-releases/easa-certifies-anra-technologies-first-u-space-service-provider accessed 19 June 2025.
[69] European Court of Auditors, Special Report No 18/2017: Single European Sky: a changed culture but not a single sky (Publications Office of the European Union 2017) https://op.europa.eu/webpub/eca/special-reports/single-european-sky-18-2017/en/?utm accessed 20 June 2025.

disparities complicate cross-border drone operations and slow the establishment of a truly unified airspace.

To address challenging topics on 3 April 2025, EUSPA and EUROCONTROL Innovation Hub introduced the integration of the Copernicus Global Human Settlement Layer (GHSL) into U-space's ground risk computation tool. U-space enhances drone safety and efficiency across Europe by managing UAS traffic through services like Specific Operation Risk Assessment (SORA), which heavily depends on population density data. With GHSL's high-resolution maps, the ground risk tool now delivers more accurate assessments of population density for any flight path, refining risk calculations and enabling better-informed decisions on where to avoid or permit drone operations. This helps aviation authorities to design U-space airspaces, mitigate potential ground impact risks, and strengthen safety measures over inhabited areas[70].

2.3.2. Regulation EU 2018/1139 on common rules in the field of civil aviation and establishing EASA

The regulatory framework surrounding UAVs in the European Union remains in the early stages of development, much like the technology itself. As drones have only recently transitioned from niche recreational gadgets and experimental tools to critical instruments in both civilian and military spheres, the corresponding legal landscape has been developing reactively rather than proactively. The pace of innovation in UAV technology has far outstripped the ability of legislators and regulatory bodies to establish comprehensive and harmonized rules across member states.

Only in recent years has the EU begun to implement unified standards for UAV operation, aiming to replace the fragmented national-level regulations that previously governed drone use[71]. The EASA is the central regulatory authority responsible for ensuring aviation safety and environmental protection within the European Union. It develops common safety and environmental rules at the European level, oversees their implementation by member states, and conducts certification, inspections, and

[70] European Union Agency for the Space Programme (EUSPA), 'Copernicus Data in U-Space Airspace Design' (EUSPA, 6 March 2024) https://www.euspa.europa.eu/newsroom-events/news/copernicus-data-u-space-airspace-design accessed 19 June 2025.

[71] Pika Mihelič and Franc Pozderec, 'The Use of Unmanned Aircraft Systems for State Operations in the Republic of Slovenia: Between Legal Confines and Technological Progress' (2023) 2(26) *International Scientific Journal European Perspectives* 27 https://www.ceeol.com/search/viewpdf?id=1357653 accessed 1 June 2025.

standardization activities. EASA has introduced a framework categorizing drones by their weight, intended use, and associated risk, intended to ensure a balance between safety, innovation, and privacy. However, these regulations are still evolving, and many gray areas remain, particularly concerning autonomous capabilities, data protection, airspace integration, and cross-border operations. Regulation EU 2018/1139 primarily addresses aviation law, but UAS operations intersect with many other legal fields. These include fundamental rights, criminal and public security law, product liability, environmental and telecoms law, and data protection. While the Regulation provides limited coordination with other EU laws, it overlooks many sectoral rules that remain under national or international jurisdiction. Future updates should better integrate these overlapping legal areas[72].

Moreover, the dynamic and dual-use nature of UAV technologies serving both civilian and military purposes adds another layer of complexity. While military regulations tend to be more robust and responsive, especially in countries like Ukraine where wartime necessity has driven rapid alignment with NATO and EU standards, civilian drone regulation lags behind. The challenge for EU lawmakers is not only to catch up with the current state of technology but also to create adaptable legal frameworks capable of evolving alongside one of the fastest-growing sectors in modern aerospace and defense[73].

The main basic document which gives a new legal status to the UAV in EU is the Regulation EU 2018/1139 of the European Parliament and of the Council of 4.July 2018 On common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and amending Regulations EC No 2111/2005, (EC) No 1008/2008, EU No 996/2010, EU No 376/2014 and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations EC No 552/2004 and EC No 216/2008 of the European Parliament and of the Council and Council Regulation EEC No 3922/91 (hereinafter – the Regulation EU 2018/1139). This regulation repealed Regulation (EC) No 216/2008, thereby introducing a more comprehensive and harmonised legal regime for civil drone operations across the Union[74].

[72] Eleonora Bassi, 'From Here to 2023: Civil Drones Operations and the Setting of New Legal Rules for the European Single Sky' (2020) 100 *J Intell Robot Syst* 493, 496 https://doi.org/10.1007/s10846-020-01185-1.
[73] Pika Mihelič and Franc Pozderec, 'The Use of Unmanned Aircraft Systems for State Operations in the Republic of Slovenia: Between Legal Confines and Technological Progress' (2023) 2(26) *International Scientific Journal European Perspectives* 29 https://www.ceeol.com/search/viewpdf?id=1357653 accessed 1 June 2025.
[74] Ibid, 30.

Regulation EU 2018/1139 represents a cornerstone in the modernization and harmonization of civil aviation safety across the European Union, even commonly referred to as the “Basic Regulation”. It replaces the previous regulation EC No 216/2008 and significantly broadens the mandate of the EASA. As stated in Article 1 the Regulation EU 2018/1139 is aimed at establishing and maintaining a high uniform level of civil aviation safety in the Union. One of the most notable advancements of this regulation is its explicit inclusion of drones within the scope of EU-level aviation safety oversight. Prior to this, drones with a maximum take-off mass of less than 150 kg were regulated at the national level, resulting in fragmented and inconsistent approaches across Member States. Regulation 2018/1139 transfers regulatory responsibility for all civil drones, regardless of weight, to the EU level, thereby laying the groundwork for a unified, risk-based regulatory system[75]. The Regulation establishes the EU legal framework for civil aviation and distinguishes between civil and state operations, as set out in Article 2(3) and allows Member States to apply its provisions to state operations through an “opt-in” mechanism. This flexible approach lets each state define what qualifies as a public-interest activity under its control. If a state opts in, it must notify the European Commission and EASA[76].

As outlined in recitals 26–28 of the Regulation, it is recognized that technologies enabling unmanned aircraft support a wide range of operations, and such operations should be governed by rules proportionate to the associated risks. Given that unmanned aircraft effectively share the airspace with manned aviation, regulatory frameworks must apply to their use, regardless of the aircraft’s operating mass. Considering the diversity of UAVs and their potential applications across various sectors and environments, it is evident that a risk-based approach and the principle of proportionality must underpin UAV regulation. Accordingly, Member States should be afforded a degree of flexibility to account for specific national characteristics, such as population density, geographical conditions, and social context, while maintaining an appropriate level of safety. Specific provisions on UAVs should also aim to ensure compliance with fundamental rights guaranteed under Union law, particularly the right to respect for private and family life as enshrined in Article 7 of the Charter of Fundamental Rights of the European Union, and the right to the protection of

[75] Bassi Eleonora, ‘From Here to 2023: Civil Drones Operations and the Setting of New Legal Rules for the European Single Sky’ (2020) 100 *J Intell Robot Syst* 493, 495 https://doi.org/10.1007/s10846-020-01185-1.
[76] Mihelič Pika and Pozderec Franc, 'The Use of Unmanned Aircraft Systems for State Operations in the Republic of Slovenia: Between Legal Confines and Technological Progress' (2023) 2(26) *International Scientific Journal European Perspectives* 31 https://www.ceeol.com/search/viewpdf?id=1357653 accessed 1 June 2025.

personal data as set out in Article 8 of the Charter, Article 16 TFEU, and further detailed in Regulation EU 2016/679 of the European Parliament and of the Council.

As outlined in recitals 29 of the Regulation in order to ensure technical coherence and effective spectrum management, the essential requirements applicable to unmanned aircraft, including their engines, propellers, components, and non-installed equipment, should also address electromagnetic compatibility and radio spectrum usage. This is necessary to prevent harmful interference, promote efficient spectrum utilization, and support broader spectrum management goals. Such alignment ensures that the regulatory treatment of unmanned aviation equipment remains consistent with that of manned aircraft and their components, which are likewise subject to certification requirements under this Regulation.

Recognising the need for a proportionate regulatory approach, it is acknowledged that, for certain types of unmanned aircraft, applying the full scope of provisions concerning registration, certification, identification, oversight, and enforcement, as well as those related to the Agency, may not be necessary to ensure an adequate level of safety. In these instances, the use of market surveillance mechanisms established under Union product harmonisation legislation should be considered sufficient and appropriate (recital 30 of the Regulation).

Recital 31 dwells that in light of the potential risks associated with unmanned aircraft operations including those related to safety, privacy, protection of personal data, security, and environmental impact, it became evident that the new Regulation needed to establish clear requirements regarding the registration of both unmanned aircraft and their operators. To support effective oversight and enforcement, Member States should be required to implement digital, harmonised, and interoperable national registration systems. These systems should store uniform basic data concerning registered unmanned aircraft and their operators, in accordance with this Regulation and its implementing acts. Furthermore, such systems must fully comply with applicable Union and national laws governing privacy and the processing of personal data, and the information contained therein should be readily accessible to relevant authorities.

To ensure that regulatory obligations are appropriately tailored to the risk and complexity of specific operations, the conditions, rules, and procedures under which the design, production, maintenance, and operation of unmanned aircraft, as well as the

activities of associated personnel and organisations, require certification should take into account the nature and risk of the type of operation concerned. In particular, these provisions should consider factors such as the size and type of the traffic handled by the responsible organisation or person; whether the operation is open to members of the public; the extent to which other air traffic or persons and property on the ground could be endangered by the operation; the purpose of the flight and type of airspace used; and the complexity and performance of the unmanned aircraft involved (as stated in recital 32).

Section VII of the Regulation EU 2018/1139 is devoted to the generalized regulations of unmanned aircraft and Annex IX sets forth the Essential requirements for unmanned aircraft. Clause 1 of the Annex IX very distinctly puts liability on the operator and the remote pilot of an unmanned aircraft by stating that both of the mentioned subjects must be aware of the applicable Union and national rules relating to the intended operations, in particular with regard to safety, privacy, data protection, liability, insurance, security and environmental protection. The operator and the remote pilot must be able to ensure the safety of operation and safe separation of the unmanned aircraft from people on the ground and from other airspace users. This includes good knowledge of the operating instructions provided by the producer, of safe and environmentally-friendly use of unmanned aircraft in the airspace, and of all relevant functionalities of the unmanned aircraft and applicable rules of the air and ATM/ANS procedures. The producers of the UAV are responsible for ensuring that the unmanned aircraft must be designed and constructed so that it is fit for its intended function, and can be operated, adjusted and maintained without putting persons at risk. The organisation responsible for the production or for the marketing of the unmanned aircraft must provide information to the operator of an unmanned aircraft and, where relevant, to the maintenance organisation on the kind of operations for which the unmanned aircraft is designed together with the limitations and information necessary for its safe operation, including operational and environmental performance, airworthiness limitations and emergency procedures.designing and production of the UAV is also regulated.

Organisations involved in unmanned aircraft design, production, maintenance, operations, related services and training are obliged to ensure compliance with the essential requirements and the relevant delegated act (referred to in Article 58 and the implementing acts referred to in Article 57) which defines standards for design, production, maintenance and operation of aircraft. Such organisation must maintain a proper management system that manages safety risks proportionate to the organisation's type of activity and size as well as establish an occurrence reporting system, as part of the safety management system.

A strong emphasis is placed on safety-related issues, and Clause 2.1 of Annex IX sets out the airworthiness features with which an unmanned aerial vehicle must comply, specifying a defined set of requirements:

(a) Unmanned aircraft must be designed in such a manner that the safety of the operator, as well as that of third parties, whether in the air or on the ground, including the protection of property, can be satisfactorily demonstrated through appropriate safety assessments or testing. This entails ensuring that the design accounts for both normal and abnormal operational scenarios.

(b) Unmanned aircraft must provide product integrity that is proportionate to the risk in all anticipated flight conditions. This includes structural soundness, system reliability, and resilience to foreseeable environmental influences such as wind, temperature variation, and electromagnetic interference.

(c) Unmanned aircraft must be safely controllable and manoeuvrable under all anticipated operational conditions. This includes the ability to maintain control even in the event of one or more system failures, thereby ensuring continued flight safety and minimizing the likelihood of harm to persons or property.

(d) Due consideration must be given to human-factor principles, particularly drawing on established knowledge regarding the safe interaction between humans and technology. This includes the design of interfaces, controls, and procedures in a manner that supports intuitive and error-resistant operation by the remote pilot or operator, thereby reducing the likelihood of human error.

(e) Unmanned aircraft, along with their constituent parts, non-installed equipment, and remote control equipment, must perform their intended functions reliably under all foreseeable operational conditions. This functional integrity must be sustained not only throughout the intended duration of the operation but also for a sufficient period beyond it, accounting for potential delays, extended missions, or emergency contingencies.

(f) The design of unmanned aircraft, including all associated components and remote control systems, must ensure that both the likelihood of failure and the potential severity of its consequences for individuals on the ground and other users of the airspace are appropriately mitigated. This risk mitigation must be carried out in accordance with the principles set out in Article 4(2), which require a proportional approach based on the type and complexity of the operation and its associated risks.

(g) Any equipment used to remotely control an unmanned aircraft during operations must be so as to facilitate flight operations, including means providing situational awareness, and management of any expected situation and emergencies.

(h) Organisations responsible for the design of unmanned aircraft, including their engines and propellers, must implement precautionary measures aimed at minimising safety risks arising from both internal and external conditions known to affect aircraft performance. These precautions include protection against interference by electronic means.

(i) The manufacturing processes, as well as the materials and components used in the production of unmanned aircraft, must ensure that the resulting aircraft consistently meet the intended design specifications. The outcome must be a product that exhibits adequate and reproducible structural and functional performance, fully aligned with the safety and airworthiness standards established in the design phase.

Clauses 2.3 and 2.4 of the Annex IX establish requirements for all individuals involved in the operation of unmanned aircraft, including remote pilots. These individuals must possess the requisite knowledge and skills necessary to ensure the safe conduct of operations, with the level of competence proportionate to the risk associated with the specific type of operation. Where applicable, they must also demonstrate appropriate medical fitness, insofar as it is required to mitigate operational risks effectively.

Unmanned aircraft operations must prioritise the safety of third parties on the ground and other users of the airspace. This includes the obligation to minimise risks posed by both external and internal factors such as environmental conditions by maintaining appropriate separation distances throughout all phases of flight. Furthermore, the operator is responsible for ensuring that the unmanned aircraft is equipped with the necessary systems and equipment such as navigation, communication, surveillance, and detect-and-avoid technologies as well as any additional systems required to support the safety of the intended operation. These requirements must take into account the nature and complexity of the operation, as well as the applicable air traffic regulations and rules of the air at every stage of the flight.

Unmanned aircraft, including their engines, propellers, parts, and non-installed equipment, must be designed and manufactured in accordance with the current state of the art, in such a way as to ensure the effective and efficient use of the radio spectrum. This is essential to prevent harmful interference and to support the reliable operation of

communication, navigation, and control systems, both onboard and in the wider airspace environment (as set in Clause 2.5.2 of the Annex IX).

According to Article 56 of the Regulation EU 2018/1139, depending on the nature and risk associated with the activity, the operational characteristics of the unmanned aircraft, and the specifics of the area of operation, a certificate may be required for the design, production, maintenance, and operation of unmanned aircraft, including their engines, propellers, parts, non-installed equipment, and remote control systems. This certification requirement extends to the personnel involved, including remote pilots, and to the organisations responsible for these activities, in accordance with the delegated acts outlined in Article 58 and the implementing acts referred to in Article 57. While the new Regulation generally limits Member States' authority over UAS, exceptions exist. Under Articles 56(8) and 71, states may adopt national rules, grant exemptions from EU requirements, or request amendments to allow alternative compliance methods[77].

Member States are required to ensure that information regarding the registration of unmanned aircraft and their operators, which are subject to registration as per the implementing acts under Article 57 and point 4 of Annex IX, is stored in digital, harmonised, and interoperable national registration systems. Furthermore, Member States must be able to access and exchange this registration information through the repository established in Article 74[78].

Pursuant to the Part 4 of the Annex IX it is required that the operators of unmanned aircraft shall be registered in accordance with the implementing acts referred to in Article 57, where they operate any of the following:

- unmanned aircraft which, in the case of impact, can transfer, to a human, kinetic energy above 80 Joules;
- unmanned aircraft the operation of which presents risks to privacy, protection of personal data, security or the environment;
- unmanned aircraft the design of which is subject to certification pursuant to Article 56(1) of the Regulation EU 2018/1139.

[77] Mihelič Pika and Pozderec Franc, 'The Use of Unmanned Aircraft Systems for State Operations in the Republic of Slovenia: Between Legal Confines and Technological Progress' (2023) 2(26) *International Scientific Journal European Perspectives* 32 https://www.ceeol.com/search/viewpdf?id=1357653 accessed 1 June 2025.

[78] Bassi Eleonora, 'From Here to 2023: Civil Drones Operations and the Setting of New Legal Rules for the European Single Sky' (2020) 100 *J Intell Robot Syst* 493, 495 https://doi.org/10.1007/s10846-020-01185-1.

Where a requirement of registration applies pursuant to point 4.1 or 4.2, the unmanned aircraft concerned shall be individually marked and identified, in accordance with the implementing acts referred to in Article 57 (as required by the par. 4.3. of the Annex IX).

The Regulation EU 2018/1139 empowers the European Commission to adopt detailed implementing and delegated acts establishing operational rules and technical requirements, to ensure the safe, secure, and efficient integration of drones into European airspace79. In 2019, two key legislative acts were adopted in the European Union to regulate unmanned aircraft systems: Commission Delegated Regulation (EU) 2019/945, which establishes technical requirements for UAS and related equipment, and Commission Implementing Regulation (EU) 2019/947, which sets forth the operational rules for drone use across Member States.

The Commission Implementing Regulation EU 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft (hereinafter – Regulation EU 2019/947) sets forth registration requirements rules and procedures for the registration and marking of unmanned aircraft and for the registration of operators of unmanned aircraft, which are referred to in Section 4 of Annex IX of the Regulation (EU) 2018/1139.

The Commission Delegated Regulation EU 2019/945 of 12 March 2019 on unmanned aircraft systems and on third-country operators of unmanned aircraft systems (hereinafter – Regulation EU 2019/945) lays down the requirements for the design and manufacture of unmanned aircraft systems, establishes rules on making UAS intended for use in the ‘open’ category and remote identification add-ons available on the market and on their free movement in the Union as well as lays down rules for third-country UAS operators, when they conduct a UAS operation pursuant to Implementing Regulation (EU) 2019/947 within the single European sky airspace. The Delegated Regulation 2019/945 and the Implementing Regulation 2019/947 follow the distinction suggested by EASA in the Opinion 01/2018[80], according to which the definition of technical and legal requirements is referred to three categories of UAS operations: open, specific and certified.

[79] Bassi Eleonora, ‘From Here to 2023: Civil Drones Operations and the Setting of New Legal Rules for the European Single Sky’ (2020) 100 *J Intell Robot Syst* 493, 495 https://doi.org/10.1007/s10846-020-01185-1 accessed 30 May 2025.

[80] European Aviation Safety Agency, Opinion No 01/2018: Introduction of a Regulatory Framework for the Operation of Unmanned Aircraft Systems in the ‘Open’ and ‘Specific’ Categories (2018) https://www.easa.europa.eu/document-library/opinions/opinion-012018#group-easa-downloads accessed 30 May 2025.

2.3.3. Commission Implementing Regulation (EU) 2019/947. Registration and usage of UAVs.

Regulation EU 2019/947 provides a comprehensive framework for the operation of Unmanned Aircraft Systems (UAS), establishing three distinct categories based on risk classification: the 'open,' 'specific,' and 'certified' categories, as outlined in Article 3. Each category is designed to address varying levels of operational risk and the corresponding regulatory requirements.

The 'open' category is intended for UAS operations that pose a relatively low risk to public safety, other airspace users, and property on the ground. As such, operations within this category are not subject to prior operational authorisation, nor do UAS operators need to submit an operational declaration before conducting the operation (Annex 4). This streamlined approach simplifies the regulatory burden for lower-risk operations, facilitating greater accessibility for a wider range of UAS operators.

Within the 'open' category, operations are further subdivided into three subcategories A1, A2, and A3 each of which is differentiated by specific operational limitations, the qualifications required of the remote pilot, and the technical specifications of the UAS itself, as described in Article 4. These subcategories are designed to provide a graduated approach to risk management, with each subcategory reflecting varying degrees of operational constraints and safety requirements. EU has implemented a risk-based regulatory approach which has been iitially established in the Basic Regulation (Recitals 12 and 32), this approach is further reinforced in implementing Regulation EU 2019/947. According to Recital 5 of this Regulation, rules and procedures for UAS operations should be proportionate to the nature and level of risk involved, and tailored to the specific operational characteristics of the unmanned aircraft and the area of operation, including factors such as population density, surface features, and the presence of buildings[81].

UAS operations are classified under the 'open' category only when they meet certain predefined criteria, ensuring that the operation remains within the scope of low-risk activities.

UAS Classification. The unmanned aircraft system must belong to one of the classes outlined in Regulation EU 2019/945, which governs the design and manufacturing standards

[81] Eleonora Bassi, 'From Here to 2023: Civil Drones Operations and the Setting of New Legal Rules for the European Single Sky' (2020) 100 *J Intell Robot Syst* 493, 495 https://doi.org/10.1007/s10846-020-01185-1 accessed 30 May 2025.

for UAS. Alternatively, the UAS may be privately built or meet the conditions defined in Article 20. Additionally, UAS placed on the market before 1 January 2024 (or in the case of the initial version, before 1 July 2022) are also considered eligible for operation under the 'open' category, provided they meet the following further specifications:

- Subcategory A1 (Part A of the Annex): In this subcategory, operations are permitted for unmanned aircraft with a maximum take-off mass of less than 250 g, including any payload. This classification is suitable for low-risk operations, such as those conducted in urban or populated areas where the risk to people and property is minimized.
- Subcategory A3 (Part A of the Annex): This subcategory applies to unmanned aircraft with a maximum take-off mass of less than 25 kg, including fuel and payload. Operations in A3 are generally permitted in less densely populated areas, where there is a lower risk to third parties, particularly in rural or remote regions[82].

Regulation EU 2019/947 introduces a structured and systematic process for ensuring that higher-risk UAS operations are properly assessed and mitigated.

Mass Limitations. The unmanned aircraft must have a maximum take-off mass of less than 25 kg, which includes its fuel and payload. This threshold ensures that only lighter, lower-risk UAS are considered for operation under the 'open' category, reducing the potential for harm to people and property on the ground in the event of a failure or accident[83].

Safety and Operational Restrictions. The remote pilot is responsible for ensuring that the unmanned aircraft is kept at a safe distance from people, and that the aircraft is not flown over assemblies of people. This safety provision helps mitigate the risk of harm to individuals who are present in public or densely populated areas, ensuring that flights are conducted in a way that does not pose a risk to public safety. The emphasis on avoiding crowds and people-centric areas is particularly important for maintaining the safe operation of UAS in urban environments[84].

Visual Line of Sight (VLOS). The remote pilot must maintain the unmanned aircraft in VLOS at all times, as specified in Part A of the Annex, except when operating in certain

[82] Commission Implementing Regulation (EU) 2019/947 on the rules and procedures for the operation of unmanned aircraft, [2019] OJ L152/45, art 20.
[83] Commission Implementing Regulation (EU) 2019/947 on the rules and procedures for the operation of unmanned aircraft, [2019] OJ L152/45, art 4(1)(b).
[84] Commission Implementing Regulation (EU) 2019/947 on the rules and procedures for the operation of unmanned aircraft, [2019] OJ L152/45, art 4(1)(c).

circumstances such as the "follow-me" mode or when utilizing a designated unmanned aircraft observer. The use of a VLOS ensures that the remote pilot is continuously aware of the aircraft's position, altitude, and any potential hazards in the surrounding environment, thereby promoting safe and controlled flight. The observer mode is specifically designed for situations where the remote pilot may need assistance in maintaining visual contact with the UAS[85].

Altitude Limitations. During flight, the unmanned aircraft must remain within 120 metres of the closest point of the earth's surface. This altitude restriction is aimed at minimizing the risk to other aircraft, particularly manned aircraft operating at higher altitudes, and ensuring that UAS operations are limited to relatively low-risk environments. However, the regulation does allow for exceptions when flying over obstacles, as defined in Part A of the Annex. This provision is particularly relevant when operating in environments with tall structures, such as buildings or towers, where higher altitudes may be necessary for safe navigation[86].

Cargo Restrictions. The unmanned aircraft is prohibited from carrying dangerous goods or dropping any material during flight. This requirement is critical for ensuring that UAS operations do not pose a risk to public safety or environmental protection. The carriage of hazardous materials or the act of releasing materials during flight could have serious consequences, particularly in urban or populated areas, and this restriction ensures that operations within the 'open' category are limited to those that do not carry such risks[87].

These operational restrictions are integral to maintaining safety standards and ensuring that UAS operations do not introduce unnecessary risk to people, property, or other airspace users. By enforcing limits on VLOS, altitude, and cargo, Regulation EU 2019/947 provides a framework that balances operational flexibility with the imperative of public safety.

UAS operations within the 'open' category are exempt from prior operational authorisation, meaning that the operator is not required to seek approval from the relevant authorities before conducting the operation. Additionally, no operational declaration is needed from the UAS operator prior to flight. This streamlined approach is designed for

[85] Commission Implementing Regulation (EU) 2019/947 on the rules and procedures for the operation of unmanned aircraft, [2019] OJ L152/45, art 4(1)(d).
[86] Commission Implementing Regulation (EU) 2019/947 on the rules and procedures for the operation of unmanned aircraft, [2019] OJ L152/45, art 4(1)(e).
[87] Commission Implementing Regulation (EU) 2019/947 on the rules and procedures for the operation of unmanned aircraft, [2019] OJ L152/45, art 4(1)(f).

lower-risk operations, where safety and regulatory concerns are sufficiently addressed by the operational limitations set forth in the regulation. The 'open' category's conditions, including size and mass limitations, operational restrictions, and the requirement for VLOS, ensure that these flights do not pose significant risks to public safety or the environment.

Conversely, UAS operations in the 'specific' category require a higher level of regulatory oversight due to the increased risk associated with these types of operations. As stipulated in Article 5, UAS operators in the 'specific' category must obtain an operational authorisation issued by the competent authority in accordance with Article 12. This authorisation ensures that the planned operation is assessed for safety and that the UAS operator has met the necessary requirements, including those related to the operational conditions, equipment, and qualifications of the personnel involved. Alternatively, Article 16 provides a pathway for receiving authorisation under specific circumstances, ensuring flexibility for different operational contexts.

Additionally, Article 5(5) allows for certain exceptions under which the UAS operator may be able to proceed with a flight based on a declaration. This provision is intended to cover specific situations where the risks are considered manageable and where an authorisation may not be necessary, provided that the operator meets the conditions outlined in the regulation.

Further, Article 5 establishes that, where a UAS operator does not meet the requirements set forth in Article 4 or in Part A of the Annex, the operator must seek an operational authorisation as specified in Article 12. This ensures that operations are conducted in compliance with the safety standards set by the competent authority in the Member State where the UAS is registered.

When a UAS operator applies for an operational authorisation under Article 12, the operator is required to conduct a comprehensive risk assessment in accordance with Article 11. This assessment must be submitted alongside the application to the competent authority. The purpose of this risk assessment is to identify any potential risks associated with the operation and propose adequate mitigating measures to address those risks. By requiring a risk assessment, the regulation ensures that UAS operations are conducted with due consideration for safety, and that operators take proactive steps to mitigate any identified hazards.

According to point UAS.SPEC.040 in Part B of the Annex, the competent authority is responsible for issuing the operational authorisation once it has reviewed the submitted risk assessment. The authority will issue the authorisation if it is satisfied that the operational risks have been appropriately mitigated in accordance with Article 12. This ensures that the competent authority has confidence that the operation will be carried out in a manner that minimizes risk to public safety, airspace users, and the environment.

When issuing the operational authorisation, the competent authority will specify the scope of the approval:

- Single or Multiple Operations: The authorisation may apply to either a single operation or a number of operations specified by time or location (or both). This flexibility allows the competent authority to tailor the authorisation to the specific needs and characteristics of the operation(s) concerned. In either case, the authorisation will include a precise list of the mitigating measures that must be implemented by the UAS operator to ensure safety throughout the operation.
- LUC (Light UAS Operator Certificate) Approval: The competent authority may also approve a Light UAS Operator Certificate (LUC) in accordance with Part C of the Annex. This option is available for operators who meet specific criteria for light UAS operations and who demonstrate an ability to manage their operations in a safe and compliant manner.

In situations where a UAS operator submits a declaration to the competent authority of the Member State of registration, in accordance with point UAS.SPEC.020 in Part B of the Annex, for operations that comply with a standard scenario as defined in Appendix 1 of that Annex, the operator is exempt from the requirement to obtain an operational authorisation. This provision acknowledges that standard scenarios, which are predefined and considered low-risk, do not require the same level of oversight as more complex operations. Instead, the procedure outlined in paragraph 5 of Article 12 applies, which is designed to streamline the approval process for these lower-risk scenarios.

The regulation outlines several situations in which an operational authorisation or declaration is not required:

(a) UAS Operators Holding an LUC (Light UAS Operator Certificate): Operators who hold an LUC with the appropriate privileges, in accordance with point UAS.LUC.060 of the Annex, are exempt from requiring a specific operational authorisation or declaration. The LUC is a certification that demonstrates the operator’s compliance with safety and

operational standards, and the privileges granted under this certificate allow operators to conduct certain activities without additional authorisation, provided that they meet the required operational criteria.

(b) Model Aircraft Clubs and Associations: UAS operations conducted by model aircraft clubs and associations that have received an authorisation in accordance with Article 16 are also exempt from the requirement for an operational authorisation. These organisations typically engage in recreational flying activities, and their operations are considered to pose a lower level of risk compared to commercial or more complex operations. However, they must still adhere to specific safety regulations set out in the framework of the authorisation.

(c) ‘Certified’ Category Operations: UAS operations falling under the ‘certified’ category, which are subject to stricter safety requirements, shall require the certification of the UAS, the certification of the operator, and, where applicable, the licensing of the remote pilot. These operations are considered high-risk and require a much higher level of oversight.

UAS operations in the ‘certified’ category are subject to the most stringent requirements, as the risks associated with these operations are deemed to be significant.

According to Article 6, the following criteria must be met for operations to be classified under this category:

(a) UAS Certification: the UAS must be certified in accordance with the requirements outlined in points (a), (b), and (c) of paragraph 1 of Article 40 of Delegated Regulation (EU) 2019/945. This certification ensures that the UAS meets rigorous safety standards and is capable of performing operations that involve higher risks.

(b) Operation Conditions: the operation must occur under one of the following conditions:

- Over assemblies of people: this refers to operations where the UAS is flown over large gatherings of people, where the risk of injury or damage in the event of an accident is high.

- Involves the transport of people: operations that involve transporting individuals with a UAS, such as passenger-carrying drones, are subject to the ‘certified’ category due to the inherent risks associated with human transport.
- Involves the carriage of dangerous goods: operations where the UAS is transporting dangerous goods that could pose a high risk to third parties in the event of an accident are also classified under the certified category. The potential harm to people or property in case of an accident involving dangerous materials necessitates a higher level of oversight.

In addition to the above conditions, UAS operations shall also be classified in the ‘certified’ category if, based on a risk assessment conducted in accordance with Article 11, the competent authority determines that the risk of the operation cannot be adequately mitigated through less stringent measures. In such cases, the competent authority may require the certification of the UAS, the certification of the UAS operator, and, where applicable, the licensing of the remote pilot to ensure that the risks are adequately addressed. This provision highlights that even if a UAS is operating under seemingly less hazardous conditions, a detailed risk assessment could reveal that the operation involves risks that cannot be adequately mitigated without these higher regulatory requirements.

The regulatory framework for UAS operations as outlined in Regulation EU 2019/947 provides a flexible approach to different levels of operational risk, ranging from low-risk operations in the ‘open’ category to high-risk operations that fall under the ‘certified’ category. The ability for operators to obtain exemptions from operational authorisation, such as for those holding an LUC or for model aircraft clubs, facilitates the efficient operation of UAS in less risky scenarios while maintaining strict oversight in more complex operations. For higher-risk operations, particularly those involving the transport of people or dangerous goods, the certification process ensures that both the UAS and the operator are thoroughly vetted, contributing to safe and regulated integration of UAS into European airspace[88].

While the framework allows for flexibility in operational classifications, it can sometimes be challenging to delineate the exact boundaries between these categories, especially in more complex scenarios. However, the Decision 2019/021/R[89] offers valuable

[88] Bassi Eleonora, ‘From Here to 2023: Civil Drones Operations and the Setting of New Legal Rules for the European Single Sky’ (2020) 100 *J Intell Robot Syst* 493, 495 https://doi.org/10.1007/s10846-020-01185-1 accessed 30 May 2025.
[89] European Union Aviation Safety Agency, 'Decision 2019/021/R – Acceptable Means of Compliance and Guidance Material to Commission Implementing Regulation (EU) No 2019/947' (8 March 2019).

clarification regarding these boundaries, helping to refine the distinctions between categories and provide more clarity to operators.

Decision 2019/021/R, specifically, helps to further define the limits between the ‘open’ and ‘specific’ categories. An operation cannot be classified under the ‘open’ category if it fails to meet at least one of the general criteria set forth in Article 4 of the UAS Regulation. For example, operations involving BVLOS flight automatically exclude the operation from the ‘open’ category, as this introduces a higher level of risk that necessitates more comprehensive oversight. Similarly, an operation that exceeds the technical limitations defined for a subcategory would also fall outside the ‘open’ category. For instance, sub-category A2 imposes a weight limit of 4 kg for UAS flying close to people. Should an operator attempt to fly a 10 kg UAS within this subcategory, such an operation would be classified under the ‘specific’ category due to the failure to meet the required operational criteria.

The boundary between the ‘specific’ and ‘certified’ categories is also outlined with precision in Article 6 of the UAS Regulation and Article 40 of Regulation EU 2019/945. These articles work in tandem, with Article 6 focusing on the operational aspects and Article 40 detailing the technical characteristics of the UAS. A UAS operation is classified as ‘certified’ when, following a risk assessment, the competent authority concludes that the risks involved cannot be sufficiently mitigated without the certification of the UAS’s airworthiness, the certification of the UAS operator, and, where applicable, the licensing of the remote pilot. Notably, these measures are not required for fully autonomous UAS, as such systems may be exempt from certain regulatory requirements due to their autonomous nature.

Certain types of operations are inherently considered to fall under the ‘certified’ category, regardless of the outcome of a risk assessment. These include operations conducted over assemblies of people with a UAS that has characteristic dimensions of 3 meters or more, operations that involve the transport of people, and operations involving the carriage of dangerous goods. The latter scenario is particularly critical, as the transportation of hazardous materials presents a high risk to third parties in the event of an accident, justifying the need for rigorous certification processes.

In conclusion, while the boundaries between UAS operation categories may be complex and challenging to verify, the regulatory framework set out in Regulation EU 2019/947 and clarified by Decision 2019/021/R provides essential guidelines. These boundaries are determined not only by operational factors such as the flight type and proximity to people, but also by the technical characteristics of the UAS involved. The distinction between the ‘specific’ and ‘certified’ categories, in particular, hinges on the ability

to mitigate operational risks through certification processes that ensure the safety of both operators and the public. Therefore, operators must carefully assess their operations to ensure compliance with the appropriate category, taking into account both the technical and operational aspects of their UAS activities.

2.3.4. Cross-Border Operations. Delegated Regulation (EU) 2019/945.

Commission Delegated Regulation EU 2019/945, in conjunction with Commission Implementing Regulation EU 2019/947, establish the essential requirements and procedures for ensuring safe, harmonized, and legally compliant drone operations across EU Member States. This regulatory architecture is built on the principle of mutual recognition, aiming to remove internal market barriers while maintaining high safety and accountability standards.

In the context of the European Union’s regulatory framework for unmanned aerial vehicles, cross-border operations refer to drone activities conducted in an EU Member State other than the one in which the UAV operator is registered. These types of operations are becoming increasingly relevant as drone usage expands across diverse sectors including logistics, inspection, and security services that often require mobility beyond national borders.

Article 13 of Regulation EU 2019/947 stipulates that an operator intending to conduct drone operations in a Member State other than their state of registration must first notify the competent authority of the host Member State. This notification is a prerequisite for the commencement of operations and must include specific details about the planned activity. Importantly, the operator must demonstrate that their intended operation falls within the framework of an operational authorization or declaration previously granted by the state of registration. Additionally, operators from third countries, whether established, resident, or having their principal place of business outside the EU, who intend to conduct UAS operations within the EU's single European sky airspace, are also subject to the provisions of this regulation.

For operations falling under the ‘specific’ category, those entailing higher levels of risk, the operator must ensure that their authorization remains valid within the regulatory framework of the host Member State. This may require supplementary risk assessments, such as the Specific Operations Risk Assessment (SORA), to align with the safety and regulatory requirements of the host country. On the other hand, for ‘open’ category operations, which are deemed to present lower risk, the operator can generally conduct their

activities throughout the EU without needing additional authorization, provided that they are duly registered and compliant with applicable regulations.

In addition to operational requirements, Regulation EU 2019/945 also addresses the technical specifications for drone manufacturers, including the availability of UAVs in the EU market. The regulation introduces the CE marking and class identification labels (ranging from C0 to C6), which certify that drones sold and operated within the EU meet uniform technical, safety, and operational standards. This standardization is crucial not only for ensuring the safe operation of UAVs but also for facilitating their use in cross-border operations within the internal market[90].

The key objective of these regulations is to ensure that UAV operations across EU borders are seamless, safe, and standardized, enabling innovation and efficiency without compromising regulatory oversight.

In the context of cross-border UAV operations, the Single European Sky (described in par 2.3. of this Master thesis above) principles manifest in several key operational obligations:

- Operators are required to notify the host Member State of their intention to conduct drone operations across borders, in accordance with the procedures outlined in the applicable regulatory framework.
- Airspace usage must align with both national U-space implementation plans and SES air traffic management (ATM) coordination structures, ensuring that drone operations do not conflict with existing traffic flows or safety protocols.
- In practice, this results in enhanced air traffic deconfliction, more effective real-time communication between national authorities, and the development of a shared digital infrastructure that supports situational awareness, regulatory compliance, and interoperability across borders.

Common Information Services is a key concept under SES and U-space, where authorities, air navigation service providers (ANSPs), and UAV operators share relevant information, like weather, airspace restrictions, and drone traffic.

[90] Janke Christian and Uijt de Haag Maarten, 'Progress and Challenges with the Implementation of European Drone Regulation – Status Quo and Outlook' (2023) 91 Photogrammetrie – Fernerkundung – Geoinformation 381 https://ieeexplore.ieee.org/document/9836165 accessed 19 June 2025.

- This system allows for the interoperability of national systems, enabling smooth cross-border drone operations.
- CIS serves as the digital backbone of SES for UAV integration, especially for autonomous or BVLOS operations.

As a practical example of cross-border use the hypothetical case of a logistics company based in Austria wanting to use a drone corridor to deliver goods to Slovenia may be used. Under SES and the drone regulations:

- The drone must comply with technical requirements under Regulation 2019/945.
- The operator must register in Austria and notify Slovenian authorities in advance (as per Regulation 2019/947).
- If the route passes through a U-space airspace, U-space service providers coordinate the flight using shared SES infrastructure.
- Air traffic management is harmonized, meaning less duplication and faster approvals.

When taking several examples, it might be mentioned, that France has been at the forefront of applying EU drone regulations, particularly in the areas of infrastructure inspection, logistics, and public safety. French drone companies regularly operate across borders, especially in neighboring countries like Belgium and Germany. For instance, Parrot SA[91], a French UAV manufacturer, develops EU-compliant drones that are deployed in various European countries for environmental monitoring and border surveillance.

To comply with cross-border regulations, French operators must notify the aviation authority in the host country (e.g., the Belgian Civil Aviation Authority) with a description of their mission and proof of regulatory compliance under their French authorization. This process ensures legal clarity and airspace deconfliction, especially in controlled zones like urban Paris or Brussels[92].

Relatedly, French drone operators have collaborated with Ukrainian partners in recent years to assist with infrastructure damage assessment and search-and-rescue

[91] Parrot, 'Parrot – European leader in professional drones' https://www.parrot.com/en accessed 14 June 2025.
[92] Hartmann Jacques, Scott Benjamyn I, Truxal Steven, Bertolini Andrea and Masutti Anna (eds), Civil Regulation of Autonomous Unmanned Aircraft Systems in Europe (Edward Elgar Publishing 2024) 51 https://doi.org/10.4337/9781035312344

operations in conflict-affected areas highlighting how cross-border cooperation can also extend to humanitarian missions[93].

Naming another example, following Brexit, the United Kingdom is no longer subject to EU UAV regulations, including Regulation EU 2019/945. However, many British drone companies continue to conduct business and operations in the EU through a system of bilateral recognition and compliance with EASA regulations when operating on the continent[94].

For example, a UK-based company providing agricultural UAV services in France must now register with EASA and obtain authorization from the French Directorate General for Civil Aviation. The process involves submitting operational risk assessments in line with EU standards and may require modifications to equipment to meet CE conformity standards.

Inversely, French and EU-based UAV manufacturers operating in the UK must adhere to regulations enforced by the UK Civil Aviation Authority, which mirrors many EU practices but applies them under a separate legal framework. This dual compliance has introduced administrative burdens but is increasingly streamlined through international cooperation and commercial demand.

Although Ukraine is not an EU member, it has increasingly aligned its UAV regulatory practices with EU standards, especially due to the integration efforts prompted by its EU accession path and the operational needs imposed by wartime conditions.

During the ongoing war, Ukraine has received significant UAV support from European allies, including civilian-made drones from France, Poland, and Germany, and military-grade systems through bilateral defense agreements. Much of this support has bypassed traditional regulatory pathways due to the urgency of the situation, but it has also highlighted the limitations of existing EU cross-border regulations in emergency contexts.

In parallel, Ukrainian volunteer groups and private drone manufacturers often engage with partners in the EU to access components and technologies unavailable domestically. For example, a Ukrainian drone team may collaborate with a French supplier to source high-

[93] Leicester John, 'Tried and tested in war: For European drone manufacturers, Ukraine is the place to be' *Associated Press* (online, 19 June 2025) https://apnews.com/article/5ff2ac41e931538258ede7b39571ef3f accessed 23 June 2025.

[94] Hartmann Jacques, Scott Benjamyn I, Truxal Steven, Bertolini Andrea and Masutti Anna (eds), Civil Regulation of Autonomous Unmanned Aircraft Systems in Europe (Edward Elgar Publishing 2024) 276 https://doi.org/10.4337/9781035312344

resolution thermal cameras or lithium-polymer batteries, transporting components across borders for on-the-ground assembly and deployment.

Such collaborations demonstrate the flexibility and gaps in current EU drone laws when applied to real-world, high-stakes contexts such as armed conflict, where humanitarian and defensive needs often exceed the scope of peacetime regulation.

As another example, Germany is recognized as one of the most structured and regulation-driven environments in the EU when it comes to unmanned aerial vehicle operations. The country has embraced the harmonized drone rules under Regulation EU 2019/945 and Regulation EU 2019/947, applying them with a high degree of procedural rigor. This structured approach has made Germany a model for how UAVs can be safely integrated into complex, densely populated airspace[95].

German UAV operators must register with the Luftfahrt-Bundesamt (LBA) Germany's Federal Aviation Office and receive appropriate training and certification depending on the risk category of their operation. Operators planning cross-border missions into or from Germany must comply not only with EU-wide notification procedures but also with local airspace restrictions, especially near cities, airports, and sensitive infrastructure.

A practical example is seen in cross-border industrial inspections, where German UAV operators conduct missions in neighboring countries such as Austria, the Netherlands, and Poland. These missions, often involving infrastructure surveillance, wind turbine inspections, or environmental monitoring, are coordinated through pre-authorization agreements and real-time airspace management platforms like Droniq[96] - a German-UAV traffic management system (UTM) operated in collaboration with Deutsche Telekom and DFS (German Air Navigation Services)[97].

Germany also participates in several EU-funded drone integration programs, such as U-space trials in urban and semi-urban environments. These projects are aimed at preparing the regulatory and technical infrastructure for full drone integration into European airspace, which will directly impact how cross-border drone traffic is managed at scale.

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[95] Janke Christian and Uijt de Haag Maarten, 'Progress and Challenges with the Implementation of European Drone Regulation – Status Quo and Outlook' (2023) 91 Photogrammetrie – Fernerkundung – Geoinformation 381 https://ieeexplore.ieee.org/document/9836165 accessed 19 June 2025.

[96] Droniq GmbH, 'Droniq: Your Partner for Professional Drone Operations' https://droniq.de/en/ accessed 14 June 2025.

[97] Hartmann Jacques, Scott Benjamyn I, Truxal Steven, Bertolini Andrea and Masutti Anna (eds), Civil Regulation of Autonomous Unmanned Aircraft Systems in Europe (Edward Elgar Publishing 2024) 157–175, DOI: https://doi.org/10.4337/9781035312344

In addition, Germany is home to a growing ecosystem of drone startups, including Wingcopter[98], which produces fixed-wing eVTOL drones for logistics, and Quantum Systems[99], known for dual-use (civilian and defense) UAVs. Both companies have conducted cross-border trials and deliveries, particularly in cooperation with partners in France and the Baltic States. Such activities require strict adherence to EU regulations, particularly in ensuring CE conformity and operator compliance across different jurisdictions.

In the context of Ukraine, German NGOs and defense contractors have been involved in providing UAV systems and technical training to Ukrainian forces. Though not always part of formal cross-border operations under the regulation, these exchanges illustrate how pan-European UAV collaboration can exist at multiple levels commercial, humanitarian, and governmental.

2.4. UAV Regulations in Ukraine

Notably, in Ukraine, where UAVs are utilized more extensively than in any other country, the regulatory framework governing the civil use of unmanned aerial vehicles remains underdeveloped, lacking the comprehensive structure and enforcement mechanisms seen in more harmonized systems such as those within the European Union.

The Air Code of Ukraine which represents is the highest normative act in the hierarchy of aviation legislation after the Constitution, was adopted in 2012. Although numerous amendments have been introduced since its adoption, provisions specifically addressing unmanned aerial vehicles were only incorporated recently, in 2023.

The authorized central executive body in the field of state aviation in Ukraine is the Ministry of Defense of Ukraine. The rules and procedures for organizing flights of civil aircraft are established by the authorized body for civil aviation, which is the State Aviation Administration of Ukraine.

While civil regulations in Ukraine remain underdeveloped, and the legal framework for civilian UAV usage has yet to reach a comprehensive and enforceable standard, certain efforts have been made to address this gap. Several draft legislations concerning civilian drone regulation have been registered and will be covered further. In contrast, the regulation of military drones has been actively optimized since 2016, drawing upon frameworks and

[98] Wingcopter GmbH, 'Wingcopter – Delivering the Future' https://wingcopter.com/ accessed 14 June 2025.
[99] Quantum Systems GmbH, 'Quantum Systems – Advanced Professional Mapping and ISR UAVs' https://quantum-systems.com/ accessed 14 June 2025.

standards established by the International Civil Aviation Organization (ICAO) and the North Atlantic Treaty Organization (NATO). This contrast once again underscores the reality that technological advancement is often driven primarily by military needs, with successful practices and innovations gradually being adapted and transferred to the civilian sector[100].

When discussing the current regulatory approach of the Ministry of Defence in the UAV sector, two key legislative acts stand out as foundational in establishing the legal framework for the use of unmanned aerial vehicles. The first normative act being the Rules on performance of flights by unmanned aircraft systems of the state aviation of Ukraine adopted by the Order No. 661 dated 08.12.2016 of the Ministry of Defense of Ukraine (with subsequent amendments) and the Rules for the Technical Operation of Unmanned Aircraft Systems of Class I of the State Aviation of Ukraine adopted by the Order No. 401 dated 10.08.2018 of the Ministry of Defense of Ukraine[101].

These Rules were developed in accordance with the standards and recommended practices of the ICAO and the NATO and contain detailed classification of the UAVs which are used by the state as well as safety regulations and requirements to the certification of pilots and operators, dealing with emergency cases.

By UAV classes, the following are distinguished[102]:

1) Class I “Light” (takeoff weight up to 150 kg), which includes:

- micro (tactical) UAVs of UAVs with a takeoff weight of less than 2 kg and a range of up to 5 km;
- mini (tactical battlefield) UAVs of UAVs with a takeoff weight of 2 to 15 kg and a range of more than 5 km;
- small (tactical) UAVs of UAVs with a takeoff weight of more than 15 kg and a range of more than 25 km. Class I UAVs are launched manually, by catapult, mobile launchers, or using runways;

[100] Yavtushenko Oleksandr, 'Drone and Technology Warfare: How Ukraine is Changing the Rules of War', The Ukrainian Review (online, 21 March 2025) https://theukrainianreview.info/drone-and-technology-warfare-how-ukraine-is-changing-the-rules-of-war accessed 18 June 2025.
[101] Samoilenko Vadym, 'Drone Regulations in Ukraine' (L2b Aviation, 10 October 2019) https://www.asterslaw.com/press_center/publications/drone_regulations_in_ukraine/ accessed 17 June 2025.
[102] Ministry of Defense of Ukraine, Rules on Performance of Flights by Unmanned Aircraft Systems of the State Aviation of Ukraine, Order No 661 (8 December 2016) Annex 1, cl 1.

2) Class II “Medium” (with a takeoff weight of 150 to 600 kg), which includes tactical (operational-tactical) UAVs of the BpAK with a range of more than 50 km. Class II UAVs are launched by catapult, mobile launchers, or using runways;

3) Class III “Heavy” (with a takeoff weight of more than 600 kg), which includes:

- Operational UAVs MALE (medium altitude long endurance), which are used at altitudes up to 13700 m (45000 ft) and have a range of more than 200 km;
- Strategic UAVs HALE (high altitude long endurance), which are used at altitudes up to 19800 m (65,000 ft) and have a range of more than 200 km. Class III UAVs require an artificially-coated runway.

According to the purpose, UAVs are classified as[103]:

1) combat UAVs - designed to perform combat missions, which include: reconnaissance UAVs, Reconnaissance and targeting UAVs, UAVs for electronic warfare, strike UAVs, UAVs - aircraft interceptors. Combat UAVs can have a combined purpose;

2) special UAVs - UAVs designed to perform special tasks as repeaters and targets, as well as for surveillance and monitoring of objects, territory, etc.

UAVs are divided into the following according to the type, place of basing, method of takeoff and landing, and type of flight control system.

1) by type of aircraft: airplane type, helicopter type, multi-rotor type;

2) by the place of basing: ground-based, river (sea) based, air-based;

3) by the method of takeoff: by airplane (from a run-up), by helicopter (from the ground); by means of launching (catapult, launcher), by hand, universal (combined);

4) by the method of landing: by airplane (with a run); by helicopter (without mileage); by means of landing equipment (parachute, braking device, etc.);

5) by type of flight control system:

[103] Ministry of Defense of Ukraine, *Rules on Performance of Flights by Unmanned Aircraft Systems of the State Aviation of Ukraine*, Order No 661 (8 December 2016) Annex 1, cl 2.

- autonomous UAVs UAVs that fly according to a pre-entered program and may have an emergency mode of bringing the UAV to the landing point or an emergency flight termination mode;
- manned UAVs of UAVs, which include: UAVs with manual piloting, UAVs piloted by an autopilot, UAVs piloted by waypoints, UAVs with a combined control system.

As previously noted, these two regulations pertain to state-operated UAV activities. However, given the extent to which military technologies and practices are increasingly integrated into civilian life and used for civil purposes, these classifications are also significant in the context of civil UAV usage in Ukraine, which remains at a very early stage of development.

Despite the fact that the aforementioned regulations are relatively recent and align with international standards, the ongoing war and the urgent need to strengthen national defense have significantly accelerated the development and deployment of drones, to such an extent that their advancement has outpaced the existing legal and institutional frameworks. This rapid progress clearly demonstrated the necessity of establishing a dedicated organizational structure for the military sector specializing in drone-assisted combat. In this context, a historic milestone was reached when, at the initiative of the President of Ukraine, the Parliament of Ukraine adopted the Law on Amendments to Article 3 of the Law of Ukraine "On the Armed Forces of Ukraine" (Reg. No. 11507)[104]. This Law was developed by the Ministry of Defense of Ukraine in pursuance of the decision of the National Security and Defense Council of Ukraine of June 25, 2024 “On the establishment of the Unmanned Systems Forces in the structure of the Armed Forces of Ukraine”, enacted by the Decree of the President of Ukraine of June 25, 2024 No. 382/2024, which provides for the establishment of a separate branch of the Armed Forces of Ukraine - the Unmanned Systems Forces. The Law provides for amendments to part one of Article 3 of the Law of Ukraine “On the Armed Forces of Ukraine” by including the Unmanned Systems Forces in the separate branches of the Armed Forces of Ukraine.

This legislative development provides a clear and practical example of how rapidly evolving technologies, actively and extensively deployed since 2022, are only gradually being codified by lawmakers in response to urgent operational realities. Furthermore, the law reflects the growing recognition of unmanned aerial vehicles as a powerful and

[104] President of Ukraine, 'I Signed a Decree Initiating the Establishment of a Separate Branch of Forces – the Unmanned Systems Forces' (6 February 2024) https://www.president.gov.ua/en/news/pidpisav-ukaz-yakij-rozpochinaye-stvorennya-okremogo-rodu-si-88817 accessed 1 June 2025.

transformative component of modern military capabilities. The institutionalization of drone units underscores the sector's strategic importance and signals a broader trend likely to extend into civilian domains. Notably, the legal formalization followed the de facto establishment and successful deployment of these units, which have played a critical role in national defense while significantly contributing to the reduction of human casualties.

Turning to the current civil UAV aviation regulations in Ukraine, all civil aircraft are generally subject to mandatory registration in the State Register of Civil Aircraft of Ukraine, with the exception of the

- unmanned unguided aerostats without payloads;
- unmanned aircraft with a maximum takeoff weight of 20 kilograms and used for entertainment, in the educational process for extracurricular education, in scientific and sports activities – these aircraft is subject to registration in sport federations or alike organizations[105].

If the aircraft is registered in other foreign registers, such aircraft cannot be registered in the State Register of Civil Aircraft of Ukraine[106].

As previously mentioned, the main executive state body which oversees supervising the air exploitation rules is the State Aviation Administration of Ukraine which acts according to the Regulation on State Aviation Administration of Ukraine adopted by the Decision of the Cabinet of Ministers of Ukraine No. 520 dated 18.10.2014.

The main document entails Aviation rules of Ukraine "Rules for the use of the airspace of Ukraine" approved by the joint order of the State Aviation service of Ukraine and the Ministry of defense of Ukraine May 11, 2018 No. 430/210 (hereinafter – Rules No. 430/210). The adoption of these rules was considered a timely and necessary measure; however, it quickly became obvious that technological advancements were outpacing the existing legal framework, and shortly after their adoption, the need for updated regulations to address emerging UAV technologies became clear[107].

The clauses 3 and 4, section II of the Rules No. 430/210 establish that flights of unmanned aircraft shall be organized and carried out in accordance with the requirements of the regulatory legal acts of Ukraine in the field of civil and state aviation in compliance

[105] Air Code of Ukraine, art 39(8).
[106] Air Code of Ukraine, art 39(1), (6).
[107] Achasova Alla, 'Ukrainian Legislation Regulating the Use of UAVs Reviewed' (50° North, 17 May 2020) https://www.50northspatial.org.ua/ukrainian-legislation-regulating-use-uavs-reviewed/ accessed 18 June 2025.

with the rules of flight in the airspace of Ukraine and these Aviation Rules. The organization of such flights shall be provided by airspace users (heads of aviation enterprises, organizations, owners or external pilots of aircraft, etc.) which plan or carry out the specified activities.

Flights of unmanned aircraft weighing up to 20 kg inclusive may be performed without submitting runway applications for usage of the airspace, without obtaining runway permits for usage of the airspace, without informing the controlling authorities of the Air Armed Forces of Ukraine and the unified civil-military system of air traffic organization of Ukraine, the State Border Guard Service of Ukraine, air traffic services and departmental air traffic control authorities, provided that the following requirements are met[108]:

1) flights are performed without crossing the state border of Ukraine;

2) flights shall be performed outside the established prohibitions and restrictions of the runway, except in cases established by the Regulations on the runway;

3) flights shall be performed not closer than 5 km from the outer limits of the runways of airfields or not closer than 3 km from the outer limits of the runway of runways/heliports, except in cases of agreement with the operator of the airfield/runway/heliport;

4) flights shall be performed no closer than 500 meters from manned aircraft;

5) flights shall not be performed over:

- crowds of people in open space and over densely built-up areas;
- objects (zones) designated by the Ministry of Defense of Ukraine, the Ministry of Infrastructure of Ukraine, the Ministry of Internal Affairs of Ukraine, the State Border Guard Service of Ukraine, the Security Service of Ukraine, the National Police of Ukraine, the National Guard of Ukraine, the State Fiscal Service of Ukraine, the Foreign Intelligence Service of Ukraine, the State Protection Department of Ukraine, other military formations and law enforcement agencies established in accordance with the laws of Ukraine, and in respect of which security/state protection is provided such flights are allowed by the corresponding authorized state bodies.

6) flights are performed within the line of sight (VLOS).

[108] State Aviation Service of Ukraine and Ministry of Defense of Ukraine, Aviation Rules of Ukraine: Rules for the Use of the Airspace of Ukraine, Joint Order No 430/210 (11 May 2018) Section II, para 4.

7) maximum flight altitude no higher than:

- 120 m above the level of the earth (water) surface outside the CTR (control zone), AFIZ (aerodrome flight information zone), ATCA (air traffic control area), ATCZ (air traffic control zone), specially designated zones, reserved airspace for flights on specially designated flight routes of state aviation.
- 50 m above the ground (water) surface level within CTR, AFIZ, ATCA, ATCZ, specially designated zones, reserved airspace for flights on specially established routes of state aviation or if there is no information on the actual status of the airspace structure elements at the time of flight.
- 50 m above static obstacles at a horizontal distance of no more than 100 m from such obstacles, such as deviations from the above height restrictions, at the request of the owner of such an object.

8) the flight speed of an unmanned aircraft is no more than 160 km/h.

In other cases, flights of unmanned aircraft weighing up to 20 kg inclusive and all flights of unmanned aircraft weighing more than 20 kg without exception are to be performed within specially established zones and routes in compliance with the requirements for applying for runway usage of the airspace, after due informing the controlling authorities of the Air Force of Ukraine, the State Border Guard Service of Ukraine, air traffic services and departmental air traffic control authorities.

Section X of the Rules No. 430/210 sets forth conditions for restriction and ban of airspace usage. Airspace usage bans are implemented by establishing prohibited zones, which are published in the documents of aeronautical information of Ukraine.

Prohibited zones may be established by the State Aviation Service over nuclear power plants, hydroelectric power plants, dams, important state facilities, nature reserves and facilities or industrial enterprises of increased environmental hazard. Such airspace usage bans may be established based on a submission from the relevant state bodies, enterprises, institutions and organizations in agreement with the General Staff of the Armed Forces of Ukraine and state enterprise servicing air traffic UkSATSE. Before the war (which exploded 24 February 2022) de-facto the UAV flights were prohibited in almost all major cities across Ukraine. Beyond the explicit ban on flights in densely populated urban areas,

there was also a de facto prohibition on the uncontrolled use of drones in large settlements[109].

Since begin of the whole scale war in Ukraine on 22 February 2022 the complete airspace usage ban was established in accordance with the Article 30 of the Air Code of Ukraine and clause 3, Section X of the Ruling, which states that in the event of a threat to national security, sovereignty over the airspace of Ukraine, territorial integrity of Ukraine or during an armed conflict, special operations related to the preservation of the territorial integrity of Ukraine and the constitutional order, restricted areas are developed by the UkSATSE at the request of the General Staff of the Armed Forces of Ukraine and/or the Security Service of Ukraine, agreed with them and established by the State Aviation Administration.

Such airspace usage ban naturally covers usage of UAVs, which means that as of current no UAV is to be used without a special separate authorization of the General Staff of the Armed Forces of Ukraine. In such circumstances the receipt of permit to use UAV on certain territories is to be decided by the local military administrations. No exemptions are made for any of the sectors of economy and even the agriculture enterprises must apply for the permit for the standard agriculture related activities as conducting spring irrigation works[110].

This terminated the provision of the Rules No. 430/210, which allowed flights of unmanned aerial vehicles weighing up to 20 kg without submitting applications, obtaining permits and informing the responsible authorities.

The lack of comprehensive legislation regulating civilian UAVs in Ukraine has been evident for several years. Since 2020, efforts to address this gap have been underway at the parliamentary level. Notably, draft law No. 3716[111], aimed at improving the legal framework for civilian unmanned aerial vehicles, has been under consideration by the Verkhovna Rada since that year and was adopted as a basis on 2 February 2021. This draft proposed amendments to the Air Code of Ukraine to refine existing regulations on civilian UAVs. Specifically, it proposed to clarify terminology, establish procedures for the

[109] Achasova Alla, ‘Ukrainian Legislation Regulating the Use of UAVs Reviewed’ (50° North, 17 May 2020) https://www.50northspatial.org.ua/ukrainian-legislation-regulating-use-uavs-reviewed/ accessed 18 June 2025.
[110] Spesivtseva Olena, 'Use of Drones During Wartime: Advice for Civilians [Використання дронів під час воєнного часу: поради для цивільних]' (Centre for Democracy and Rule of Law, 15 November 2022) https://cedem.org.ua/consultations/vykorystannya-droniv/ accessed 1 June 2025.
[111] Draft Law on Amendments to the Air Code of Ukraine Regarding the Improvement of Legislative Regulation in the Sphere of Civil Aviation Unmanned Aerial Vehicles (2020) Bill No 3716, 3rd Session IX Convocation.

registration of drones, set competency requirements for remote pilots, including their training, retraining, certification, renewal, and qualification upgrades, and introduce the operator's obligation to insure liability for damage caused to third parties, among other provisions. The draft law proposed numerous measures that closely mirror recent innovations in EU legislation, aligning Ukraine's regulatory framework with contemporary international standards for drone usage, however, this draft has seen no progress and remains inactive in the Parliament of Ukraine[112].

More efforts have since been made to establish effective regulations in this area. In May 2023 the Parliament of Ukraine adopted as a basis two draft of laws No. 8185[113] and No. 8186[114], aimed at combating the illegal use of drones. The draft of law No. 8185 was focused on maintaining public safety and order, protecting the life and health of people, safeguarding the state border, critical infrastructure facilities, and important state objects from threats arising from the unlawful use of unmanned aerial vehicles. The draft of law envisages expanding the powers of law enforcement agencies, forming the foundation for an effective system to counter threats of terrorist acts (sabotage) committed using drones. It also aimed to regulate the operation of civilian drones through the adoption of appropriate aviation rules. In its turn, the draft of law No. 8186 provides for administrative liability for violations of the rules and procedures regarding the use of airspace by unmanned aerial vehicles.

Noteworthy, as an interim measure for the period of martial law in Ukraine at the end of May, the Parliament of Ukraine adopted two laws, No. 9275[115] and No. 9276[116], aimed at supporting drone production in Ukraine. Specifically, Law No. 9276 temporarily exempts components used for the manufacture or repair of unmanned systems from import duties.

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[112] Mamka Hryhoriy (Мамка Григорій), 'Drones During the War: Legislative Regulation and Liability for Airspace Violations' ['Безпілотники під час війни: законодавче врегулювання та відповідальність за порушення повітряного простору'] (Business Development Fund [Фонд розвитку підприємництва], 25 June 2023) https://bdf.gov.ua/bezpilotnyky-pid-chas-viyny-zakonodavche-vrehuliuvannia-ta-vidpovidalnist-za-porushennia-povitrianoho-prostoru/ accessed 17 June 2025.

[113] Draft Law on Amendments to Certain Legislative Acts of Ukraine Regarding the Application of Unmanned Aerial Vehicles by Law Enforcement Agencies and Counteraction to Their Illegal Use (2022) Bill No 8185, 8th Session IX Convocation.

[114] Draft Law of Ukraine on Amendments to the Code of Ukraine on Administrative Offences Regarding the Establishment of Responsibility for Violations of the Order and Rules of Use of Ukrainian Airspace by Unmanned Aerial Vehicle Operators (2022) Bill No 8186, 8th Session IX Convocation.

[115] Law of Ukraine on Amendments to Subsection 2 of Section XX "Transitional Provisions" of the Tax Code of Ukraine Regarding Exemption from Value Added Tax on Import Operations of Goods for the Production and/or Repair of Unmanned Systems (2023) Bill No 9275, 9th Session IX Convocation.

[116] Law of Ukraine on Amendments to Certain Legislative Acts of Ukraine Regarding the Application of Unmanned Aerial Vehicles by Law Enforcement Agencies and Counteraction to Their Illegal Use (2022) Bill No 8185, 8th Session IX Convocation.

Meanwhile, Law No. 9275 cancels the payment of VAT on the import of components for unmanned systems into Ukraine. Both laws will remain in effect until the end of martial law.

At the opinion of the Member of the Verkhovna Rada of Ukraine of the 9th convocation, Doctor of Juridical Sciences, Honored Lawyer of Ukraine Hryhoriy Mamka the process of adoption proper legislation in the sphere of UAV development and in particular the mentioned drafts of laws represent a significant addition to the national security framework by establishing control over the use of UAVs as they align national legislation with international standards and norms on UAV usage, which helps improve Ukraine's reputation in the global community and fosters cooperation with other countries in the field of unmanned systems. Moreover, the use of UAVs must be harmonized with European legislation, particularly in the areas of certification, licensing, application, and taxation. These draft laws fall within the scope of European Union law concerning the rules and procedures for operating unmanned aerial systems. While the draft laws themselves do not conflict with Ukraine's obligations under the Association Agreement and EU law, they still require further refinement to ensure legal certainty and full compliance with Regulation (EU) 2018/1139[117].

Notwithstanding the rapid growth of drone production and usage in Ukraine, particularly in response to the full-scale invasion by Russia, as it was described above the country still lacks a coherent and comprehensive regulatory framework for unmanned aerial vehicles. While drones have become an essential component of Ukraine's defense, reconnaissance, and even civilian logistics sectors, legal regulation remains rudimentary at best and solid fundamental judicial practice virtually nonexistent.

The wartime context has undoubtedly accelerated innovation. Ukraine has emerged as a surprising global leader in drone development, with both state-sponsored and grassroots initiatives contributing to a booming ecosystem of FPV drones, strike-capable UAVs, and ISR platforms. In these conditions, the average innovation cycle for a new drone model in Ukraine has been reduced to just 10 weeks - a remarkable pace by any global standard. This means that within roughly two and a half months, a concept can move from design to battlefield deployment, often with real-time feedback from soldiers on the front lines. Such agility has allowed Ukrainian manufacturers to rapidly adapt to enemy tactics,

[117] Mamka Hryhoriy (Мамка Григорій), 'Drones During the War: Legislative Regulation and Liability for Airspace Violations' ['Безпілотники під час війни: законодавче врегулювання та відповідальність за порушення повітряного простору'] (Business Development Fund [Фонд розвитку підприємництва], 25 June 2023) https://bdf.gov.ua/bezpilotnyky-pid-chas-viyny-zakonodavche-vrehuliuvannia-ta-vidpovidalnist-za-porushennia-povitrianoho-prostoru/ accessed 17 June 2025.

improve survivability, and enhance strike accuracy, effectively turning the war into a laboratory of military tech innovation[118].

This unprecedented demand and technological dynamism, however, has not been matched by legislative progress. Currently, the only regulations governing drone use in Ukraine are limited in scope and based on general aviation rules developed before the current wartime realities. These include basic provisions concerning altitude restrictions, no-fly zones, and operator responsibilities, primarily from civil aviation authorities. Such rules may suffice for recreational or commercial drone usage in peacetime, but they fall short in addressing the multifaceted roles drones now play in modern warfare and national security.

Moreover, these basic rules do not provide clear legal pathways for accountability, responsibility, or oversight, especially when it comes to sensitive issues like military-civilian coordination, airspace deconfliction, or dual-use technologies. The lack of a robust legal framework leaves many grey areas regarding ownership, licensing, liability, and usage in urban or contested environments.

Equally concerning is the near absence of judicial practice in this domain. While there are isolated cases involving procurement fraud or administrative violations related to the misuse or loss of drones, court decisions addressing violations of UAV operational rules, airspace breaches, or liability for drone-related incidents are practically nonexistent. This legal silence contributes to operational uncertainty and limits the ability of state institutions to enforce standards or mediate disputes[119].

The consequences of this vacuum are twofold. On the one hand, the lack of regulation enables rapid deployment and tactical flexibility, which is advantageous in wartime conditions. On the other, it risks undermining the safety, coordination, and legitimacy of UAV operations both during and after the war.

As Ukraine looks toward eventual reconstruction and EU integration, the development of a comprehensive regulatory framework for drone use will become not only necessary but urgent. Harmonization with EU norms, clarification of military and civilian

[118] Yavtushenko Oleksandr, 'Drone and Technology Warfare: How Ukraine is Changing the Rules of War', The Ukrainian Review (online, 21 March 2025) https://theukrainianreview.info/drone-and-technology-warfare-how-ukraine-is-changing-the-rules-of-war accessed 18 June 2025.
[119] Samoilenko Vadym, 'Drone Regulations in Ukraine' (L2b Aviation, 10 October 2019) https://www.asterslaw.com/press_center/publications/drone_regulations_in_ukraine/ accessed 1 June 2025.

competencies, and the establishment of legal protections for all parties involved in UAV operations must be prioritized.

3. Chapter III. Noise and sustainability, environment and drones. Drones and air mobility. Developments of drones usage in business sectors.

3.1. Noise and sustainability, environment and drones.

Drones and air mobility are rapidly evolving technologies that hold significant promise for various applications, from delivery services to urban air transportation. However, these innovations come with concerns regarding noise pollution and sustainability.

Drones, especially those intended for commercial or urban air mobility, can generate considerable noise. This noise primarily comes from the drone's rotors or propellers, which can be disruptive, especially in densely populated areas. The noise levels may vary depending on the size, design, and type of drone, but they can impact the quality of life for residents and wildlife. As drones become more prevalent, addressing the noise pollution issue is crucial to ensure public acceptance.

The sustainability of drones and air mobility depends largely on the energy sources they use and the environmental impact of their production and operation. Electric drones are seen as a more sustainable alternative to those using fossil fuels, but challenges remain in terms of battery efficiency, energy consumption, and waste management. The environmental impact of manufacturing and disposing of drones, especially their batteries, is also a significant concern. The carbon footprint of operating fleets of drones, especially in large-scale logistics, requires careful management to ensure that the benefits of these technologies outweigh their environmental costs[120].

Research conducted by Airbus indicates that noise ranks among the primary public concerns regarding the rising use of drones[121]. The World Health Organization has identified noise as an increasing public health issue, associating it with hearing loss, cognitive decline, and cardiovascular problems[122].

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[120] European Union Aviation Safety Agency, 'Drones & Air Mobility – Noise & Sustainability' (EASA, 2025) https://www.easa.europa.eu/en/domains/drones-air-mobility/drones-air-mobility-landscape/noise-sustainability accessed 14 June 2025.

[121] Yedavalli P and Mooberry J, An Assessment of Public Perception of Urban Air Mobility (UAM) (Airbus UTM: Defining Future Skies 2019) https://www.airbus.com/sites/g/files/jlcbta136/files/2022-07/Airbus-UTM-public-perception-study%20-urban-air-mobility.pdf accessed 14 June 2025.

[122] World Health Organization, 'How much does environmental noise affect our health? WHO updates methods to assess health risks' (WHO, 4 August 2024) https://www.who.int/europe/news/item/04-08-2024-how-much-does-environmental-noise-affect-our-health--who-updates-methods-to-assess-health-risks accessed 14 June 2025.

To mitigate the environmental impact of drones and various air mobility technologies, a range of strategies are put into action. These include government regulations, the creation of no-fly zones, the use of geofencing, noise reduction measures, altitude limits, environmental impact assessments, remote identification systems, wildlife monitoring, the development of sustainable technologies, public education initiatives, research, and collaboration among key stakeholders. The aim is to strike a balance between leveraging the advantages of these technologies and minimizing their environmental footprint.

The EASA plays a critical role in regulating the noise and sustainability of drones and air taxis, which are innovative technologies offering new potential for urban mobility and transport.

In accordance with the Article 87 Regulation EU 2018/1139 EASA's role in managing noise and sustainability for these emerging air mobility solutions is to develop a unified set of regulations and standards at the EU level. These regulations are designed to guide the integration of air mobility for both people and goods, ensuring that the noise and environmental effects of these technologies are minimized and deemed acceptable by the public. In addition, EASA conducts research and surveys to gauge the social acceptance of Urban Air Mobility (UAM) across Europe and collaborates with international organizations and stakeholders to foster global harmonization and promote best practices.

EASA has published important standards for measuring the noise of drones and eVTOL aircraft, including:

- The Environmental Protection Technical Specifications: these are the first global proposals to assess and limit air taxi noise. The Environmental Protection Technical Specifications define harmonized noise assessment criteria and procedures, as well as maximum permissible noise levels, specifically for eVTOL aircraft that are powered by multiple, vertical, non-tilting, evenly distributed rotors. The goal is to achieve a high and consistent level of environmental protection while preventing significant negative health impacts from noise in the EU.
- Guidelines on Noise Level Measurements for Drones: these are the first set of guidelines on this issue. They provide standardized procedures for measuring the noise generated by drones used in low and medium-risk operations in the 'specific' category those that require authorization from national aviation authorities or a declaration from the operator. These guidelines are designed to ensure a high and consistent level of

environmental protection, reducing the risk of harmful noise effects on human health in line with the EU's EASA Basic Regulation[123].

Commission Delegated Regulation (EU) 2020/1058 of 27 April 2020[124] establishes testing protocols for measuring the noise levels of various drone classes and sets maximum allowable sound power limits assigned to specific classes. Sections 13 to 15 of the regulation focus on these aspects. It outlines the procedure for determining the A-weighted sound power level for different drone categories, following the ISO 3744:2010 standard. Additionally, the regulation specifies the maximum permitted sound power levels based on drone class and includes phased requirements to reduce these limits, starting two years after the regulation's enactment and further reductions four years after enactment.

The sustainability of drones and air mobility systems, including UAM, Advanced Air Mobility (AAM), and Innovative Air Services (IAS), is contingent upon various factors such as energy sources, emissions, noise pollution, infrastructure, safety, operational efficiency, public acceptance, technological advancements, and environmental impact assessments. Achieving sustainable implementation requires prioritizing clean energy sources, minimizing emissions, and optimizing infrastructure efficiency. However, meticulous planning and continuous evaluation are imperative to ensure that these technologies align with sustainability objectives and do not adversely impact the environment or local communities. The introduction of drone noise regulations by entities such as the European Union indicates a growing global awareness of this issue, suggesting that similar regulatory frameworks are likely to be adopted by other countries as drone usage continues to expand[125].

To comprehensively address these factors, a full life-cycle environmental assessment is essential. In this context, the EASA is developing a standardized methodology known as the Environmental Footprint Aviation (EFA), which aims to prevent greenwashing and promote credible environmental accountability.

The EFA methodology will adopt the format of a Product Environmental Footprint (PEF) Category Rule (PEFCR), which is the European Commission's recommended

[123]European Union Aviation Safety Agency, 'Drones & Air Mobility – Noise & Sustainability' (EASA, 2025) https://www.easa.europa.eu/en/domains/drones-air-mobility/drones-air-mobility-landscape/noise-sustainability accessed 14 June 2025.
[124] Commission Delegated Regulation (EU) 2020/1058 of 27 April 2020 amending Delegated Regulation (EU) 2019/945 as regards the introduction of two new unmanned aircraft systems classes [2020] OJ L 244.
[125] Kennedy John, Garruccio Simone and Cussen Kai, 'Modelling and Mitigation of Drone Noise' (2021) Vibroengineering Procedia https://doi.org/10.21595/vp.2021.21988 accessed 14 June 2025.

framework for evaluating the environmental impacts of products throughout their life cycles. This approach encompasses assessments of environmental impacts during product use, 'upstream' impacts related to manufacturing and raw material extraction, and 'downstream' impacts associated with end-of-life disposal[126].

The PEF methodology was selected due to its comprehensive suite of environmental indicators, which helps prevent burden-shifting and mitigates the risk of "carbon tunnel vision." Additionally, its adoption by the European Commission and its integration into key European policies, such as the Sustainable Batteries Regulation, further reinforce its credibility and relevance for environmental assessments in the aviation sector.

By developing a standardized Product Environmental Footprint Category Rule (PEFCR) for eVTOL aircraft and delivery drones, the EASA aims to facilitate the accurate and consistent quantification and communication of these aircrafts' environmental impacts. This standardized approach will enable eVTOL and drone manufacturers and operators to present their environmental performance transparently and comparably. As a result, investors and consumers will be better equipped to make informed decisions regarding the environmental implications of their choices, while mitigating the risk of greenwashing that can stem from inconsistent environmental assessment methodologies.

The Environmental Footprint (EF) methodology distinguishes between the sixteen environmental impact categories. PEF methodology applies a weighting system to each impact category, enabling the calculation of a weighted average that represents the overall environmental impact. The resulting final score is dimensionless, reflecting this aggregated impact assessment.

For the drone benchmark data, referred to as the PEF Representative Product (PEF-RP), the following impact categories were identified as the most significant, collectively contributing over 80% to the single aggregated score:

- Climate change
- Particulate matter
- Resource use (minerals and metals)
- Resource use (fossil fuels)
- Acidification

[126] European Union Aviation Safety Agency, 'Sustainability: Environmental Footprint' (EASA) https://www.easa.europa.eu/en/en/domains/drones-air-mobility/drones-air-mobility-landscape/noise-sustainability/sustainability-environmental-footprint accessed 14 June 2025.

EASA currently works under further studies, conducts consultations gathers feedbacks from the profile organizations and mass users and targets to elaborate the plan for further development based on the recommendations outlined in the current drone PEFCR and the received public comments.

As stated in Annex III of the Regulation EU 2018/1139 that applies to the unmanned aircraft pursuant to Article 9(2) of the same regulation, in the context of ensuring the environmental compatibility of aircraft products, the following principles and obligations govern the design, production, and maintenance of systems and equipment, with a focus on minimising environmental impact and promoting sustainability.

a. Minimisation of Noise Emissions. All aircraft products shall be designed to minimise noise emissions to the greatest extent possible. In applying this requirement, due consideration must be given to the potential trade-offs outlined in point 4. This implies that noise reduction measures must not be implemented in isolation but evaluated in relation to other environmental and operational factors.

b. Minimisation of General Emissions. Aircraft products must be designed with the aim of minimising all types of emissions as far as technically and operationally feasible. Again, the principle of integrated evaluation under point 4 applies, recognising that efforts to reduce one form of emission should not result in disproportionate increases in another.

c. Control of Evaporative and Fluid Discharge Emissions. Products shall be specifically designed to minimise emissions arising from the evaporation or discharge of fluids. This includes emissions that may result from fuel systems, hydraulic systems, or other fluid-handling components. The trade-offs described in point 4 must be carefully considered in evaluating and implementing such design features.

d. Consideration of Trade-Offs. In implementing measures aimed at reducing noise and emissions, manufacturers must give due regard to trade-offs between different environmental objectives. This includes balancing the need to minimise noise against the need to reduce various types of emissions, as well as preventing fluid discharge. No single environmental benefit should be pursued at the unjustifiable expense of another, and holistic assessments must guide all design decisions.

e. Operational and Geographical Scope. The entire range of normal operating conditions and all relevant geographical areas where noise and emissions are a concern must be taken into account during the design process. This ensures that environmental

protection measures remain effective and appropriate regardless of where and how the aircraft is operated, including in sensitive or regulated areas.

f. Reliability and Performance of Environmental Systems. Aircraft systems and equipment that are installed specifically for environmental protection purposes must be designed, produced, and maintained to ensure their intended function is reliably performed under any foreseeable operating condition. The level of reliability must be commensurate with the importance of their role in ensuring the environmental compatibility of the product, reinforcing the obligation to integrate durability and robustness into all environmental protection mechanisms.

g. Provision of Compliance Instructions and Operational Guidance. To ensure the ongoing compliance of aviation products with the essential environmental requirements set out in this Annex, all relevant instructions, procedures, manuals, operational limitations, and inspection regimes must be clearly defined, documented, and provided to the intended users. These materials must be presented in a clear, unambiguous, and accessible manner, ensuring that those responsible for the operation, maintenance, or oversight of the product can consistently apply the required measures. The aim is to promote transparency and enable continued environmental performance throughout the product's lifecycle.

h. Organisational Responsibilities for Compliance. Organisations engaged in the design, production, and maintenance of aviation products bear a shared responsibility for ensuring full compliance with the essential requirements of the Annex III of the Regulation EU 2018/1139. To this end:

- Each organisation must possess and maintain all necessary resources, competencies, processes, and tools required to ensure that the aviation product meets the environmental design and operational criteria outlined herein. This includes technical capabilities, human expertise, quality assurance systems, and environmental management frameworks.
- Where compliance obligations span across multiple entities or stages in the product's lifecycle, organisations must establish effective arrangements and cooperation mechanisms with other relevant parties. These arrangements should ensure a coordinated approach to compliance and enable the flow of critical environmental data and responsibilities across organisational boundaries.

Interestingly, a study titled Modelling and Mitigation of Drone Noise was conducted to examine the acoustic impact of various drone operating conditions and flight paths. The

research sought to identify effective mitigation strategies to reduce noise exposure for individuals living near prospective drone ‘charging hubs’ and high-traffic aerial corridors. A key objective was also to assess the effectiveness of commercial noise modelling software, particularly ‘iNoise’, in simulating drone noise emissions. The findings indicated that noise levels could be reduced by operating drones at higher altitudes and speeds, and by employing vertical take-off and landing procedures. While most of the measured noise levels were below the maximum LDEN (day-evening-night level) threshold set for road traffic noise, they approached this limit at lower speeds. Since the study used a small quadcopter as the noise source, it is likely that larger commercial drones would produce higher sound power levels, underscoring the importance of robust noise mitigation. The study also confirmed the suitability of iNoise as a tool for modelling drone-related noise emissions[127].

Overall, understanding the importance of ensuring proper comfort for individuals, special emphasis is placed on noise control and sustainability in the regulation of drone usage.

3.2. Drones and air mobility. Developments of drones usage in business sectors.

3.2.1. Air taxi

Drones have already proven an outstanding capacities to make numerous tasks more efficient, which makes it very logical that majority of business solutions involve pilotless vehicles.

When considering air mobility, the primary focus is typically laid on the concept of a vehicle capable of seamlessly transitioning between road and air travel. Flying cars have long been a central aspiration in futuristic visions, as their dual capabilities could address numerous logistical challenges, particularly in densely populated urban areas. In major cities, helicopters have become the preferred mode of transportation for critical tasks. However, their operation requires designated landing sites, which are often impractical within urban environments, except for specially designated locations such as rooftops of skyscrapers or similar structures.

The first prototype of a flying car dates back to the early 20th century. One of the earliest attempts was the Curtiss Autoplane, developed in 1917 by aviation pioneer Glenn

[127] Kennedy J, Garruccio S and Cussen K, 'Modelling and Mitigation of Drone Noise' (2021) Vibroengineering Procedia https://doi.org/10.21595/vp.2021.21988 accessed 14 June 2025.

Curtiss. This prototype was displayed in the Pan American aeronautical show that year and featured a triplane wing design and a pusher propeller, but it never achieved sustained flight, only short hops off the ground were accomplished. Almost all publicly available information on the topic consists of reprinted versions of a single press release, repeated verbatim across various publications, from The New York Times on February 11, 1917, to the Tombstone Weekly Epitaph as late as April 1, 1917. A particularly clear version can be found in the Kansas City Kansan from March 24, 1917[128]. The article read:

> "The main body of the "autoplane" bears marked resemblance to an automobile, but it is fitted with three wings, which are attached just back of the side doors which allow entrance to the interior. These wings vary in size, the largest being at the top and the smallest at the bottom. The machine rests on four wheels, the two front ones capable of being turned in the same manner as those on a motor car. The interior resembles very much a modern sedan or a small limousine. The machine is equipped with an eighty-cylinder 100-horse power Curtiss motor, which will drive the autoplane at a maximum speed of 65 miles per hour through the air."

The Curtiss Autoplane is particularly significant as it transformed the concept of a flying car into a tangible reality, captivating the public with the promise of integrating cutting-edge aviation and automotive technologies into a versatile, all-purpose vehicle.

Another notable example is the Aerocar, developed by Moulton Taylor in the 1940s and 1950s. It was one of the few flying cars to receive Federal Aviation Administration of the United States certification which acknowledged an important milestone in aviation history. It was designed as a hybrid vehicle, capable of operating both on roads and in the air, making it one of the most practical attempts at creating a real flying car. The Aerocar featured a compact car-like body with detachable wings and a rear-mounted propeller, allowing it to transition between driving and flying. Switching from car mode to airplane mode took about 10 minutes, as the wings could be folded and towed behind the vehicle when not in use. It could reach speeds of 60 mph (97 km/h) on roads and up to 110 mph (177 km/h) in the air, with a range of approximately 300 miles (480 km) when flying. Although the Aerocar did not become a mainstream product, it remains an iconic example of early flying car technology. Some original Aerocars still exist in museums or private collections[129].

Nowadays several Silicon Valley companies made significant strides in developing and testing flying car prototypes. In February 2025, the private company Alef Aeronautics

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[128] 'Automobile-Airplane Combination' Kansas City Kansan (24 March 1917) reprinted in Flying Cars and Food Pills, 'Glenn Curtiss – A First Flying Car' https://www.flyingcarsandfoodpills.com/glenn-curtiss---a-first-flying-car accessed 14 June 2025.

[129] Rita Cipalla, 'The Aerocar, a combination car and plane, makes its first public flight in Longview on December 8, 1949' (HistoryLink.org, 12 March 2019) HistoryLink.org Essay 20930 https://www.historylink.org/File/20930 accessed 14 June 2025.

released a groundbreaking video showcasing a flying car's vertical takeoff, demonstrating the potential for new transportation possibilities. The 100% electric vehicle features distributed electric propulsion, allowing it to lift off and soar, marking a significant milestone akin to the Wright Brothers' first flight[130]. The prototype, an ultralight version of the Alef Model Zero, was tested on a closed-off road. The commercial version, the Alef Model A, will seat two, feature autopilot flight capabilities, and have a driving range of 200 miles and a flying range of 110 miles. It is expected to be street-legal, differing from other eVTOLs (electric Vertical Take-Off and Landing aircraft) limited to flight. Despite a modest top speed of 25 mph, the Model A includes advanced features like obstacle detection, glide landing, and a ballistic parachute, with prices starting at $300,000. By 2035, Alef plans to launch the Model Z, a four-person flying sedan with an extended range[131].

Another private company ASKA shows considerable progress in developing their version of a flying car. The ASKA A5 is the roadable electric-hybrid VTOL (vertical takeoff and landing) is the world's first electric flying car to start the type certification process with the FAA. The A5 prototype has been awarded the FAA's Certificate of Authorization and is undergoing flight testing. This four-seater vehicle operates both on roads and in the air, featuring vertical takeoff and landing capabilities as well as short takeoff and landing (STOL). The prototype is equipped with the lithium ion batteries and the engine, has the flight range up to 250 miles and flight speed up to 150 mph. ASKA aims to provide a versatile transportation solution, bridging the gap between traditional driving and aviation[132].

In 2024 another private company Joby Aviation continued to advance its electric vertical takeoff and landing (eVTOL) aircraft. The company received FAA approval to flight test its first production prototype and plans to deliver early units to the U.S. Air Force as part of a $131 million contract. Joby's aircraft is designed to carry four passengers and a pilot, aiming for speeds up to 200 mph with a range of 100 miles. The company anticipates full certification and entry into commercial service in 2025.

In September 2024 Joby Aviation announced that it has commenced the initial steps toward obtaining certification as an air taxi operator in the United Arab Emirates. Earlier in

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[130] *The Wright Brothers' Kitty Hawk flight on December 17, 1903, was a revolutionary moment in aviation history. Orville and Wilbur Wright successfully flew the Wright Flyer, the first powered, heavier-than-air aircraft, in Kitty Hawk, North Carolina.* Video from Reuters Archive: The Wright brothers first aeroplane flight (1903) (British Pathé) https://www.britishpathe.com/asset/172258/ accessed 14 June 2025.

[131] Ben Cost, 'Flying car soars over traffic in astonishing first-ever video: "New transportation is possible"' (New York Post, 21 February 2025) https://nypost.com/2025/02/21/lifestyle/flying-car-soars-over-traffic-in-astonishing-first-ever-video-new-transportation-is-possible/ accessed 14 June 2025.

[132] ASKA, 'ASKA A5 – Roadable Electric-Hybrid VTOL' https://www.askafly.com accessed 14 June 2025.

2024 the company entered into a definitive agreement with Dubai's Road and Transport Authority to introduce air taxi services in the Emirate of Dubai, positioning the city as a global leader in advanced air mobility. This strategic partnership will facilitate the introduction and scaling of Joby's air taxi services within Abu Dhabi and beyond[133].

These developments reflect the rapid progress in the flying car industry within Silicon Valley, with companies moving closer to making aerial personal transportation a reality.

The FAA sees the beginning of new era of air mobility as well. Advanced Air Mobility (AAM) aircraft refers to a broad category of highly automated, electrically powered vehicles capable of vertical take-off and landing. These aircraft, frequently categorized as powered-lift, are commonly known as air taxis. This is a new development stream that is prioritized by FAA[134].

Innovative Air Mobility (IAM) offers a promising alternative, especially in the form of vertical take-off and landing (VTOL) aircraft. Recognizing this shift, the European Commission has recently adopted a package of secondary legislation aimed at regulating piloted electric air taxis and unmanned aircraft systems, marking a significant milestone in the development of urban air transport.

This new legislative package, finalized in early 2024, is built upon the proposals made by the EASA in its Opinion No. 03/2023, released in August 2023. The package introduces a comprehensive regulatory framework covering critical operational domains: Air Operations (Air OPS), Flight Crew Licensing (FCL), Standardised European Rules of the Air (SERA), and Air Traffic Management (ATM). These regulations are designed to ensure the safe, controlled, and standardized deployment of air taxi services across EU member states. Moreover, the framework also includes certification and maintenance protocols for VTOL-capable drones, laying the groundwork for their broader adoption[135].

Importantly, this legislation is not standalone as it serves as the final legal element required to enable commercial air taxi services in Europe. It complements existing regulatory instruments concerning drone operations, U-space, and airworthiness requirements, forming a cohesive policy environment that supports the real-world implementation of IAM.

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[133] Davoren Haley, 'Joby applies to be first certified electric air taxi operator in UAE' (GlobalAir.com, 10 September 2024) https://www.globalair.com/articles/joby-applies-to-be-first-certified-electric-air-taxi-operator-in-uae?id=7915 accessed 14 June 2025.

[134] Federal Aviation Administration, 'Advanced Air Mobility | Air Taxis' https://www.faa.gov/air-taxis accessed 14 June 2025.

[135] European Commission, 'Commission adopts regulatory package, giving go-ahead for VTOL operations and air taxis' (10 April 2024) https://www.easa.europa.eu/en/newsroom-and-events/news/european-commission-adopts-regulatory-package-giving-go-ahead-vtol accessed 14 June 2025.

However, while the legal path is now clear, air taxi manufacturers must still obtain EASA certification for their vehicles before services can commence. This ensures that both the aircraft and their operators meet stringent safety and performance criteria equivalent to those applied in manned aviation.

The implications of this new framework are substantial. By integrating air taxis into the broader aviation ecosystem, the EU is taking a global leadership role in shaping the future of urban mobility. These developments could revolutionize transport in metropolitan areas,cutting commute times, reducing surface traffic, and opening up new corridors for logistics and emergency response. Nonetheless, the successful deployment of air taxis will require continued investment in infrastructure, public acceptance, and urban air traffic integration, particularly in dense urban environments where safety, noise, and environmental impact are of heightened concern[136].

3.2.2. UAVs in business

Drones are transforming industries by offering innovative solutions to traditional challenges. As technology advances and regulations evolve, their use in business is expected to grow even further. UAVs have become increasingly popular across various business sectors due to their versatility, cost-effectiveness, and ability to access hard-to-reach areas. The following provides a breakdown of how drones are being used in different industries.

In construction and real estate, drones have revolutionized operations by facilitating high-precision site surveys that generate topographical data and 3D models of construction sites. This technology enables construction projects to be planned and executed with greater accuracy and speed. Drones also allow for ongoing monitoring of construction progress, helping ensure that projects stay on schedule by providing real-time data to project managers[137]. In the real estate market, drones have transformed property marketing by capturing stunning aerial footage and creating virtual tours of properties, providing potential

[136] Buzgó László, 'Skybound Regulations: Navigating the Future of Air Taxis and eVTOLs in the EU' (Flying Cars Market, 19 April 2024) https://flyingcarsmarket.com/skybound-regulations-navigating-the-future-of-air-taxis-and-evtols-in-the-eu/?utm_ accessed 14 June 2025.

[137] Flare Dynamics, ‘Construction Progress Monitoring’ (Flare Dynamics, 2024) https://www.flaredynamics.com/drones-as-a-service/constructionprogress-monitoring accessed 15 June 2025. This website is cited as an example of how companies use drones in construction for real-time monitoring and site data collection.

buyers with an immersive experience that enhances decision-making and expedites sales[138].

Environmental monitoring and conservation efforts have been significantly bolstered by the use of drones. In wildlife tracking, drones enable researchers to observe and monitor endangered species without disturbing their natural habitats. This non-intrusive method ensures the collection of accurate data while preserving the integrity of ecosystems. Additionally, drones are essential in disaster management, providing real-time aerial assessments of damage caused by natural disasters such as earthquakes, floods, or hurricanes. This capability allows for quicker response times and more efficient coordination of relief efforts. Drones are also making a significant impact in reforestation projects, where they plant seeds in deforested areas, accelerating the process of restoring damaged ecosystems on a much larger scale than traditional methods[139].

The healthcare industry has also embraced drone technology, particularly for the delivery of medical supplies. Drones have proven invaluable in transporting medicines, vaccines, and blood to remote or disaster-stricken areas, overcoming logistical challenges posed by difficult terrain or damaged infrastructure[140]. In emergency situations, drones provide first responders with real-time aerial views, offering critical insights that aid in making timely and informed decisions, thereby improving response effectiveness and saving lives[141].

In the energy and utilities sector, drones are increasingly being used to inspect infrastructure such as power lines, wind turbines, and pipelines. This application greatly reduces the need for risky manual inspections and provides a safer, more efficient alternative for monitoring critical assets[142]. Drones are also used in solar panel maintenance, identifying

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[138] Zachary Dulla, 'Transform Your Real Estate Marketing with FPV Drone Property Tours' (Hawkeye Aerial Media, 2023) https://hawkeyeaerialmedia.co.uk/transform-your-real-estate-marketing-with-fpv-drone-property-tours/ accessed 15 June 2025. This website is cited as an example of how drone tours are used in real estate marketing.

[139] Wildlife Drones, 'Drones for Wildlife Conservation' (Wildlife Drones, 2024) https://wildlifedrones.net/drones-for-wildlife-conservation accessed 15 June 2025. Fatos Bytyci, 'Seed-Dropping Drones Seek to Halt Kosovo's Deforestation' (Reuters, 15 May 2024) https://www.reuters.com/business/environment/seed-dropping-drones-seek-halt-kosovos-deforestation-2024-05-14/ accessed 15 June 2025.These websites cited as an example of how drones are used in wildlife tracking and conservation without disturbing natural habitats.

[140] Ajadi Samuel, 'Are drones suitable tools for delivering medical supplies in developing countries?' (Mobile for Development, 21 December 2020) https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-for-development/blog/are-drones-suitable-tools-for-delivering-medical-supplies-in-developing-countries/ accessed 15 June 2025.

[141] Johnson et al Anna M, 'Impact of Using Drones in Emergency Medicine: What Does the Future Hold?' (Open Access Emergency Medicine, 2021) https://pmc.ncbi.nlm.nih.gov/articles/PMC8605877/ accessed 15 June 2025.

[142] Reuters, 'Britain to allow drones to inspect power lines, wind turbines' (Reuters, 14 October 2024) https://www.reuters.com/world/uk/britain-allow-drones-inspect-power-lines-wind-turbines-2024-10-14/

defects or dirt on panels, which is essential for ensuring optimal performance and maximizing energy production[143]. In the oil and gas industry, drones monitor offshore rigs and pipelines for potential leaks or damage, enabling faster detection and more effective maintenance, reducing risks and downtime[144].

The media and entertainment industry has been significantly enhanced by the versatility of drones. Aerial photography and videography have become a standard in movies, TV shows, advertisements, and other productions. Drones capture breathtaking aerial shots that would have been previously difficult or expensive to achieve. Additionally, drones provide unique perspectives for live event coverage, such as sports events, concerts, and festivals. The ability to fly overhead and capture dynamic, real-time footage adds a new dimension to broadcast media, engaging audiences in ways that traditional cameras cannot[145].

Among the top business sectors which use UAV are the agriculture and delivery services. Drones have emerged as a transformative tool in modern agriculture, offering efficient solutions for monitoring and managing large fields and vast territories. Equipped with advanced technologies, drones are capable of detecting pests, identifying diseases, and assessing crop health, enabling farmers to make informed decisions. They play a pivotal role in precision farming, optimizing the distribution of resources such as water and fertilizers, thereby minimizing environmental impact[146].

Drones are also utilized for targeted spraying of water and pesticides, ensuring efficient resource utilization while reducing chemical runoff. In many countries around the globe, not only EU and USA (India, Australia, Israel no name a few) drones are at the forefront of agricultural innovation, assisting in tasks such as harvesting, sorting, and

accessed 15 June 2025. This article provides an example of how drones are being authorized and used in the UK to safely and efficiently inspect critical energy infrastructure such as power lines and wind turbines.

[143] Steve Dempsey, 'Benefits Of Drones For Solar Inspections' (Sky Drone Solutions, 27 January 2025) https://skydronesolutions.com/benefits-of-drones-for-solar-inspections/ accessed 15 June 2025. This article illustrates how drones are employed in solar panel inspections to enhance efficiency, safety, and accuracy.

[144] Jennifer Goforth Gregory, 'How Drone Pipeline Monitoring Benefits the Oil and Gas Industry' (Verizon, 18 September 2024) https://www.verizon.com/business/resources/articles/s/how-drone-pipeline-monitoring-could-benefit-the-oil-and-gas-industry/ accessed 15 June 2025.

[145] Michael Izquierdo, 'Beverly Hills Aerials Elevates Video Production With DJI's Inspire 3 Drone' (TV Technology, 11 April 2025) https://www.tvtechnology.com/equipment/beverly-hills-aerials-elevates-video-production-with-djis-inspire-3-drone accessed 15 June 2025. This article illustrates how Beverly Hills Aerials utilizes DJI's Inspire 3 drone to enhance its aerial cinematography services, providing high-quality footage for various productions.

[146] Tabssum Hassan, 'Drones in Agriculture: Revolutionizing Farm Monitoring' (Agrinext Conference, 21 February 2025) https://agrinextcon.com/drones-in-agriculture-revolutionizing-farm-monitoring/?utm_ accessed 16 June 2025.

inspecting fruits[147]. These systems are increasingly integrated with machine learning algorithms, allowing them to quickly adapt and improve their performance.

In the near future, drones are expected to oversee the entire cultivation process, from planting to harvesting. With rapidly evolving learning systems, they will continue to enhance productivity, sustainability, and precision in agriculture, paving the way for smarter and more efficient farming practices.

Ukraine is often referred to as the "breadbasket of Europe" due to its vast agricultural lands and fertile soil. Our country has been increasingly adopting drone technology to modernize its farming practices. Drones are playing a crucial role in enhancing productivity, sustainability, and efficiency in Ukrainian agriculture, helping farmers address challenges such as large-scale field management, resource optimization, and environmental concerns.

While the adoption of drone technology in Ukrainian agriculture is growing, there are still challenges to overcome. These include the high initial cost of advanced drone systems, limited technical expertise among farmers, and regulatory restrictions on drone usage. However, as technology becomes more affordable and accessible, and as farmers receive more training, these barriers are expected to diminish.

The future of drones in Ukrainian agriculture looks promising. With ongoing advancements in artificial intelligence, machine learning, and drone capabilities, these tools will become even more integral to farming operations. Drones are likely to play a key role in helping Ukraine maintain its position as a global agricultural powerhouse while embracing sustainable and innovative practices[148].

In the United States, drones have also proven valuable in agricultural operations. According to the Federal Aviation Administration, the use of drones for agricultural purposes falls under specific regulations outlined in the Code of Federal Regulations. Title 14, Part 137 governs the use of aircraft, including drones, in agricultural applications. To operate a drone for such purposes, operators must seek special approval, and the FAA mandates a certification process.

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[147] Brian Blum, 'Fruit-picking drones can solve the farm labor shortage' (ISRAEL21c, 17 August 2022, updated 22 November 2022) https://www.israel21c.org/fruit-picking-drones-solve-the-farm-labor-shortage/ accessed 16 June 2025. Agroinsurance, ‘How Agri-Tech Drones Are Revolutionizing Crop Monitoring and Yield Optimization’ (29 May 2024) https://agroinsurance.com/en/News/How-agri-tech-drones-are?utm_ accessed 16 June 2025.

[148] Velykyi Bohdan, 'What Was the Year 2023 for Ukrainian Business? The Results of the DroneUA Group' (DroneUA, 29 December 2023) https://drone.ua/en/blogs/news/what-was-the-year-2023-for-ukrainian-business-the-results-of-the-droneua-group?utm_ accessed 16 June 2025.

There is, however, a new, streamlined certification process for those seeking a Part 137 UAS certificate. This system simplifies the approval process for agricultural drone operations, including VLOS operations, provided these operations adhere to specific altitude and airspeed limits. Moreover, the FAA has provided exemptions for some standard operating procedures that don't apply to drone operations, such as the requirement for carrying flight manuals onboard.

For commercial drone operations BVLOS, operators must adhere to Part 135 of the Code of Federal Regulations, which outlines rules for commuter and on-demand operations, as well as requirements for persons on board. While this part was initially designed for traditional aircraft, the FAA has adapted it to drone operations by granting certain exemptions where applicable. Part 135 certification remains the only pathway for small drones to transport goods for compensation in BVLOS operations, underscoring the complexity and evolving nature of drone regulation[149].

Package delivery by drone is a separate popular streamline in the USA. As drones are steadfastly introduced into everyday life and with the legal system not yet factually designed for such operations, FAA prioritizes safety issues and continues to elaborate the best possible solutions for setting up of proper regulations. The FAA is actively fostering innovation and collaborating with industry stakeholders, as well as state, local, and tribal governments, to harness the benefits of drones and shape future rules and regulations. Between 2017 and 2020, the Unmanned Aircraft Systems Integration Pilot Program (IPP) concentrated on testing and assessing the integration of civil and public drone operations into the national airspace system. This effort has continued under the UAS BEYOND program, which addresses ongoing challenges in UAS integration, such as BVLOS operations, the societal and economic advantages of UAS use, and community involvement.

Participants in these initiatives are pioneers in demonstrating innovative concepts, including drone-based package delivery achieved through Part 135 air carrier certification[150].

In April 2019, the FAA granted Wing Aviation, LLC the first Part 135 Single Pilot Air Carrier Certificate for drone operations. Subsequently, in October 2019, the FAA awarded Wing a standard Part 135 Air Carrier Certificate to operate drone aircraft. Wing Aviation initially participated in the Integration Pilot Program (IPP), where it conducted deliveries of

[149] Federal Aviation Administration, 'Dispensing Chemicals and Agricultural Products (Part 137) with UAS' (2020) https://www.faa.gov/uas/advanced_operations/dispensing_chemicals accessed 16 June 2025.
[150] Federal Aviation Administration, 'BEYOND' (2020) https://www.faa.gov/uas/programs_partnerships/beyond accessed 16 June 2025.

food and over-the-counter pharmaceuticals directly to residents in Christiansburg, VA. Following the conclusion of the IPP in October 2020, Wing continued its operations under the BEYOND program.

Similarly, UPS Flight Forward, Inc., another participant in the IPP that transitioned to the BEYOND program, became the first company to receive a standard Part 135 Air Carrier Certificate for drone aircraft operations. On September 27, 2019, UPS Flight Forward executed its inaugural drone package delivery under Part 135 certification, transporting medical supplies across the WakeMed hospital campus in Raleigh, NC[151].

Amazon, a participant in the Partnership for Safety Plan (PSP), became the first company to operate a drone weighing more than 55 pounds under a standard Part 135 Air Carrier Certificate. The company commenced its commercial operations in August 2020[152].

On June 17, 2022, Zipline achieved a significant milestone as the fourth drone operator to receive a Part 135 Certificate, authorizing it to function as an air carrier and conduct common carriage operations. This marked the first Part 135 Certificate issued under the BEYOND program and the first certification granted to a fixed-wing UAS operator[153].

In January 2023, Causey Aviation Unmanned, a long-standing partner of Flytrex, was awarded a standard Part 135 Air Carrier Certification, enabling it to perform long-range, on-demand commercial drone deliveries within the United States.

Most recently, on November 27, 2024, DroneUp, LLC became the sixth U.S. drone operator to obtain a Part 135 Air Carrier Certificate. Certified as a Standard Part 135 operator, DroneUp, LLC will initially provide on-demand package delivery services in the Dallas/Fort Worth area[154].

According to the lates statistics of drone operations as of Arpil 2025 in EASA countries there are:

- 1,669,510 registered drone operators

[151] Federal Aviation Administration, 'FAA Authorizes UPS Flight Forward and uAvionix to Operate Drones Beyond Visual Line of Sight' (6 September 2023) https://www.faa.gov/newsroom/faa-authorizes-ups-uavionix accessed 16 June 2025.
[152] Federal Aviation Administration, 'Package Delivery by Drone (Part 135)' (2020) https://www.faa.gov/uas/advanced_operations/package_delivery_drone?utm accessed 16 June 2025.
[153] Zipline, 'Zipline Receives FAA Part 135 Air Carrier Certification to Grow Its Automated, On-Demand Delivery Service in the U.S.' (21 June 2022) https://www.globenewswire.com/news-release/2022/06/21/2466591/0/en/Zipline-Receives-FAA-Part-135-Air-Carrier-Certification-to-Grow-Its-Automated-On-Demand-Delivery-Service-in-the-U-S.html accessed 16 June 2025.
[154] Federal Aviation Administration, 'Package Delivery by Drone (Part 135)' (2020) https://www.faa.gov/uas/advanced_operations/package_delivery_drone?utm accessed 16 June 2025.

- 1,139,235 of A1/A3 remote pilot certificates
- 184,159 of A2 remote pilot certificates
- 2,204 operational authorizations

Germany is the leader in number of registered operators (680 000) and issued certificates (400,000 of A1/A3 and 25000 of A2 remote pilot certificates)[155].

According to the FAA data as of April 2025, there are over 1 million registered drones in the United States, 420 commercial drone registrations, approximately 383,000 recreational registrations and 444,960 certified remote pilots[156].

Summarizing, the use of drones in business has rapidly expanded due to their numerous advantages, transforming industries by offering significant cost savings, increased efficiency, enhanced safety, and high-quality data collection. Drones reduce labor and operational costs by automating tasks that would otherwise require manual labor or expensive machinery. Drones can carry out complex tasks more quickly, provide greater accuracy in various applications, improve safety by minimizing the need for human workers to perform dangerous tasks in hazardous environments, drones can safely access hard-to-reach areas, reducing the risk of accidents and injuries. Furthermore, drones offer the ability to collect high-quality, real-time data, which enables businesses to make more informed decisions.

Despite these advantages, the use of drones in business comes with several challenges. One of the primary hurdles is navigating the strict regulations governing airspace in certain regions. Many countries have established comprehensive airspace restrictions to ensure the safety of both manned and unmanned aircraft. These regulations can sometimes limit drone operations or slow down the adoption of drone technology in certain industries. Privacy concerns also pose a significant challenge, as drones can be used for surveillance, leading to potential misuse. The risk of infringing on individual privacy rights has prompted debates around the ethical use of drones, particularly in public spaces. Additionally, drones still face technical limitations, such as limited battery life and payload capacity, which can restrict their operational range and ability to carry heavy or large equipment. These

[155] Esri, 'Layer 7: Data Source 3-1907c1d1216' [Web Map] (2025) https://experience.arcgis.com/experience/1cad6eae759746c0a2cc8cb85f6db776#data_s=id%3AdataSource_3-1907c1d1216-layer-7%3A7 accessed 16 June 2025. *This interactive map, created by Esri, visualizes drone operations across the European Union, illustrating spatial patterns, regulatory zones, and operational data relevant to EU member states.*

[156] Federal Aviation Administration, 'Drones by the Numbers (as of 4/1/2025)' (2025) https://www.faa.gov/node/54496 accessed 16 June 2025.

limitations often require businesses to invest in multiple drones or more advanced models to meet specific needs. Lastly, the initial investment required to purchase advanced drones can be high, posing a barrier for smaller businesses or startups. While the cost of drones has been decreasing over time, the upfront expenditure for sophisticated models with specialized capabilities remains a consideration for many companies.

4. Chapter IV. Unique opportunities and real adverse effects of drones. Data collection and AI. Society alarms, aerial trespass, privacy rights and other threats.

4.1. Privacy and data collection.

When discussing the enormous potential and efficiency of drones, it is only natural to also consider their adverse effects, chief among them being the intrusion of privacy and the unrestricted collection of personal data.

Cujus est solum ejus est usque et coelum, which in Latin means "whoever's is the soil, it is theirs all the way to Heaven and all the way to Hell". This maximum was formally entrenched as a absolute right of a person under ancient Roman law[157]. This poetic phrase means that since ancient times people made efforts to find a proper solution for land owners and their rights to the air and underground of the plot and the solution was found by entitling the real estate owner with the undivided right to the land plot, all resources above and below it. And the Supreme Court of the United States quoted this ancient formula in Latin when deciding a very interesting case U.S. vs. Causby et ux. No. 630, May 27, 1946[158]. It sounds very unexpectedly and yet Mr. Cuasby, the chicken farmer from North Carolina sued the state in the middle of XX century for unauthorized usage of this air above his dwelling house and farm.

The circumstances of the case were as follows. The respondent owned a land plot of 2.8 acres near the airport outside of Greensboro in North Carolina, on which his dwelling house and various outbuildings mainly used for raising chickens were situated. The end of the airport's northwest-southeast runway was very close from the respondents' barn and house (from 2,220 to 2,275 feet). The path of glide to this runway passed directly over the property.

The Court of Claims found the following essential facts in the case. Since the United States began operations in May, 1942, its four-motored heavy bombers, other planes of the heavier type, and its fighter planes have frequently passed over respondents' land buildings in considerable numbers and rather close together. They came close enough at times to appear barely to miss the tops of the trees. The noise was startling and at night the glare from the planes brightly lighted up the place. As a result of the noise, Mr. Cuasby had to give up the chicken business as the described conditions did not go in line with the ones that

[157] Ruwantissa I R Abeyratne, Convention on International Civil Aviation: A Commentary (Springer International Publishing 2014) 15.
[158] United States v Causby, 328 US 256 (1946) https://supreme.justia.com/cases/federal/us/328/256/ accessed 19 June 2025.

were needed to ensure proper biological functioning and maintenance for the house birds, as six to ten of the chickens were killed in one day by flying into the walls from fright. The total chickens lost in that manner was about 150. Production also fell off. The result was the destruction of the use of the property as a commercial chicken farm. Respondents were frequently deprived of their sleep and the family has become nervous and frightened. Although there occured no airplane accidents on respondents' property, there were several accidents near the airport and close to respondents' place.

On the basis of these facts, the Court of Claims found that respondents' property had depreciated in value. It held that the United States had taken an easement over the property on June 1, 1942, and that the value of the property destroyed and the easement taken was $2,000. Although there were arguments in favour of the state, which said that airspace is a public highway, the airplane was part of the modern environment of life, and the inconveniences which it caused were not compensable and that the the path of glide taken by the planes was approved by the Civil Aeronautics Authority, the U.S. Supreme Court upheld the position that the landowner owns at least as much of the space above the ground as can occupy or use in connection with the land in order to have full enjoyment of the land[159]. The U.S. Supreme Court explicitly stated that the factual easement took place and the servitude was imposed upon the land due to usage of the airspace above the land plot which adversely impacted the right of utilization of the land plot. Notwithstanding the fact that the U.S. Supreme Court could not decide on the proper amount of compensation to Mr. Causby as the court stated that on that record it was not clear whether the easement taken was a permanent or a temporary one, this was a groundbreaking decision that kept its actuality till nowadays.

Nowadays, the topic of trespassing private lands by air has become highly relevant, especially with the widespread use of drones. These UAVs are advancing rapidly in technology and are often equipped with high-resolution cameras capable of capturing intricate details from above. While drones offer many practical benefits, they also pose serious privacy concerns. They can easily fly over private properties, although not always technically violating any ground boundaries, and still record images, video, and even audio of people’s lives without their knowledge or consent. This means that even without physical entry, drones can invade personal space through surveillance, raising ethical and legal questions about the limits of privacy in an era where the sky is no longer a barrier.

[159] United States v Causby, 328 US 256 (1946) https://supreme.justia.com/cases/federal/us/328/256/ accessed 19 June 2025.

Curiously, the first prototypes of modern UAVs equipped with cameras were pigeons. According to scientists[160] reconnaissance carrier pigeons were used over three thousand years ago by the Egyptians, Persians, Greeks, Romans, and others. Despite the development of optical telegraph signalling systems in France in the late eighteenth century, carrier pigeons remained popular in France. They went on to prove their worth during the four-month siege of Paris during the Franco-Prussian War in 1870-1871 when, it is said, 400 birds delivered nearly 115,000 government messages and about a million private messages. By the outbreak of First World War in August 1914, the military use of carrier pigeons was well established. French and German Armies and later the British Army established a carrier pigeon service, which was actively used in espionage. In 1907 a German apothecary and amateur pigeon fancier Dr Julius G. Neubronner patented a pigeon camera, which was put into limited use for aerial reconnaissance by the German Army during the First World War before they were superseded by aircraft reconnaissance.

Back then society was not burdened with the data protection rights and could not imagine to which technological modernization will it be led. Today as the UAVs are mostly equipped with the high-hech cameras and/or listening devices with the unique mobility opportunities, the usage of drones is subject to compliance with the Data Protection Act or GDPR[161].

When considering the ethical implications of drone usage, personal data privacy and necessity of obtaining an individual consent take precedence. In accordance with data protection regulations, namely Article 4 of the GDPR '*personal data*' means any information relating to an identified or identifiable natural person ('data subject'); an identifiable natural person is one who can be identified, directly or indirectly, in particular by reference to an identifier such as a name, an identification number, location data, an online identifier or to one or more factors specific to the physical, physiological, genetic, mental, economic, cultural or social identity of that natural person. Since the definition includes "any information," one must assume that the term "personal data" should be as broadly interpreted as possible.

[160] 'Exciting Tales and Top Secret Work of Pigeons in the First World War' (Science Museum Blog) https://blog.sciencemuseum.org.uk/exciting-tales-and-top-secret-work-of-pigeons-in-the-first-world-war/#:~:text=Carrier%20pigeons%20were%20used%20for,were%20superseded%20by%20aircraft% accessed 19 June 2025.

[161] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data (General Data Protection Regulation) [2016] OJ L119/1

In addition in should be considered that in the scope of the general personal data a special attention is laid above all on the special categories of personal data (also known as sensitive personal data) which are highly relevant because they are subject to a higher level of protection. These data include genetic, biometric and health data, as well as personal data revealing racial and ethnic origin, political opinions, religious or ideological convictions or trade union membership.

'*Processing*' means any operation or set of operations which is performed on personal data or on sets of personal data, whether or not by automated means, such as collection, recording, organisation, structuring, storage, adaptation or alteration, retrieval, consultation, use, disclosure by transmission, dissemination or otherwise making available, alignment or combination, restriction, erasure or destruction.

'*Biometric data*' means personal data resulting from specific technical processing relating to the physical, physiological or behavioural characteristics of a natural person, which allow or confirm the unique identification of that natural person, such as facial images or dactyloscopic data.

The UAVs may facilitate easy access to the personal data and especially the sensitive category of personal data, as the high-tech cameras capture faces, private places, addresses, cars, equipment, goods located on the private plots. Capturing or disseminating images of identifiable individuals without their explicit consent is prohibited. This restriction applies primarily to images taken within private domains, such as residential properties, but also extends to those captured in public spaces[162].

According to the Article 9 of the GDPR processing of personal data revealing racial or ethnic origin, political opinions, religious or philosophical beliefs, or trade union membership, and the processing of genetic data, biometric data for the purpose of uniquely identifying a natural person, data concerning health or data concerning a natural person's sex life or sexual *orientation shall be prohibited*. Although paragraph 2 enlists certain exemptions from such prohibition, under regular circumstances of private or commercial UAV usage such collection of personal data may not be justified by these exemptions. As an example, some of such exemptions are the following:

[162] Bassi Eleonora and others, 'The Design of GDPR-Abiding Drones Through Flight Operation Maps: A Win–Win Approach to Data Protection, Aerospace Engineering, and Risk Management' (2019) 29 Minds and Machines 579 https://doi.org/10.1007/s11023-019-09511-9 accessed 19 June 2025.

- the data subject has given explicit consent to the processing of those personal data for one or more specified purposes;
- processing is necessary to protect the vital interests of the data subject or of another natural person where the data subject is physically or legally incapable of giving consent;
- processing relates to personal data which are manifestly made public by the data subject;
- processing is necessary for reasons of substantial public interest;
- processing is necessary for archiving purposes in the public interest, scientific or historical research purposes or statistical purposes.

Article 6(1) of the GDPR states that processing personal data shall be lawful only if and to the extent that at least one of the six conditions apply. While being one of the more well-known legal bases for processing personal data, *consent* is only one of six bases mentioned in the indicated Article. The others are: contract, legal obligations, vital interests of the data subject, public interest and legitimate interest as stated in Article 6(1) of the GDPR.

The basic requirements for the effectiveness of a valid legal consent are defined in Article 7 and specified further in recital 32 of the GDPR. One of the most widely used ground for data protection is the person's consent. The request for consent is to be presented in a manner which is clearly distinguishable from the other matters, in an intelligible and easily accessible form, using clear and plain language. Consent must be freely given, specific, informed and unambiguous. In order to obtain freely given consent, it must be given on a voluntary basis. In addition, the data subject always has the right to withdraw his or her consent at any time.

When flying a drone a key challenge lies in differentiating between private and public spaces. Generally, public areas are accessible to all, whereas non-public areas are restricted to certain individuals. Within the non-public domain, private spaces are those limited to a specific person or a small group, such as a family or an individual property owner. Therefore, the use of drones for activities such as data collection over both private and public spaces must ensure that individuals remain unidentifiable. If individuals are recognizable in the collected data, their identity must not bring damage or harm. The GDPR's co-regulatory model is based on the idea that personal data processing is inherently risky, and data controllers are best placed to manage those risks. Therefore, the accountability principle

underpins key provisions such as Article 25 on data protection by design and by default, Article 32 on processing security, and Article 35 on impact assessments. Safeguards should be proactive, not just reactive, and must comply with all regulatory requirements—not only to protect data subjects, but also to ensure responsible system design and organisational practices[163].

Interestingly, the results of the research that was conducted by three colleagues from Technical University of Braunschweig by carrying out a questionnaire among active drone users in Germany showed that 44% of drone users in geospatial sector have faced problems with privacy issues, and as consequences they either cancelled their fight missions, or took extra time on identity closure of individuals. The overview of the research was published on 15 June 2023 in the Journal of Photogrammetry, Remote Sensing and Geoinformation Science Germany. Noteworthy is that Germany is the biggest drone user country in the EU. The same research article refers to the study conducted in March 2021 by the German Unmanned Aviation Association, which focuses on the practical applications of drone technology. In that study it was revealed that since 2012, approximately 420 million euros have been invested in German drone enterprises and institutions. Notably, 67% of this total investment was allocated within the last two years (2020 and 2021) alone. Investors have directed their financial resources towards a diverse range of drone-based applications, including monitoring, inspections, and disaster management. As a result of these substantial investments, Germany has secured the position of the second-largest recipient of drone-related funding on the global stage[164].

In order to foster lawful usage of the UAVs in lines with GDPR the EASA has provides a Data Protection Impact Assessment (DPIA) which is a risk management procedure that is required in Article 35 of the GDPR whenever personal data is processed and when such processing is “likely to result in a high risk to the rights and freedoms of natural persons”[165].

Pursuant to the Article 35 of the GDPR where a type of processing in particular using new technologies, and taking into account the nature, scope, context and purposes of the processing, is likely to result in a high risk to the rights and freedoms of natural persons, the

[163] Bassi Eleonora and others, ‘The Design of GDPR-Abiding Drones Through Flight Operation Maps: A Win–Win Approach to Data Protection, Aerospace Engineering, and Risk Management’ (2019) 29 Minds and Machines 579 https://doi.org/10.1007/s11023-019-09511-9 accessed 19 June 2025.
[164] Christian Janke and Maarten Uijt de Haag, ‘Progress and Challenges with the Implementation of European Drone Regulation – Status Quo and Outlook’ (2023) 91 Photogrammetrie – Fernerkundung – Geoinformation 381 https://ieeexplore.ieee.org/document/9836165 accessed 19 June 2025.
[165] European Union Aviation Safety Agency (EASA), ‘Data Protection Impact Assessment’ (EASA, updated 2023) https://www.easa.europa.eu/en/domains/civil-drones/privacy/data-protection-impact-assessment accessed 24 June 2025.

controller shall, prior to the processing, carry out an assessment of the impact of the envisaged processing operations on the protection of personal data. A single assessment may address a set of similar processing operations that present similar high risks.

Processing personal data is considered to pose a high risk to individuals and consequently the data protection impact assessment is required in the case of one the following is true[166]:

- A systematic and extensive evaluation of personal aspects relating to natural persons is carried out during the UAV fly, which is based on automated processing, including profiling, and on which decisions are based that produce legal effects concerning the natural person or similarly significantly affect the natural person. This could be the case if the personal data collected during the UAV flight is used to determine whether individuals or a neighbourhood receive certain benefits, e.g. construction or infrastructure projects.
- Processing on a large scale of special categories of data referred to in Article 9(1), or of personal data relating to criminal convictions and offences referred to in Article 10. This may be the case when UAV captures significant amounts of potentially sensitive data, such as information about people's political opinions, religious beliefs or criminal records. For example, capturing on a regular basis individuals going in or out of religious buildings, medical facilities, police stations, political party headquarters or sexually relevant areas, e.g. red light districts which could give grounds to make assumptions of their opinions, beliefs or personal preferences.
- a systematic monitoring of a publicly accessible area on a large scale. This could be the case where UAV flies repetitively or for a prolonged period of time over the same area.

If one of the named cases is true when the UAV is used by a natural person or a legal entity and such natural person or a legal entity is a data controller of this personal data processing, the DPIA is legally required before any processing with the personal data occurs.

[166] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data (General Data Protection Regulation) [2016] OJ L119/1, art 35(3).

According to the mentioned guidance of the EASA is it noteworthy to pay additional attention in the following cases which could also be potentially assessed as posing high risk to the rights and freedoms and individuals when flying UAVs[167]:

- The processing of personal data can hinder individuals from exercising their rights or accessing services or contracts[168], particularly in situations where data is collected in public spaces, leaving people with no real ability to avoid, prevent, or escape the surveillance.
- Personal data is often collected and processed on a large scale, which may refer to the number of affected individuals, the volume and variety of data involved, the length of time the data is processed, or the geographical scope of the operation.
- Innovative, experimental and/or powerful new technology is used[169]. New methods of data collection and usage demand careful evaluation of the risks they may pose to individuals' rights and freedoms, particularly with technologies like facial recognition and high-resolution, high-speed cameras, which can capture and process personal information in increasingly intrusive ways.
- Sharing data with another organization, especially if such an organization is located outside the borders of the EU or the EEA is considered or planned.
- In cases when capturing information about vulnerable individuals, people who may be unable to oppose being captured or to fully understand the consequences of being captured (for example employees, children, the elderly, medical patients, asylum seekers)[170].
- The data collected can be repurposed, matched, or combined with information from other sources, allowing it to be used for purposes beyond those originally intended—often in ways that go beyond what individuals could reasonably expect when their data was first gathered.

The assessment shall contain at least[171]:

[167] European Union Aviation Safety Agency (EASA), 'Data Protection Impact Assessment' (EASA, updated 2023) https://www.easa.europa.eu/en/domains/civil-drones/privacy/data-protection-impact-assessment accessed 24 June 2025.
[168] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data (General Data Protection Regulation) [2016] OJ L119/1, art 22, rec 29.
[169] Ibid, rec 89,91.
[170] Ibid, rec 75.
[171] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data (General Data Protection Regulation) [2016] OJ L119/1, art 35(7).

(a) a systematic description of the envisaged processing operations and the purposes of the processing, including, where applicable, the legitimate interest pursued by the controller;
(b) an assessment of the necessity and proportionality of the processing operations in relation to the purposes;
(c) an assessment of the risks to the rights and freedoms of data subjects; and
(d) the measures envisaged to address the risks, including safeguards, security measures and mechanisms to ensure the protection of personal data and to demonstrate compliance with GDPR taking into account the rights and legitimate interests of data subjects and other persons concerned.

When usage of UAV is plotted with the entrepreneurial aims involvement of the data protection specialist shall be required. It is a common practice currently that big businesses obligatory appoint a data protection officer (DPO) who is responsible for analyzing whether the company's activities are not breaching the data protection rules. And especially in circumstances, when UAV operations are analyzed and planned it is recommended to seek guidance and advice of the DPO. The data protection rules are quite complex DPO and he/she would be the right person to be responsible for compiling the assessment, monitoring the implementation of the DPIA in practice. Important to understand that in case the flying operation includes the use of a data processor, collaboration with the prosessor should also be arranged to receive all necessary relevant information. The same applies with regard to any clients or joint controllers where they hold relevant personal data information. This is especially true for information regarding sharing data with third parties within the EEA or in third countries.

More to that, in some cases it might be necessary to consult with data subjects or their representatives, when completing a DPIA. For drone missions carried out in populated areas, this could be done by, for example, consulting with local business and residents, neighbourhood panels, institutional, educational, medical, political or religious establishments close-by. This would both facilitate assessment of the impact of flying activities, as well as inform local communities of flying operations. Where this is not appropriate or impossible, the reason for not pursuing external consultation should be documented. In cases when consultation have been carried out but the decision was made

to act contrary to some of the stakeholder input, the reasons for doing so should be documented as well[172].

In case when upon completing the DPIA, DPO comes to the conclusion that UAV flying activities continue to pose a high risk to the rights and freedoms of people affected by the drone operation, despite the safeguards that have been considered and may be implemented, consultation with the national or local supervisory authority is required before carrying out of the mission. This could be the case where a serious risk have been identified which is not possible to mitigate. In such cases the UAV user should turn to the relevant data protection authority with all relevant information as described in Article 36 of the GDPR. The data protection authority is obliged to provide the advice how to carry out the data processing within a period of eight weeks (which may be extened by another six weeks). This is a legal requirement of the European Union and a procedure that should be followed whenever required.

Interestingly, the EASA has found an effective way to anticipate and promote best practices in data protection by developing a privacy by design guide tailored specifically for drone manufacturers. This guide is intended to support them in integrating data protection principles into the design and development of their products. It introduces the core concepts of privacy by design, provides a practical questionnaire to assess privacy risks and identify appropriate safeguards, and outlines how various drone features can give rise to specific privacy concerns, offering suggested solutions. Under the GDPR organisations that process personal data, including drone operators and pilots, are required to apply data protection by design and by default. These principles ensure that privacy is considered from the outset in the development of technologies, processes, and flight operations, and that only the minimum necessary personal data is processed. Furthermore, European regulators are currently considering privacy-related technical requirements for drones that could soon become mandatory. Once adopted, these standards will apply to all drones sold in the EU, making privacy by design not only a best practice but a legal necessity[173].

When considering Ukrainian regulations, the essential circumstance is that the GDPR are not part of the legislation and are not required to be followed. Instead, the Law on Data

[172] Bassi Eleonora and others, ‘The Design of GDPR-Abiding Drones Through Flight Operation Maps: A Win–Win Approach to Data Protection, Aerospace Engineering, and Risk Management’ (2019) 29 Minds and Machines 579 https://doi.org/10.1007/s11023-019-09511-9 accessed 19 June 2025.
[173] European Union Aviation Safety Agency (EASA), ‘Privacy by Design’ (EASA, updated 2023) https://www.easa.europa.eu/cs/domains/civil-drones/privacy/privacy-by-design accessed 19 June 2025.

protection of Ukraine[174] regulates proper collection, usage and processing of personal data. At that, the fundamental approach of the law remains the same, namely the data collection and processing is not allowed without the proper legal grounds, with the consent of the data subject being one of the most widespread due legal grounds.

Noteworthy is, that the practical implementation of data protection laws in the context of drone usage remains largely undeveloped in Ukraine. Despite the existence of legal provisions regulating personal data, there is a lack of clear guidelines or regulatory frameworks specifically tailored to the unique challenges posed by drones. This includes issues such as identifying responsible data controllers, determining accountability for airborne surveillance, and addressing cross-border data flows when drone data is stored or processed abroad[175]. In the absence of established administrative procedures or case law, both drone operators and data subjects face uncertainty regarding their rights and obligations, leading to inconsistent practices and limited enforcement. This legal gap underscores the urgent need for more specific regulation and oversight to ensure the responsible use of drones in line with data protection principles.

4.1.2. EU Case Law and Regulatory Practice on Drone Use and Data Protection

An important source of insight into how data protection laws are applied to drone operations in practice comes from court cases and decisions issued by data protection authorities across the European Union, where, in contrast to Ukraine, the legal and regulatory practice in this area is far more extensive and well-developed.

Court of Justice of the European Union (Case C-212/13 dated 11 December 2014)

Noteworthy is the Judgement of the Court of Justice of the European Union (CJEU or Court) in Case C-212/13 dated 11 December 2014[176] where the Court decided in frames of the request for a preliminary ruling concerning the interpretation of Article 3(2) of Directive 95/46/EC of the European Parliament and of the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data (OJ 1995 L 281, p. 31). Although this case was decided under the previous (old) version of the directive on data protection, its reasoning remains relevant

[174] Law of Ukraine No 2297-VI, 'On Personal Data Protection' (1 June 2010).
[175] Danilo Hloba, 'Адаптація – не клонування: як депутати хочуть витратити мільярди на захист персональних даних' ['Adaptation – Not Cloning: How Deputies Want to Spend Billions on Personal Data Protection'] (Mind.ua, 23 May 2024) https://mind.ua/openmind/20273976-adaptaciya-ne-klonuvannya-yak-deputati-hochut-vitratiti-milyardi-na-zahist-personalnih-danih accessed 19 June 2025.
[176] Case C-212/13 Ryneš v Úřad pro ochranu osobních údajů EU:C:2014:2428, Judgment of the Court (11 December 2014).

under the General Data Protection Regulation (GDPR) as well as further practices continued to pursue the same line of logics when deciding the data protection issue in scope of surveillance and monitoring by means of technical appliances including drones.

The principles established in this judgment continue to guide the interpretation of when personal data processing, even if intended for private purposes, may fall under the scope of EU data protection regulations, maintaining consistency in the protection of individuals' privacy rights. This court case marks a pivotal moment in the development of the European Court's position on the application of data protection laws to various forms of personal data processing, not just limited to surveillance systems but extending to any type of recording of individuals.

By addressing whether the operation of a camera system in a private home that also monitors public space constitutes a "purely personal or household activity" under Article 3(2) of Directive 95/46/EC, the judgment laid the groundwork for the Court's broader approach to how personal data protection laws apply to the recording of individuals in both private and public settings. The background of the case is the use of a video surveillance system by Mr. Ryneš, who installed a camera at his family home for security purposes. The camera monitored both his private property and a public space, recording images of individuals in the vicinity. The Czech Office for Personal Data Protection found that Mr. Ryneš had violated personal data protection laws, as he did not inform the individuals being recorded about the data processing, nor did he report it to the relevant authority. Mr. Ryneš challenged this decision in court.

The main issue referred to the CJEU for a preliminary ruling was whether the operation of a video surveillance system in a private home, which also recorded a public space, could be considered a "purely personal or household activity" under Article 3(2) of Directive 95/46/EC, which would exempt it from the scope of data protection rules.

The Court ruled that the processing of personal data through video surveillance in such a scenario does not fall under the exemption for "purely personal or household activity." Since the camera monitored a public space and recorded identifiable individuals outside the private domain, it cannot be considered a purely personal or household activity, even if the purpose was to protect the property, health, and life of the homeowners.

The Court clarified that the use of a surveillance system that captures public space, even when installed for private security, constitutes data processing subject to the

protections under Directive 95/46, rather than falling under the exemption for personal activities. The court stated that "the operation of a camera system, as a result of which a video recording of people is stored on a continuous recording device such as a hard disk drive, installed by an individual on his family home for the purposes of protecting the property, health and life of the home owners, but which also monitors a public space, does not amount to the processing of data in the course of a purely personal or household activity, for the purposes of that provision."

This case and the Court's decision have had a lasting and significant impact on the legal interpretation of surveillance technologies, including drones. By establishing that surveillance extending into public spaces, even for private purposes, constitutes data processing subject to data protection law, the ruling set a clear precedent. Today, it continues to influence how drone usage is regulated across the EU, reinforcing the principle that any collection of personal data in public areas, regardless of intent, must comply with applicable data protection frameworks.

"Covid-19 Case" (Case Number 440442 & 440445 dated 18.05.2020)

A particularly notable and well-documented case occurred in France, where the use of drones for government surveillance in public spaces prompted significant legal and public debate over privacy rights and the limits of state monitoring. In the case Number 440442, 440445, Ordinance of May 18, 2020[177] the French Highest Administrative Court (CE) ruled that the Police Commissioner (Prefet de Police) must cease the use of drones that were used to carry out surveillance of Covid rules to monitor compliance with health regulations in Paris. The CE determined that the government's use of drones resulted in the collection of personal data without adequate safeguards.

The police forces used drones equipped with cameras to capture and process images of public over Paris streets, justifying collection of personal data by the exceptional circumstance of the COVID-19 pandemic. The association "La Quadrature du Net" and the Human Rights League filed a suit to the administrative court demanding cessation of unlawful practice of police, still the first instance court rejected the claims and upheld the police practices to use drones under such circumstances. The applicants appealed to the higher court and among other reasoning stated that the use of drones flying over public

[177] Conseil d'État, ordonnance n° 440442, 440445 du 18 mai 2020, Association La Quadrature du Net et Ligue des droits de l'homme, ECLI:FR:CEORD:2020:440442.20200518 https://gdprhub.eu/index.php?title=CE_-_440442_%26_440445 accessed 19 June 2025.

space, equipped with an image capture device, constitutes illegal processing of personal data and serious and manifestly unlawful interference with the exercise of the right to respect for private life.

The absence of any explicit administrative act specifically framing the usage of the device in question violated Article 8 of the European Convention for the Protection of Human Rights man and fundamental freedoms, Article 6 (3) of the GDPR. The representatives of the State stated that the law enforcement agencies were responsible for effectively enforcing of health safety rules and with the help of drones the police monitored crowds in Paris with the aim to detect, on determined sectors exclusively located on the road or in public spaces, gatherings of the public contrary to the restrictive measures in force during the period of deconfinement. The purpose of usage of the disputed device was not to find the offenses or to identify perpetrator but to inform the staff of the prefecture of police so that a decision can be taken, to deploy an intervention in order to put an end to or prevent the public disorder caused by ignorance of health safety rules.

The Highest Administrative Court ruled that Article 3 of the Directive of 27 April 2016 defines personal data such as "any information relating to a person identified or identifiable person "and specifies that he is deemed to be a "*natural person identifiable*"" a natural person who can be identified, directly or indirectly, in particular by reference to an identifier, such as a name, an identification number, data location, an online identifier, or one or more specific elements specific to its physical, physiological, genetic, psychic, economic, cultural or social identity". Even though it was argued that the data collected by the drones used by the prefecture police did not have a personal character since, on the one hand, the use which is made of these devices, did not lead, in practice, to the identification of the people filmed and, on the other hand, in the absence of any preservation images, real-time viewing of the people filmed is in any case an obstacle to that they can be identified, it follows from the instruction that the devices in question which are equipped with an optical zoom and which can fly at a distance less than that fixed by the local laws are likely to collect identifying data.

In accordance with the reasons for this ordinance, the State was ordered to cease, without delay, to carry out surveillance measures by drone, to respect, in Paris, the rules of health security applicable to the deconfinement period.

“Olympic Games 2024 Case” (Case number Délibération 2023-076 dated 15.06.2023)

Another significant case involves preparations for the 2024 Olympic Games in Paris[178], where the planned use of drones for security and surveillance purposes raised important legal questions regarding data protection and the balance between public safety and individual privacy. In this case the French Ministry of the Interior applied to the French Data Protection Authority with the request to preliminary approve the planned activities on surveillance of the territory of Paris with help of UAV during the 2024 Olympic Games to identify potential terrorism risks. The French Data Protection Authority has authorized a draft decree and a data protection impact assessment conducted by the French Ministry of the Interior. The draft decree outlined the proposed development and implementation of a system for the algorithmic processing of images captured through aerial video surveillance.

The Minister of the Interior (the data controller) sought the opinion of the French Data Protection Authority regarding a draft decree issued under Act No. 2023-380 of 19 May 2023. Article 10 of this Act provides a framework for the development and implementation of an algorithmic image-processing system, which used aerial video surveillance data to identify terrorism risks during the 2024 Olympic Games. The controller intended to base the processing on Article 6(1)(e) of the GDPR (public interest), which requires that processing be lawful only if it is regulated by either Union law or national law to which the controller is subject (Article 6(3) GDPR).

In this case, Act No. 2023-380 of 19 May 2023 served as the domestic law regulating the processing in accordance with the requirements of Article 6(3) GDPR. Article 10 of the Act stipulated that for the processing to be lawful, it must first receive authorization through a decree following consultation with the French DPA (CNIL). As part of this process, the Ministry of the Interior conducted a data protection impact assessment (DPIA), as required by Article 35 of the GDPR, and submitted it along with the draft decree to the French DPA for approval in accordance with Article 36 of the GDPR.

The French Data Protection Authority (CNIL) issued a favorable opinion regarding the draft decree and the accompanying data protection impact assessment (DPIA) submitted pursuant to Act No. 2023-380 of 19 May 2023. The CNIL approved the use of algorithmic

[178] Conseil d'État, ord., 18 May 2020, req. Nos 440442 & 440445, *La Quadrature du Net* and *Ligue des droits de l'homme*, ECLI:FR:CEORD:2020:440442.20200518 https://www.conseil-etat.fr/fr/arianeweb/CE/decision/2020-05-18/440442 accessed 19 June 2025.

image processing via aerial video surveillance, as the measures proposed by the controller were considered adequate to mitigate the risks associated with this high-risk processing.

In the draft decree and DPIA, the controller provided a comprehensive list of predefined events that the algorithmic system was authorized to detect. The system was primarily designed to identify abandoned objects and only to detect individuals in the event of a disruptive occurrence, such as a disturbance in the premises. It was specifically prohibited from detecting or processing images of individuals who were seated continuously (Article 3 of Act No. 2023-380 of 19 May 2023).

Additionally, Article 2 of the draft decree ensured that the data collected would not be used for monitoring or re-identifying individuals, whether through biometric or non-biometric methods, such as clothing recognition.

Finally, the CNIL approved the draft decree and DPIA, as the controller had taken appropriate measures to implement safeguards in accordance with Article 22(3) of the GDPR. This included the integration of human intervention in the systematic identification of alerts.

The CNIL recommended that, during the design phase, the data processed should be subject to pseudonymisation and blurring techniques to the extent possible. Furthermore, the CNIL requested that, during this phase, the Ministry of the Interior ensure that the disclosure requirements under Article 14 of the GDPR were clearly communicated through the controller’s website. This disclosure had to include specific details such as the location and date of the filmed event, the purpose of the surveillance, and any potential re-use of the images. Although the CNIL acknowledged that communications under Article 14 of the GDPR were not legally required in this case, due to the application of Article 23 of the GDPR, which permits certain restrictions under Union or Member State law, it still emphasized the importance of providing this information to promote “greater transparency and fairness” to the public.

Additionally, the CNIL recommended that, during the implementation phase, the Ministry of the Interior pay particular attention to the principle of data minimisation as outlined in Article 5(1)(b) of the GDPR. This would involve limiting the number of personnel authorized to access the processed data. The CNIL also strongly advised that, during both the design and implementation phases, no data collected be transferred outside of the European Union and that no access to the data be granted to foreign authorities.

Helenic Case (Case 13/2024, protocol number Gen/Ext/104 dated 03.04.2024)

Another noteworthy case has been recently decided by the Helenic Data Protection Authority, which took the staggering decision on 03 April 2024 (case 13/2024, protocol number Gen/Ext/1042)[179] to impose an administrative fine of record € 175,000 on the Ministry of Migration and Asylum of Greece for the breaches found in relation to the cooperation with the Authority and the impact assessments, while at the same time it sent the Ministry an order to comply within three months with its obligations under the GDPR.

At the end of 2021, the Hellenic Data Protection Authority (HDPA) was informed of the Ministry of Migration and Asylum's implementation of the "Centaurus" and "Hyperion" Programmes, systems deployed at Closed Controlled Access Centres for third-country nationals on the Aegean islands of Lesvos, Chios, Samos, Leros, and Kos. The HDPA also received formal requests for examination and clarification from the LIBE Committee of the European Parliament, as well as from various civil society organizations, concerning the deployment of these systems within asylum facilities. The Centaurus Programme was presented as a comprehensive digital infrastructure designed to manage both physical and electronic security in and around the centers. Its components included CCTV surveillance, artificial intelligence (AI)-based behavioral analysis, and the use of unmanned aerial vehicles (UAVs) to capture and process image and personal data. In parallel, the Hyperion Programme served as an integrated access control system, intended to track the movements of asylum seekers and authorized NGO personnel through the processing of personal data, including biometric identifiers.

The HDPA imposed a €175,000 fine, concluding that the Ministry of Migration and Asylum (the controller) violated Articles 5(1)(a), 6(1), 12, 13, 14, 15(e), 25, 30, 35, 58(1)(e) of the GDPR.

Firstly, the HDPA identified ambiguity concerning the legal bases underpinning the data processing activities carried out under the "Hyperion" and "Centaurus" systems. The Authority specifically noted that Article 6(1)(f) of the GDPR, which permits data processing on the grounds of legitimate interests, cannot be invoked by public authorities when acting within the scope of their official duties. Additionally, the HDPA pointed out the absence of a

[179] Hellenic Data Protection Authority, Decision No 13/2024, Own-initiative investigation into the development and installation of the "Centaur" and "Hyperion" programmes by the Ministry of Migration and Asylum concerning the control of reception and accommodation facilities for third-country nationals (3 April 2024) https://www.dpa.gr/en/enimerwtiko/press-releases/ministry-migration-and-asylum-receives-administrative-fine-and-gdpr accessed 19 June 2025.

clear legal basis for processing data across different categories of data subjects, such as employees, vulnerable individuals, minors, and NGO personnel. With respect to the processing of sensitive personal data, the HDPA found insufficient evidence to support the controller's assertion that no special category data was being processed. On the contrary, it concluded that the surveillance operations carried out by the Centaurus system could potentially involve the processing of sensitive data, including information revealing racial or ethnic origin, religious beliefs, or other protected characteristics. Consequently, the HDPA determined that the data controller should have identified an appropriate legal basis for such processing in accordance with Article 9 of the GDPR.

Secondly, the HDPA found a violation of the lawfulness principle under Article 5(1)(a) of the GDPR. The information provided to data subjects was deemed insufficient, as it was evident that the individuals did not understand Greek or English. Consequently, the information provided failed to meet transparency requirements, breaching Articles 12, 13, and 14 of the GDPR.

Additionally, the HDPA criticized the Ministry of Migration and Asylum for its insufficient level of cooperation during the investigation. In particular, the Ministry failed to provide the data protection contracts concluded with data processors, citing reasons of confidentiality. The HDPA determined that this refusal constituted a breach of Articles 15(e) and 58(1)(e) of the GDPR, which entitle supervisory authorities to obtain access to all information necessary for the performance of their duties. Furthermore, the submission of vague, incomplete, and at times contradictory information was deemed to be a violation of Article 31 of the GDPR, which obliges data controllers and processors to cooperate with supervisory authorities in the performance of their tasks.

The HDPA also noted that the controller failed to complete the record of processing activities before the programs began, which led to a violation of Article 30(1) GDPR.

Furthermore, the HDPA highlighted that the data protection impact assessments (DPIAs) were insufficient and not conducted prior to the commencement of each processing operation. This led to a violation of Articles 35(1), (2), and (3) GDPR, as well as a failure to ensure data protection by design and by default, violating Articles 25(1) and (2) GDPR.

Lastly, the HDPA noted that the controller failed to provide adequate explanations regarding the interconnections between the "Hyperion" and "Centaurus" systems and other governmental data infrastructures. Additionally, no assessment of the potential risks

associated with such integration was conducted. This lack of transparency and failure to evaluate the broader implications of the data processing represented a breach of the accountability principle. Specifically, the controller did not supply complete, accurate, or clear information, nor did it sufficiently document the lawfulness of the processing activities, thereby violating Article 31 of the GDPR.

As a consequence, the HDPA imposed an administrative fine of €175,000 on the Ministry of Migration and Asylum and issued an order requiring the controller to bring its data processing operations into full compliance with data protection regulations within a three-month period.

These court practices underscore the seriousness with which data protection and privacy are upheld under the GDPR, particularly in the context of drone operations. They demonstrate that the use of emerging technologies does not exempt organizations or individuals from compliance with fundamental privacy rights. Moreover, they reflect a strong commitment to ensuring that personal data is processed lawfully and transparently, with every effort made to preserve fundamental freedoms.

4.2. Artificial intelligence and drones.

The integration of artificial intelligence (AI) into unmanned aerial systems has undoubtedly unlocked unprecedented potential across various sectors. From agriculture and infrastructure monitoring to emergency response and logistics, AI-powered drones are redefining efficiency, enabling autonomous navigation, real-time data analysis, and dynamic decision-making. However, alongside these innovations comes a growing concern about their implications for privacy, data protection, and civil liberties.

Artificial intelligence is rapidly becoming an integral part of our reality, reshaping industries, economies, and everyday life. In this context, it is impossible not to mention the revolutionary Stargate Project - a bold and unprecedented initiative launched by the United States to secure its global leadership in AI development. Announced in January 2025, the $500 billion project is a collaboration between OpenAI, Oracle, SoftBank, and investment firm MGX. The project’s primary objective is to build a nationwide network of cutting-edge data centers to power the next generation of AI technologies. The first phase, already underway in Abilene, Texas, involves a $100 billion investment and the construction of a 1 million-square-foot facility, one of 20 planned across the U.S. In addition to creating over 100,000 jobs, the Stargate Project positions the U.S. as a central hub for AI innovation while

also responding to strategic geopolitical challenges. However, the scale of this initiative also brings pressing concerns related to energy consumption, environmental sustainability, and ethical resource sourcing. As such, Stargate represents not only a technological breakthrough but also a complex turning point in the global AI landscape[180].

One of the most pressing challenges associated with AI-equipped drones is their capacity for real-time surveillance and data collection at scale. Modern drones, enhanced with computer vision, facial recognition, and behavioral analytics, can identify, track, and analyze individuals or environments autonomously. This shift from passive observation to active interpretation and response transforms drones from mere flying cameras into intelligent agents capable of making decisions that can significantly impact individuals and communities.

While the benefits in security, search-and-rescue, and infrastructure inspection are substantial, the risks to personal privacy and data sovereignty cannot be ignored. The extensive and often non-consensual collection of images, movement patterns, and other personal data raises ethical and legal concerns, particularly when drones operate in public or residential spaces. The absence of clear boundaries regarding what constitutes acceptable surveillance further complicates matters.

In response to these challenges, regulatory bodies are beginning to address the use of AI in drones, recognizing the need for robust legal frameworks to ensure accountability and transparency. A landmark initiative in this regard is the European Union's AI Act[181], which aims to establish a comprehensive legal framework for AI technologies based on a risk-based approach.

The European Union's AI Act is one of the world's most ambitious efforts to regulate AI technology ensuring safe and responsible AI deployment. The AI Act was formally adopted on 13 June 2024 and and will enter into force in its major part on 2 August 2026. However, Chapter I (General Provisions) and Chapter II (Prohibited AI Practices) have been

[180] Garth Friesen, 'Trump's AI Push: Understanding The $500 Billion Stargate Initiative' (Forbes, 23 January 2025) https://www.forbes.com/sites/garthfriesen/2025/01/23/trumps-ai-push-understanding-the-500-billion-stargate-initiative/?utm accessed 19 June 2025.
[181] Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act) [2024] OJ L 2024/1689.

already enforced since 2 February 2025. This early application is particularly significant in the context of drone usage and related regulatory compliance.

The AI Act classifies AI systems according to their potential risk to rights and safety, categorizing them into four levels: *minimal risk, limited risk, high risk, and unacceptable risk.* AI systems that pose an unacceptable risk are subject to an outright ban. AI surveillance technologies, such as those used in AI-powered drones, shall most likely fall into the high-risk category, requiring stringent regulatory oversight.

In particular, biometric AI systems, including those deployed via drones for facial recognition or gait analysis, are considered high-risk AI systems under Article 5 of the AI Act. These technologies are subject to stringent requirements, including risk assessments, human oversight, and accountability mechanisms. As per Chapter II Section 2 of the AI Act, high-risk AI systems must undergo rigorous compliance and transparency obligations, including establishing of risk management system, data governance processes, providing clear and understandable information to the public about the purpose and use of the technology, and how personal data is collected and processed.

One of the most critical provisions of the AI Act concerning drones is its *prohibition of real-time remote biometric identification* (such as facial recognition) in publicly accessible spaces. This restriction shall not apply to cases when AI systems used for biometric categorisation and emotion recognition, which are permitted by law to detect, prevent or investigate criminal offences, subject to appropriate safeguards for the rights and freedoms of third parties, and in accordance with Union law (as stated in Article 50 of the AI Act). The AI Act explicitly prohibits the use of biometric surveillance systems by private entities in public spaces unless authorized under strict conditions. This restriction is designed to prevent mass surveillance and the potential abuse of AI technologies, ensuring that individuals' movements and actions are not monitored without their consent. Among the banned are as well the biometric categorisation systems that categorise individually natural persons based on their biometric data to deduce or infer their race, political opinions, trade union membership, religious or philosophical beliefs, sex life or sexual orientation; this prohibition does not cover any labelling or filtering of lawfully acquired biometric datasets, such as images, based on biometric data or categorizing of biometric data in the area of law enforcement (Article 5 of the AI Act). In understanding of the AI Act "*biometric categorisation system*" means an AI system for the purpose of assigning natural persons to specific categories on the basis of their biometric data, unless it is ancillary to another commercial

service and strictly necessary for objective technical reasons. The "*real-time remote biometric identification system*" means a remote biometric identification system, whereby the capturing of biometric data, the comparison and the identification all occur without a significant delay, comprising not only instant identification, but also limited short delays in order to avoid circumvention.

In certain exceptional cases, such as in criminal investigations or when there is a direct and imminent threat to public safety, law enforcement agencies may deploy AI systems for real-time biometric identification under judicial oversight. However, even in these scenarios, the AI Act demands strict limitations on data retention, transparency, and compliance with data protection laws like the GDPR. The Act mandates that these systems must be used in a manner that respects the fundamental rights of individuals, particularly regarding their privacy and freedom of movement.

This is particularly important for drones, as their ability to quickly access and process biometric data, coupled with their ability to cover large areas in a short time, poses significant risks of unwarranted surveillance and data misuse. Facial recognition, for instance, could lead to identification of individuals without their knowledge or consent, potentially resulting in profiling and discriminatory practices if not tightly controlled.

AI-powered drones offer immense operational advantages, but they also introduce complex ethical dilemmas and legal uncertainties. The potential for widespread surveillance and data collection could pose significant threats to privacy, especially if AI systems are not properly regulated or accountable. While technological advancements continue to outpace legislation, regulatory bodies in the EU are taking critical steps to ensure AI technologies are deployed responsibly and in a way that respects individuals' rights[182].

The AI Act is a step in the right direction, providing a framework to manage the risks associated with AI systems used in drones, particularly in surveillance applications. However, as technology continues to evolve, international cooperation and continuous dialogue between policymakers and industry stakeholders will be crucial to ensure that AI-powered drones are used in ways that benefit society without compromising privacy or fundamental freedoms.

[182] Pagallo Ugo, Bassi Eleonora and Durante Massimo, 'The Normative Challenges of AI in Outer Space: Law, Ethics, and the Realignment of Terrestrial Standards' (2023) 36 Philosophy & Technology 23 https://doi.org/10.1007/s13347-023-00626-7 accessed 19 June 2025.

4.3. Drone-Related Security Threats

Unauthorised drones present a considerable challenge for Air Traffic Controlers (ATCOs) because drones are not (yet) integrated into the air traffic management systems. Moreover, smaller drones usually do not carry transponders and are therefore often not visible on the ATCOs radar displays. In the future, the creation of areas with U-space services will provide for the integration of cooperative drones and their distinction from non-cooperative drones. However, until that time and in areas where U-space services might not be deployed, the potential presence of unauthorised drones is, and will remain, a considerable challenge that must be managed.

The EASA has recently published its Annual Safety Review 2024[183], which includes a dedicated chapter on Unmanned Aircraft Systems safety for the first time. This marks a significant step towards integrating drones into the broader aviation safety framework. In 2023, there were 12 safety-relevant incidents involving UAS within EASA member states. These incidents encompassed both commercial drones and recreational model aircraft. Two of the incidents resulted in injuries to individuals on the ground, both occurring at model airfields. Two incidents involved Airprox situations, where drones were observed in close proximity to manned aircraft during takeoff or landing phases.

As stated in the EASA Aerodrome Insidents report dated 8 March 2021[184] the presence of unauthorised drones in the vicinity of aerodromes has posed a latent risk for several years, but it was not until the disruption at London Gatwick Airport in December 2018 that the issue gained significant public and regulatory attention. Over the course of three days, from 19 to 21 December, 115 drone sightings were reported near the airport, resulting in the closure of its single runway for 33 hours. This incident led to the cancellation of over 1,000 flights and disrupted travel for approximately 140,000 passengers, highlighting the serious vulnerability of critical air transport infrastructure. Since then, several high-profile incidents have occurred across Europe. For example, on 3 February 2020, drone activity led to the temporary closure of three out of four runways at Madrid Barajas Airport, resulting in the diversion of 26 flights. Similarly, Frankfurt Airport, one of Europe's busiest airport, was affected twice in one month (8 February and 2 March 2020), with runway operations

[183] European Union Aviation Safety Agency, *Annual Safety Review 2024* (2024) https://www.easa.europa.eu/en/document-library/general-publications/annual-safety-review-2024 accessed 19 June 2025.
[184] European Union Aviation Safety Agency, *Drone Incident Management at Aerodromes* (8 March 2021) https://www.easa.europa.eu/en/newsroom-and-events/press-releases/easa-issues-guidelines-management-drone-incidents-airports accessed 19 June 2025.

suspended following reported drone sightings. According to DFS, the German Air Navigation Service Provider, more than 500 drone-related incidents were recorded between 2015 and 2020. Notably, despite the significant decline in air traffic due to the COVID-19 pandemic, 92 drone interferences were still reported in 2020 alone. These events underscore the urgent need for robust drone regulation, detection technologies, and counter-drone measures to ensure the safe and uninterrupted operation of aerodromes across the European Union.

While each drone-related incident is unique, several common characteristics emerge. These events often unfold rapidly, with high-speed drones capable of breaching aerodrome protection zones in minutes. Their agile flight patterns make tracking difficult, and the inability to reliably identify drones or their operators adds to the complexity. Detection is often human-based and unreliable, especially at large aerodromes. Crucially, unauthorised drone operations near airports are not an integration issue, they are equivalent to illegal manned aircraft intrusions and pose serious safety and security risks.

Beyond the immediate threat to passengers and crew, such incidents can have major economic consequences. The 2018 Gatwick disruption alone is estimated to have cost up to EUR 64 million. Even brief runway closures can cause delays costing hundreds of thousands of euros, particularly at Europe’s busiest airports. Increasing frequency of such disruptions may also undermine public trust in drones and lead to stricter regulations, ultimately affecting the broader drone industry. It is therefore essential that the aviation sector addresses this growing safety challenge collectively.

A drone is considered *unauthorised* when operated in breach of applicable UAS regulations, such as flying outside designated geographic zones or beyond the conditions of its authorisation. Drones up to 25 kg, typically operating in the "open category", which requires no prior authorisation due to their generally low risk. However, home-built or modified commercial drones in this category can still pose a serious threat to civil aircraft, especially near aerodromes during take-off and landing. To mitigate these risks EASA proposed to develop comprehensive guidance material on how to manage drone incidents at and in the surroundings of aerodromes, before, during and after they occur. In addition to that the system of remote identification was set and integrated into the regulations which is mandatory only from 2023, when the new EU regulations stated to come into action, and is not yet standard on older drones. Which makes the risk with unauthorized usage of drones even operating in the open category still potentially dangerous.

EASA defines three main categories of drone incident offenders causing the hazard to civil aviation[185]: non-criminal motivation, gross-negligence, and criminal/ terrorist motivation. They relate to the intent of the drone's remote pilot:

Negligent users include *clueless* individuals who unknowingly violate drone regulations due to lack of awareness, and *careless* individuals who are aware of the rules but breach them through fault or oversight—both without intent to disrupt civil aviation.

Gross negligence refers to *reckless individuals* who are fully aware of regulations but deliberately disregard them for personal or professional gain, knowingly disrupting civil aviation. *Activists or protesters* may also use drones to intentionally disrupt aerodromes and flight operations, often as a group, without intending to endanger lives, though their actions can still have serious consequences for aviation safety.

Criminals and terrorists are individuals who intentionally use drones to threaten the safety and security of civil aviation, showing complete disregard for human lives and property. Their actions are deliberate and motivated by criminal or terrorist intent.

As incidents involving dangerous drone activity become increasingly frequent across the EU and globally, the deployment of both physical and digital counter-drone measures is becoming essential. This includes empowering law enforcement and critical infrastructure operators to adopt appropriate technologies.

[185] European Union Aviation Safety Agency, Drone Incident Management at Aerodromes (8 March 2021) https://www.easa.europa.eu/en/newsroom-and-events/press-releases/easa-issues-guidelines-management-drone-incidents-airports accessed 19 June 2025, 11.

Chapter V. Avalanching necessity to adopt legislation to booming technologies.

5.1. ICAO Proposals for Regulatory Reform.

While drones have become integral to a range of industries, their regulations have not yet been fully integrated into existing air traffic management systems. The integration of drones into both urban and rural airspaces raises complex issues related to safety, privacy, security, and the environment, among others. Given the fast-paced evolution of drone technologies and their applications, it is clear that existing regulatory frameworks are often insufficient to address the novel risks and opportunities they present. Therefore, the adoption of specialized, forward-looking legislation is not only necessary but critical in order to ensure safe and responsible drone operations. The next steps in this legislative journey will involve creating a regulatory structure that is flexible enough to adapt to rapid technological advancements while safeguarding public interests.

At the same time, it must be acknowledged that regulatory progress in the drone and advanced air mobility sectors has been both active and accelerating. A notable example of such proactive timely approach is EASA Opinion No. 03/2023[186], which proposed a comprehensive regulatory framework designed to accommodate emerging operational and mobility concepts, including those enabled by UAS and VTOL aircraft. This Opinion aimed to support the integration of innovative technologies into the European aviation system while simultaneously fostering public acceptance and trust.

Importantly, Opinion 03/2023 introduced a range of concrete regulatory proposals, majority of which have already been implemented within the EU legal framework, namely on 23 May 2024 the European Commission has adopted a final package of secondary legislation concerning drones and vertical take-off and landing (VTOL) capable aircraft, thereby completing the regulatory framework necessary for the introduction of Innovative Air Mobility services, including piloted air taxis[187].

[186] European Union Aviation Safety Agency, *Opinion No 03/2023: Regulatory Framework to Enable Innovative Air Mobility, Introduction of Vertical Take-Off and Landing (VTOL) Capable Aircraft and Operations, and Piloted Electric Air Taxi Operations* (30 August 2023) https://www.easa.europa.eu/en/document-library/opinions/opinion-032023 accessed 19 June 2025.

[187] European Union Aviation Safety Agency, 'European Commission Adopts Regulatory Package Giving Go-Ahead to VTOL and Air Taxi Services' (EASA, 29 April 2024) https://www.easa.europa.eu/en/newsroom-and-events/news/european-commission-adopts-regulatory-package-giving-go-ahead-vtol accessed 19 June 2025.

This proactive and adaptable regulatory approach reflects the European Union's broader commitment to ensuring that innovation in aviation proceeds responsibly, safely, and in alignment with fundamental rights and societal values.

Globally efforts are being made by ICAO as well to seek the best solutions for the safe and efficient integration of drones into the airspace. In November 2019, the ICAO organized the third Drone Enable Symposium in Montréal, Canada[188], bringing together key stakeholders from government, industry, academia, and international organizations active in the unmanned aviation sector. This event marked a critical moment in advancing the dialogue on the regulation and management of drones in the global airspace. During the symposium, ICAO issued a request for information, seeking the collaboration of States, industry, academia, and other stakeholders to contribute ideas and solutions in support of the development of a safe and efficient Unmanned Aircraft Systems Traffic Management capability. The third symposium concluded that while progress had been made, substantial work remained in creating a comprehensive and harmonized framework for UAS operations worldwide.

In September 2024, ICAO hosted the first Advanced Air Mobility (AAM) Symposium at its headquarters in Montréal, Canada[189], further emphasizing the next frontier in aviation. ICAO recognized that AAM, driven by innovations in aircraft and propulsion technologies, digitalization, and increased automation, would reshape the landscape of aviation by introducing new scales of operations and services. This included new modes of mobility such as urban air mobility and the potential for drones to operate in complex environments alongside manned aircraft. The symposium highlighted the urgency of addressing regulatory challenges and developing integrated solutions that will accommodate the emerging needs of AAM while ensuring safety and efficiency. As this new era in aviation unfolds, it is clear that global collaboration and forward-thinking regulations will be essential to harness the potential of drones and AAM technologies responsibly.

Understanding the significant international milestones in the development of the AAM ecosystem, ICAO has played a central role in uniting a broad spectrum of stakeholders. These include ICAO Member States, local governmental entities (both regional and

[188] International Civil Aviation Organization, *DRONE ENABLE, ICAO's Third Unmanned Aircraft Systems Industry Symposium (DRONE ENABLE/3)* (ICAO, 12–14 November 2019) https://www.icao.int/Meetings/DRONEENABLE3/Pages/default.aspx accessed 19 June 2025.
[189] International Civil Aviation Organization, *Advanced Air Mobility Symposium 2024* (ICAO, 9–12 September 2024) https://www.icao.int/Meetings/AAM2024/Pages/default.aspx accessed 19 June 2025.

municipal), intergovernmental organizations (such as UN entities), academia, research institutions, aircraft manufacturers, infrastructure providers (covering both airspace and physical infrastructure), as well as those offering supporting services such as air traffic management. The gathering of these diverse parties highlighted the complexity and scale of the challenges ahead, underscoring the need for collective action.

In response to this, ICAO called all stakeholders to engage in a unified effort to advance the global AAM system. ICAO urged participants to focus on three main areas to build a solid, efficient, and sustainable AAM framework[190]:

- *Comprehensive Data Collection, Research, and Solution Development:* Stakeholders are encouraged to engage in extensive research to fully understand the potential and challenges of AAM, ensuring that the role of each type of stakeholder—governmental, industrial, and academic—is clearly defined and effectively integrated into the overall system.
- *Development of Scalable Physical and Digital Infrastructure:* A concerted effort is required to develop both affordable and scalable infrastructure, both physical and digital, that can support the growth of AAM systems on a global scale. This includes exploring how existing infrastructures can be adapted and enhanced to accommodate AAM technologies.
- *Cooperation on Regulatory Frameworks:* It is essential to cooperate in establishing adaptive, flexible, and harmonized regulatory frameworks that not only foster innovation but are also compatible with existing aviation systems. This will involve close collaboration between international bodies, national governments, and other relevant entities to ensure consistency and cohesion across regulatory structures.

By bringing together a wide array of stakeholders and focusing on these key areas, ICAO has set the stage for a collaborative approach to AAM that can facilitate the safe, efficient, and sustainable integration of advanced air mobility into the global aviation landscape.

ICAO has identified a number of critical challenges that must be addressed for the world to begin realizing the full benefits of scalable AAM. These challenges reflect the

[190] International Civil Aviation Organization, Call to Action: Paving the Way for the Future of Aviation with Advanced Air Mobility (2024) https://www.icao.int/Meetings/AAM2024/Documents/AAM%202024%20Call%20to%20Action%20(all%20languages)/International%20Call%20to%20Action%20-%20English.pdf 2 accessed 24 June 2025.

complexity of integrating a transformative aviation model into existing global frameworks and highlight the urgency of coordinated international action[191]. Among the key issues are:

- *Interoperability and Regulation:* The rapid advancement of AAM technologies demands the coordinated development of international standards as a foundation for regulatory harmonization. These standards are essential to ensure interoperability between systems, enhance operational efficiency, and enable scalability on a global level.
- *Airspace Integration:* A core requirement for successful AAM implementation is the seamless integration of diverse aircraft types, both conventional and novel, within shared airspace. This must be done without compromising the safety or efficiency of either current or future airspace users.
- *Multilevel Coordination:* Effective deployment of AAM systems requires strong coordination across all levels of government, national, regional, and local. Each level plays a vital role in shaping operational environments, regulatory frameworks, and public acceptance.
- *Information Sharing:* Open communication and transparency among all stakeholders, including the public, are indispensable. Improved information exchange fosters innovation, supports sustainable solutions, and helps build public trust in AAM technologies.
- *Regulation Adequacy:* New regulatory frameworks must be developed to balance the promotion of innovation with core aviation priorities, such as safety, security, efficiency, environmental sustainability, and accessibility. Without modernized regulations, the potential of AAM may remain largely unrealized.
- *Supporting Early Movers:* ICAO recognized the crucial role of innovators and early adopters in setting the pace for AAM development. These stakeholders require targeted support in the early stages to enable the successful demonstration and scaling of complex AAM capabilities.

The symposium brought together leading companies and organizations from the air mobility sector, all of whom expressed a shared conviction that the world is on the threshold of a new era in aviation. However, participants unanimously emphasized that a unified, harmonized regulatory and operational environment is essential for this vision to materialize.

Despite this momentum, ICAO has acknowledged that significant disparities remain. As of the latest updates, not all countries have developed specific regulatory frameworks for UAVs, let alone the more advanced requirements for AAM. This regulatory lag underscores

[191] ibid

the urgent need for international coordination and action to ensure a coherent and future-ready global aviation ecosystem.

5.2. EASA Inputs: European Legislative Initiatives.

On 18 November 2023, the European Commission published the Communication from the Commission to the Council and the European Parliament on countering potential threats posed by drones[192], marking a pivotal step in addressing the growing security challenges associated with unmanned aircraft systems. This Communication underscored three critical and urgent needs.

First, it calls for the establishment of a *comprehensive and unified policy framework* capable of guiding Member States in developing coherent and harmonised approaches to counter-drone threats[193].

Second, it emphasises the importance of *fostering a shared understanding* among stakeholders, particularly national authorities, law enforcement, and critical infrastructure operators, regarding the procedures necessary to effectively manage the evolving threat landscape[194].

Third, it highlights the necessity of *keeping pace with rapid technological developments*, which have enabled increasingly sophisticated and accessible drone capabilities, heightening the risk of misuse. The Commission's initiative reflects a clear recognition that fragmented or reactive measures are insufficient, and that a proactive, coordinated, and future-oriented strategy is essential to protect European airspace and public safety from the misuse of drones[195].

The number of drones operating within the European Union is projected to rise significantly in the coming years, driven by advancements in speed, maneuverability, range, payload capabilities, sensor precision, and the integration of artificial intelligence. These

[192] European Commission, Communication from the Commission to the Council and the European Parliament on countering potential threats posed by drones COM(2023) 659 final, 18 October 2023 https://op.europa.eu/en/publication-detail/-/publication/70141f3f-6d97-11ee-9220-01aa75ed71a1/language-en accessed 24 June 2025.
[193] European Commission, Communication from the Commission to the Council and the European Parliament on countering potential threats posed by drones COM(2023) 659 final, 18 October 2023 https://op.europa.eu/en/publication-detail/-/publication/70141f3f-6d97-11ee-9220-01aa75ed71a1/language-en accessed 24 June 2025, 1.
[194] Ibid,2.
[195] Ibid,3.

technological improvements will expand the scope of lawful and beneficial drone applications across various sectors. However, the full realization of this potential hinges on effectively addressing the risks posed by non-cooperative drones. Such drones are defined by their non-compliance with regulations, which can stem from deliberate criminal activity, including terrorism and smuggling, or from unintentional misuse due to ignorance or negligence.

The threat posed by drones is evident when viewed through the lens of recent global incidents. In modern conflict and war zones such as Ukraine, Yemen, and Syria, drones have demonstrated their effectiveness as low-cost weapons of war, including in surveillance, targeting, and direct attacks. These uses highlight the potential for similar tactics to be deployed in the EU, with significant implications for internal security. Moreover, off-the-shelf drones have already been used or threatened to be used in terrorist attacks, including targeted assassinations, underscoring the urgency of robust countermeasures.

Counter-drone systems must therefore address a wide spectrum of threats, from malicious intent to accidental violations. While the majority of licensed drone operators adhere to safety and legal standards, incidents involving careless or unlawful use, particularly around critical infrastructure or public gatherings, continue to pose serious risks. In addition to the physical threats, unlawful drone operations can infringe on privacy and personal safety, especially in densely populated or residential areas.

To mitigate these risks, there is a growing need for affordable and effective counter-drone technologies. These systems should focus on detection, tracking, and identification capabilities, with public authorities also requiring tools for neutralisation and forensic analysis. However, a one-size-fits-all approach is impractical due to the diversity of operational contexts. Some situations may require immediate drone destruction to prevent imminent harm, while others may prioritise recovery for investigative purposes. Cyber-based solutions, such as commandeering a drone mid-flight, also represent a key area of development.

Enhancing detection technologies through the use of advanced sensors and flight pattern analysis is critical, particularly for identifying payloads or suspicious behaviour. Artificial intelligence will play a growing role in improving threat detection, route prediction, and real-time risk assessment. Keeping pace with technological trends will be essential to identify investment priorities and guide the development of comprehensive counter-drone strategies tailored to evolving threats and operational needs.

It is equally important to monitor the development and use of counter-counter-drone technologies by criminals which are specifically designed to evade or disable established counter-drone measures. As many counter-drone solutions originally developed for military purposes share technological foundations with those used in the civilian sphere, close collaboration between the defence and civil sectors is essential. This rapidly evolving technological landscape highlights the need for a harmonised and continuously updated regulatory framework to govern the deployment and use of counter-drone systems.

These considerations prompted the European Union to define six key activities to be pursued.

a. Community Building & Information Sharing[196]

A key initiative involved the establishment of a dedicated expert group composed of representatives from Member States and relevant stakeholders. This group would serve as a collaborative platform to share technical expertise, operational experiences, and policy recommendations related to counter-drone activities. Its role lays in being an instrumental in fostering a harmonised approach across the European Union, ensuring that efforts to address drone threats are coherent and mutually reinforcing.

In addition to this, the Commission planed to explore the creation of a secure digital platform designed to collect and disseminate information on drone-related incidents. Such a platform would significantly enhance situational awareness by enabling authorities and critical infrastructure operators to access timely, relevant data. This would support more informed decision-making and help identify patterns or emerging threats at both national and EU levels.

Furthermore, the Commission committed to facilitate regular meetings to enable the exchange of classified information among Member States regarding major drone-related security incidents. These meetings are aimed to play a vital role in strengthening trust and cooperation among national authorities, enabling more coordinated responses to cross-border threats and contributing to a more resilient security framework. Together, these measures reflect the EU's commitment to building a proactive, collaborative, and technologically informed counter-drone strategy that can adapt to the rapidly evolving nature of the threat.

[196] Ibid,5.

b. Testing of Counter-Drone Systems[197]

To support the effective deployment and evaluation of counter-drone technologies across the European Union, the Commission has committed to implementing a harmonised testing methodology for such systems. This initiative builds on the findings of the Courageous project, which has laid important groundwork in assessing the operational effectiveness of various counter-drone solutions. A harmonised testing approach will ensure consistency, comparability, and transparency in how counter-drone technologies are assessed, ultimately supporting the selection and use of systems that meet common performance and safety standards across Member States.

In parallel, the Joint Research Centre (JRC) will take on a central role in monitoring technological progress in the counter-drone field by producing an annual report on key developments. This report will serve as a valuable resource for policymakers, law enforcement, and infrastructure operators, offering insights into emerging technologies, potential vulnerabilities, and investment priorities.

Moreover, the Commission, in collaboration with expert groups such as the European Network of Law Enforcement Technology Services (ENLETS), the High Risk Security Network (HRSN), and AIRPOL, will work to establish voluntary performance requirements for counter-drone systems. These requirements will not be legally binding but are intended to guide procurement, ensure interoperability, and promote high operational standards. Together, these actions reflect the EU's commitment to fostering a coordinated, evidence-based, and forward-looking framework for counter-drone capabilities, grounded in both technological innovation and practical application.

c.Practical Guidance & Operational Support[198]

As part of the European Commission's comprehensive counter-drone strategy, the Joint Research Centre (JRC) has made a significant contribution through the publication of two specialized handbooks, officially released on 18 October 2023[199]. These handbooks are a key component of the EU's broader efforts to counter the unlawful and dangerous use of drones, particularly in the protection of public spaces. By offering practical guidance and

[197] Ibid,6.

[198] Ibid,8.

[199] European Commission, Protection against Unmanned Aircraft Systems: Handbook on UAS protection of Critical Infrastructure and Public Space – A five-phase approach for C-UAS stakeholders (2023); European Commission, Protection against Unmanned Aircraft Systems: Handbook on UAS Risk Assessment Principles for Physical Hardening of Buildings and Sites (2023); These handbooks are part of the EU's Counter-UAS package initiative under the Communication A Drone Strategy 2.0 for a Smart and Sustainable Unmanned Aircraft Ecosystem in Europe.

technical insights, the publications aim to support Member States and stakeholders in enhancing their preparedness and response capabilities against drone-related threats.

In addition to these knowledge-building tools, the Commission will take further steps to expand the reach and impact of counter-drone preparedness by extending relevant training programs to the private security sector. Recognizing the crucial role that private security providers play in safeguarding public and critical infrastructure, this initiative seeks to ensure that they are equipped with the necessary awareness and skills to respond effectively to drone-related incidents.

Furthermore, counter-drone components will be integrated into the EU's exercise planning with law enforcement networks. By embedding drone threat scenarios into training exercises and simulations, authorities will be better prepared to respond to real-world events in a coordinated and efficient manner. Together, these initiatives reflect a multi-layered approach that combines technical knowledge, capacity building, and cross-sector collaboration to strengthen the EU's resilience against the growing and evolving threat posed by non-cooperative drones.

d. Research & Innovation[200]

Looking ahead, the European Commission, in cooperation with Member States, committed to evaluate future counter-drone needs to inform priorities within European research and innovation programmes, including Horizon Europe. This forward-looking assessment aimed to ensure that research funding is strategically aligned with emerging technological demands and evolving threat scenarios. By identifying gaps and opportunities in the current counter-drone landscape, the EU seeks to foster innovation that directly enhances its security and resilience.

As part of this process, a curated list of promising counter-drone solutions is to be compiled, with certain technologies considered for pre-commercial procurement. This approach allows public authorities to invest in the development and refinement of solutions that show strong potential but are not yet fully market-ready. By doing so, the EU not only supports innovation but also accelerates the deployment of advanced capabilities tailored to real-world operational needs.

To further bridge the gap between defence and civilian applications, the Commission seeks to facilitate the integration of these technologies into existing and future defence

[200] Ibid,9.

capabilities, while also supporting projects that adapt them for use in the civil sector. This dual-use strategy maximises the utility and efficiency of investment in counter-drone innovation and ensures that both public safety and national security benefit from technological advances.

Finally, the Joint Research Centre committed to establish a dedicated Counter-Drone Centre of Excellence, evolving from its current “living lab” framework. This centre will serve as a hub for experimentation, validation, and knowledge exchange, playing a vital role in supporting policy development, operational testing, and cross-sector collaboration across the EU.

e. *Funding Support*[201]

The Commission found efficien to launch a dedicated call for counter-drone proposals under the Internal Security Fund’s (ISF) thematic work programmes for the 2026–2027 period. This initiative aimed at stimulating the development and deployment of innovative and effective counter-drone solutions by supporting projects that enhance detection, neutralisation, and response capabilities across Member States.

In parallel, Member States are be encouraged to make full use of their national ISF programmes for the 2021–2027 funding period to identify, finance, and implement suitable counter-drone technologies and strategies. By aligning national efforts with EU-level funding and policy objectives, the Commission seeks to ensure a coordinated and well-resourced approach to counter-drone capacity building. These funding mechanisms play a crucial role in bridging technological gaps, fostering cross-border cooperation, and ensuring that counter-drone measures are scaled appropriately to the evolving threat environment.

f. Regulatory Measures[202]

To support a more coherent and effective legal framework for addressing drone-related threats, the European Commission has undertaken a comprehensive mapping study aimed at identifying existing regulatory gaps and harmonising the laws and procedures of Member States. This initiative has been designed to assess the current landscape of national regulations governing drone operations and counter-drone measures, with the objective of fostering greater alignment and legal clarity across the EU. By highlighting

[201] Ibid,11.
[202] Ibid,12.

inconsistencies and identifying best practices, the study has laid the groundwork for future legislative updates that reflect both technological progress and evolving security needs.

In addition, the Commission has carried out a targeted aviation security-risk assessment focused on identifying vulnerabilities at airports. This assessment has helped determine whether current safety and security regulations are sufficient or whether further measures are required to mitigate the risks drones pose to such critical infrastructure.

Moreover, the Commission has engaged in a structured dialogue with industry stakeholders to examine the potential need for additional security measures specific to drones. This ongoing dialogue has ensured that the perspectives of manufacturers, operators, and service providers are incorporated into policy discussions. It also reflects the Commission's commitment to striking a balance between safeguarding public safety and fostering innovation.

Collectively, these actions have contributed to the development of a more harmonised, responsive, and forward-looking regulatory framework for drones within the European Union.

Considering the abovementioned, my estimations are that the rapid advancement of drone and counter-drone technologies has consistently outpaced the development of corresponding legal and regulatory frameworks, creating a widening gap between innovation and oversight. This imbalance poses a serious challenge: without timely and well-integrated legislation, the benefits of emerging technologies may be undermined by unchecked security, safety, and privacy risks. The European Union has recognised this urgency and responded with a measured yet proactive approach, gradually building a regulatory foundation through coordinated studies, structured dialogue, strategic investments, and ongoing collaboration with Member States and stakeholders. Through initiatives such as the publication of technical handbooks, the establishment of expert groups, the integration of counter-drone components into law enforcement exercises, and the harmonisation of testing standards, the EU has taken important steps toward building a balanced, future-proof framework.

Nevertheless, this progress has been deliberately paced, balancing innovation with regulation to avoid stifling industry while ensuring public protection. While this controlled tempo reflects a cautious and methodical policy environment, it also stands in contrast to the situation in countries like Ukraine, where drone use has become widespread and operationally sophisticated, particularly in defence and security contexts. Despite this high

level of practical deployment, Ukraine has yet to launch comprehensive regulatory initiatives that align with EU standards or adequately address the dual-use nature and risks of drone technology. As Ukraine continues to deepen its cooperation with the EU, the timely adoption and integration of aligned legislation will be crucial not only for enhancing interoperability and security but also for ensuring that technological progress contributes positively to civil society rather than becoming a source of unmanaged risk.

In conclusion, as drone technology becomes more embedded in both public and private sectors, the alignment of fast-moving innovation with adaptable and harmonised legal frameworks is not only desirable, but essential. The EU's evolving regulatory approach offers a model of structured integration, while Ukraine's position highlights the need for accelerated legal action to match operational realities.

6. Conclusion

The development of drone regulations is a relatively young field, reflecting the rapid evolution of drone technologies themselves. As drones have transitioned from niche tools to integral components of various industries, the regulatory landscape has struggled to keep pace with their expanding capabilities and applications. While drone technologies have advanced quickly, offering vast potential in areas ranging from agriculture to defence, the legislative frameworks designed to ensure their safe and responsible use are still in the process of maturation. This gap between technological development and regulatory oversight presents both challenges and opportunities, making the ongoing efforts to create and adapt drone regulations a critical aspect of ensuring that these technologies can be integrated safely into society.

Drone technologies have proved its high efficiency in military sector and consequently conquer civil domains as it is often develops with regards to technological tools. And yet their legal and regulatory environment remains fragmented and often lagging behind technological innovation. In the European Union, regulatory efforts are relatively new and struggle to match the speed at which drone technology is advancing.

To facilitate the safe integration of UAS into the European airspace, the European Union has enacted a harmonized regulatory framework developed by the EASA. This framework is primarily set out in the basic regulation - Regulation EU 2018/1139 on common rules in the field of civil aviation and establishing EASA as well as the Regulation EU 2019/947 on the rules and procedures for the operation of UAS and the Regulation EU 2019/945 concerning the requirements for UAS and third-country operators. These instruments aim to reconcile the benefits offered by drone technology with essential legal obligations placed on manufacturers and operators, particularly in relation to safety, the protection of privacy, environmental concerns, noise abatement, and public security. The regulations establish a clear legal basis for drone operations across all categories, from those that do not require prior authorisation to those necessitating certification and operator approval, ensuring legal certainty for both recreational and professional users. While the framework includes minimum standards for remote pilot training, especially for non-commercial use, it acknowledges residual risks, including inadvertent operations near aerodromes and the potential for malicious use, which remain challenging to fully eliminate through regulation alone.

Over the next five to ten years, Europe is expected to witness the safe, secure, and efficient integration of unmanned aircraft systems into airspace, particularly in zones characterised by high volumes of drone activity or in areas where drones operate in proximity to manned aircraft. This evolving operational environment necessitates the development and implementation of additional, specific regulatory measures and operational procedures governing both UAS activities and the organisations involved. A high level of automation and digitalisation will be essential to support this transition. Central to this framework is the concept of U-space, which comprises a set of services, designated airspace volumes, and information-sharing mechanisms designed to facilitate the effective management of drone traffic. U-space is intended to reduce the risk of collisions, both among UAS and between UAS and manned aircraft, within shared airspace. The current suite of proposed mandatory U-space services includes network identification, geo-awareness, UAS flight authorisation, and traffic information. Additional services will be phased in progressively as they are validated through practical implementation. Notably, geo-awareness capabilities are expected to play a key role in mitigating the risk of unauthorised drone incursions into restricted zones, including areas surrounding critical infrastructure such as nuclear facilities, oil pipelines, motorways, high-speed rail lines, and airports[203].

Despite these efforts, one of the most pressing issues remains the lack of full integration of drones into traditional air traffic control systems. Legacy aviation laws are ill-equipped to manage low-altitude, semi- or fully-autonomous drone flights. For instance, conventional “visual line of sight” rules do not apply to BVLOS operations, and many legal systems lack provisions for real-time drone identification, dynamic airspace access, or scalable digital coordination across multiple operators. In addition, despite the EU's efforts to create a harmonized aviation framework, EU Member States have pursued varying timelines, adopted different technologies, and interpreted regulations in diverse ways. These differences hinder seamless cross-border drone operations and delay the creation of a fully integrated European airspace.

Counter-drone measures are another critical frontier. With the growing accessibility and capability of drones, the risks of criminal misuse, espionage, and disruptions to public safety are increasing. However, legal frameworks for detecting, intercepting, or neutralizing rogue drones remain underdeveloped in many jurisdictions. Effective counter-drone

[203]European Union Aviation Safety Agency, *Drone Incident Management at Aerodromes* (8 March 2021) https://www.easa.europa.eu/sites/default/files/dfu/drone_incident_management_at_aerodromes_part1_website_suitable.pdf accessed 24 June 2025.

legislation and technologies must be urgently advanced to protect sensitive sites and national infrastructure.

Ukraine presents a particularly vivid case. Henri Seydoux, the founder and head of French drone maker Parrot, said Ukraine is “fascinating” from a drone-technology perspective because “it changes so quickly, there are new ideas non-stop.”[204] Despite being at the forefront of both civil and military drone use, especially in response to wartime conditions, Ukraine still lacks a robust legal framework to regulate UAS. The rapid advancement of drone technology in Ukraine, driven by wartime necessity, has outpaced existing legal and institutional frameworks, prompting the creation of a dedicated military branch, the Unmanned Systems Forces, through recent legislative reforms. However, a significant gap remains lack of civil drone usage regulations as well very immature data protection regulations, with the GDPR not applicable in the country. While this legal vacuum allows for flexibility in combat scenarios, it also poses risks to safety and coordination. As Ukraine moves toward post-war reconstruction and EU integration, establishing a clear, harmonized regulatory framework for both military and civilian drone use is an urgent priority.

Beyond security and airspace management, drones raise pressing legal and ethical issues tied to their data collection capabilities, surveillance potential, privacy implications, and cybersecurity risks. The integration of AI into drones further complicates matters, raising concerns about surveillance and data privacy. Although initiatives like the EU’s AI Act aim to address these risks, ongoing international cooperation and updated regulations are essential to ensure responsible and ethical drone deployment.

As drones take on increasingly important roles in vast majority of business sectors including logistics, agriculture, journalism, emergency response, and law enforcement, these concerns will only grow. Their widespread adoption challenges lawmakers to strike a balance between innovation and regulation, requiring a flexible, technology-aware approach to policymaking.

To address these challenges, the EU has launched key initiatives to support drone integration. It is accelerating U-space deployment by promoting investment and simplifying regulations, while also developing interoperable digital systems to ensure safe, efficient cross-border operations. A coordinated roadmap involving EASA, EUROCONTROL, and

[204] Leicester John, ‘Tried and tested in war: For European drone manufacturers, Ukraine is the place to be’ Associated Press (online, 19 June 2025) https://apnews.com/article/5ff2ac41e931538258ede7b39571ef3f accessed 23 June 2025.

national ANSPs is also being implemented to align technical and regulatory progress. Though full UAV integration remains ongoing, these efforts lay a strong foundation for a unified European airspace.

Ultimately, drones are no longer emerging, they are here. Their dual-use nature across military and civil life, coupled with their potential to reshape industries and societies, suggests the eventual emergence of a dedicated field of drone law. This new legal branch will need to operate at the intersection of aviation, data protection, AI governance, and international humanitarian principles. To harness the benefits while mitigating the risks, a proactive, adaptive, and integrated legal framework is not just advisable, it’s essential.

Literature

Normative Acts and Regulations EU and US

Convention on International Civil Aviation (opened for signature 7 December 1944, entered into force 4 April 1947) 15 UNTS 295 https://www.icao.int/publications/pages/doc7300.aspx

Regulation (EC) No 551/2004 of the European Parliament and of the Council of 10 March 2004 on the organisation and use of the airspace in the single European sky [2004] OJ L 96/20.

Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data (General Data Protection Regulation) [2016] OJ L 119/1.

European Aviation Safety Agency, Opinion No 01/2018: Introduction of a Regulatory Framework for the Operation of Unmanned Aircraft Systems in the 'Open' and 'Specific' Categories (2018) https://www.easa.europa.eu/document-library/opinions/opinion-012018#group-easa-downloads accessed 30 May 2025.

International Civil Aviation Organization, Unmanned Aviation Bulletin 2018/1 (ICAO 2018) https://www.icao.int/safety/UA/Documents/UABulletin_2018-1.pdf

Commission Delegated Regulation (EU) 2019/945 of 12 March 2019 on unmanned aircraft systems and on third-country operators of unmanned aircraft systems [2019] OJ L 152/1.

Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft systems [2019] OJ L 152/1.

International Civil Aviation Organization, Unmanned Aviation Bulletin 2019/1 (ICAO 2019) https://www.icao.int/safety/UA/Documents/UABulletin_2019-1.pdf.

European Union Aviation Safety Agency, 'Decision 2019/021/R – Acceptable Means of Compliance and Guidance Material to Commission Implementing Regulation (EU) No 2019/947' (8 March 2019).

International Civil Aviation Organization, Unmanned Aviation Bulletin 2020/1 (ICAO 2020) https://www.icao.int/safety/UA/Documents/UABulletin_2020-1.pdf

European Union Aviation Safety Agency, Drone Incident Management at Aerodromes (8 March 2021) https://www.easa.europa.eu/en/newsroom-and-events/press-releases/easa-issues-guidelines-management-drone-incidents-airports

Regulation (EU) 2021/664 of the European Parliament and of the Council of 15 April 2021 on a regulatory framework for the U-space [2021] OJ L 143/1.

Commission Implementing Regulation (EU) 2021/664 of 22 April 2021 on a regulatory framework for the U-space [2021] OJ L 139/1.

Commission Implementing Regulation (EU) 2021/665 of 22 April 2021 amending Implementing Regulation (EU) 2017/373 as regards requirements for providers of air traffic

management/air navigation services and other air traffic management network functions in the U-space airspace designated in controlled airspace [2021] OJ L 139/7.

Commission Implementing Regulation (EU) 2021/665 of 22 April 2021 amending Implementing Regulation (EU) 2017/373 as regards requirements for providers of air traffic management/air navigation services and other air traffic management network functions in the U-space airspace designated in controlled airspace [2021] OJ L 141/1.

Commission Implementing Regulation (EU) 2021/666 of 22 April 2021 amending Regulation (EU) No 923/2012 as regards requirements for manned aviation operating in U-space airspace [2021] OJ L 139/13.

Commission Implementing Regulation (EU) 2021/666 of 22 April 2021 amending Regulation (EU) No 923/2012 as regards requirements for manned aviation operating in U-space airspace [2021] OJ L 141/19.

International Civil Aviation Organization, ICAO Model UAS Regulations (ICAO, 2022) https://www.icao.int/safety/UA/Pages/ICAO-Model-UAS-Regulations.aspx accessed 22 June 2025.

International Civil Aviation Organization, Model UAS Regulations: Parts 101, 102 and 149 (ICAO 2022) https://www.icao.int/safety/UA/Pages/Model-UAS-Regulations.aspx

European Union Aviation Safety Agency (EASA), ‘Opinion No. 03/2023’ (August 2023) https://www.easa.europa.eu/en/newsroom-and-events/news/european-commission-adopts-regulatory-package-giving-go-ahead-vtol.

European Union Aviation Safety Agency, Opinion No 03/2023: Regulatory framework to enable innovative air mobility, introduction of vertical take-off and landing (VTOL) capable aircraft and operations, and piloted electric air taxi operations (30 August 2023) https://www.easa.europa.eu/en/document-library/opinions/opinion-032023.

European Union Aviation Safety Agency (EASA), ‘Data Protection Impact Assessment’ (EASA, updated 2023) https://www.easa.europa.eu/en/domains/civil-drones/privacy/data-protection-impact-assessment.

European Commission, 'Communication from the Commission to the Council and the European Parliament on Countering Potential Threats Posed by Drones' COM(2023) 659 final, 18 October 2023 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52023DC0659.

European Commission, Communication from the Commission to the Council and the European Parliament on countering potential threats posed by drones COM(2023) 659 final, 18 October 2023.

International Civil Aviation Organization, Model UAS Regulations: Parts 101, 102 and 149 (ICAO 2022) https://www.icao.int/safety/UA/Pages/Model-UAS-Regulations.aspx

European Commission, 'Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A Drone Strategy 2.0 for a Smart and Sustainable Unmanned Aircraft Eco-System in Europe' COM (2022) 370 final.

European Commission, 'Drone Strategy 2.0 for a Smart and Sustainable Unmanned Aircraft Eco-System in Europe' COM(2022) 652 final of 29 November 2022.

European Commission, Communication from the Commission to the Council and the European Parliament on countering potential threats posed by drones COM(2023) 659 final, 18 October 2023 https://op.europa.eu/en/publication-detail/-/publication/70141f3f-6d97-11ee-9220-01aa75ed71a1/language-en accessed 19 June 2025.

European Union Aviation Safety Agency, Annual Safety Review 2024 (2024) https://www.easa.europa.eu/en/document-library/general-publications/annual-safety-review-2024

Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act) [2024] OJ L 2024/1689.

International Civil Aviation Organization, International Call to Action (ICAO, 2024) https://www.icao.int/Meetings/AAM2024/Documents/AAM%202024%20Call%20to%20Action%20(all%20languages)/International%20Call%20to%20Action%20-%20English.pdf

Regulation (EU) 2024/2803 of the European Parliament and of the Council of 23 October 2024 on the implementation of the Single European Sky (recast) [2024] OJ L 2803/1.

14 CFR Part 137 – Agricultural Aircraft Operations (Title 14, Code of Federal Regulations) (eCFR, current as of 15 May 2025) https://www.ecfr.gov/current/title-14/chapter-I/subchapter-G/part-137

Normative Acts and Regulations of Ukraine

Convention on International Civil Aviation 1944 (signed 7 December 1944, entered into force for Ukraine 9 August 1994) https://zakon.rada.gov.ua/laws/show/995_038#Text accessed 22 June 2025.

Law of Ukraine No 2297-VI, ‘On Personal Data Protection’ (1 June 2010).

Air Code of Ukraine, Law of Ukraine No 3393-IV, 19 May 2011.

Cabinet of Ministers of Ukraine, 'Regulation on State Aviation Administration of Ukraine' Decision No 520, 18 October 2014.

Ministry of Defence of Ukraine, 'Rules on Performance of Flights by Unmanned Aircraft Systems of the State Aviation of Ukraine' Order No 661, 8 December 2016.

Ministry of Defence of Ukraine, 'Rules for the Technical Operation of Unmanned Aircraft Systems of Class I of the State Aviation of Ukraine' Order No 401, 10 August 2018.

State Aviation Service of Ukraine and Ministry of Defence of Ukraine, 'Rules for the Use of the Airspace of Ukraine' Joint Order No 430/210, 11 May 2018.

Draft Law on Amendments to the Air Code of Ukraine Regarding the Improvement of Legislative Regulation in the Sphere of Civil Aviation Unmanned Aerial Vehicles (2020) Bill No 3716, 3rd Session IX Convocation

Draft Law on Amendments to Certain Legislative Acts of Ukraine Regarding the Application of Unmanned Aerial Vehicles by Law Enforcement Agencies and Counteraction to Their Illegal Use (2022) Bill No 8185, 8th Session IX Convocation.

Draft Law of Ukraine on Amendments to the Code of Ukraine on Administrative Offences Regarding the Establishment of Responsibility for Violations of the Order and Rules of Use of Ukrainian Airspace by Unmanned Aerial Vehicle Operators (2022) Bill No 8186, 8th Session IX Convocation.

Law of Ukraine on Amendments to Certain Legislative Acts of Ukraine Regarding the Application of Unmanned Aerial Vehicles by Law Enforcement Agencies and Counteraction to Their Illegal Use (2022) Bill No 8185, 8th Session IX Convocation.

Law of Ukraine on Amendments to Subsection 2 of Section XX "Transitional Provisions" of the Tax Code of Ukraine Regarding Exemption from Value Added Tax on Import Operations of Goods for the Production and/or Repair of Unmanned Systems (2023) Bill No 9275, 9th Session IX Convocation.

Ministry of Defence of Ukraine, 'Law on the Establishment of the Unmanned Systems Forces in the Structure of the Armed Forces of Ukraine' in pursuance of the Decision of the National Security and Defense Council of Ukraine, 25 June 2024, enacted by Decree of the President of Ukraine No 382/2024.

Books and Book Chapters

Abeyratne Ruwantissa IR, Convention on International Civil Aviation: A Commentary (Springer International Publishing 2014).

Hartmann Jacques, Scott Benjamyn I, Truxal Steven, Bertolini Andrea and Masutti Anna (eds), Civil Regulation of Autonomous Unmanned Aircraft Systems in Europe (Edward Elgar Publishing 2024) 31-63, 157–175 https://doi.org/10.4337/9781035312344.

Tucker Spencer C, Instruments of War: Weapons and Technologies That Have Changed History (ABC-CLIO 2015).

Articles

Achasova Alla, ‘Ukrainian Legislation Regulating the Use of UAVs Reviewed’ (50° North, 17 May 2020) https://www.50northspatial.org.ua/ukrainian-legislation-regulating-use-uavs-reviewed/ accessed 18 June 2025.

Ajadi Samuel, ‘Are drones suitable tools for delivering medical supplies in developing countries?’ (Mobile for Development, 21 December 2020) https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-for-development/blog/are-drones-suitable-tools-for-delivering-medical-supplies-in-developing-countries/ accessed 15 June 2025.

Baghai Christian, ‘How Ukraine’s Underground Drone Makers Are Changing the Face of War’ (Medium, 30 December 2023) https://christianbaghai.medium.com/how-ukraines-

underground-drone-makers-are-changing-the-face-of-war-7eb27f28f31b accessed 24 May 2025.

Bassi Eleonora, ‘From Here to 2023: Civil Drones Operations and the Setting of New Legal Rules for the European Single Sky’ (2020) 100 Journal of Intelligent & Robotic Systems 493 https://doi.org/10.1007/s10846-020-01185-1 accessed 29 May 2025.

Bassi Eleonora and others, ‘The Design of GDPR-Abiding Drones Through Flight Operation Maps: A Win–Win Approach to Data Protection, Aerospace Engineering, and Risk Management’ (2019) 29 Minds and Machines 579 https://doi.org/10.1007/s11023-019-09511-9 accessed 19 June 2025.

Bogdan Drap'yatyi, 'Проблемні питання правового регулювання застосування безпілотних літальних апаратів в Україні та шляхи їх вирішення [Problematic Issues of Legal Regulation of the Use of Unmanned Aerial Vehicles in Ukraine and Ways to Solve Them]' (Censor.NET, 18 April 2023) https://censor.net/ua/blogs/3412889/problemn_pitannya_pravovogo_regulyuvannya_zastosuvannya_bezplotnih_ltalnih_aparatv_v_ukran_ta_shlyahi accessed 24 May 2025.

Buzgó László, 'Skybound Regulations: Navigating the Future of Air Taxis and eVTOLs in the EU' (Flying Cars Market, 19 April 2024) https://flyingcarsmarket.com/skybound-regulations-navigating-the-future-of-air-taxis-and-evtols-in-the-eu/?utm_ accessed 14 June 2025.

Davoren Haley, 'Joby applies to be first certified electric air taxi operator in UAE' (GlobalAir.com, 10 September 2024) https://www.globalair.com/articles/joby-applies-to-be-first-certified-electric-air-taxi-operator-in-uae?id=7915 accessed 14 June 2025.

Daly Jess, ‘How Ukraine Defends Against Russia’s Invisible Onslaught of Electronic Warfare’ (United24 Media, 20 March 2025) https://united24media.com/war-in-ukraine/how-ukraine-defends-against-russias-invisible-onslaught-of-electronic-warfare-6868 accessed 24 May 2025.

European Commission, 'Single European Sky Regulation enters into force, aiming for a more efficient and sustainable airspace' (2 December 2024) https://transport.ec.europa.eu/news-events/news/single-european-sky-regulation-enters-force-aiming-more-efficient-and-sustainable-airspace-2024-12-02_en accessed 29 May 2025.

European Commission, 'Single European Sky' (European Commission, 2025) https://transport.ec.europa.eu/transport-modes/air/single-european-sky_en accessed 29 May 2025.

European Commission, ‘Drones: Commission Adopts New Rules and Conditions for Safe, Secure and Green Drone Operations’ (22 April 2021) Directorate-General for Mobility and Transport https://transport.ec.europa.eu/news-events/news/drones-commission-adopts-new-rules-and-conditions-safe-secure-and-green-drone-operations-2021-04-22_en accessed 30 May 2025.

European Commission, 'Commission adopts regulatory package, giving go-ahead for VTOL operations and air taxis' (10 April 2024) https://www.easa.europa.eu/en/newsroom-and-events/news/european-commission-adopts-regulatory-package-giving-go-ahead-vtol accessed 14 June 2025.

European Union Aviation Safety Agency, 'EASA Certifies ANRA Technologies as First U-space Service Provider' (30 October 2024) https://www.easa.europa.eu/en/newsroom-and-events/press-releases/easa-certifies-anra-technologies-first-u-space-service-provider accessed 31 May 2025.

European Union Aviation Safety Agency, 'Drones & Air Mobility – Noise & Sustainability' (EASA, 2025) https://www.easa.europa.eu/en/domains/drones-air-mobility/drones-air-mobility-landscape/noise-sustainability accessed 14 June 2025.

European Union Aviation Safety Agency (EASA), ‘EASA Certifies ANRA Technologies as First U-space Service Provider’ (EASA, 15 May 2025) https://www.easa.europa.eu/en/newsroom-and-events/press-releases/easa-certifies-anra-technologies-first-u-space-service-provider accessed 19 June 2025.

European Union Aviation Safety Agency, 'Sustainability: Environmental Footprint' (EASA) https://www.easa.europa.eu/en/en/domains/drones-air-mobility/drones-air-mobility-landscape/noise-sustainability/sustainability-environmental-footprint accessed 14 June 2025.

European Union Aviation Safety Agency (EASA), ‘Privacy by Design’ (EASA, updated 2023) https://www.easa.europa.eu/cs/domains/civil-drones/privacy/privacy-by-design accessed 19 June 2025.

European Court of Auditors, Special Report No 18/2017: Single European Sky: a changed culture but not a single sky (Publications Office of the European Union 2017) https://op.europa.eu/webpub/eca/special-reports/single-european-sky-18-2017/en/?utm accessed 20 June 2025.

European Union Agency for the Space Programme (EUSPA), ‘Copernicus Data in U-Space Airspace Design’ (EUSPA, 6 March 2024) https://www.euspa.europa.eu/newsroom-events/news/copernicus-data-u-space-airspace-design accessed 19 June 2025.

ENAIRE, 'U-Space and ENAIRE’s Role' (ENAIRE, 2025) https://www.enaire.es/services/drones/everything_you_need_to_know_to_fligh_your_drone/uspace_and_enaires_role accessed 31 May 2025.

Federal Aviation Administration, 'Advanced Air Mobility | Air Taxis' https://www.faa.gov/air-taxis accessed 14 June 2025.

Federal Aviation Administration, 'Dispensing Chemicals and Agricultural Products (Part 137) with UAS' (2020) https://www.faa.gov/uas/advanced_operations/dispensing_chemicals accessed 16 June 2025.

Federal Aviation Administration, 'BEYOND' (2020) https://www.faa.gov/uas/programs_partnerships/beyond accessed 16 June 2025.

Federal Aviation Administration, 'FAA Authorizes UPS Flight Forward and uAvionix to Operate Drones Beyond Visual Line of Sight' (6 September 2023) https://www.faa.gov/newsroom/faa-authorizes-ups-uavionix accessed 16 June 2025.

Federal Aviation Administration, 'Package Delivery by Drone (Part 135)' (2020) https://www.faa.gov/uas/advanced_operations/package_delivery_drone?utm accessed 16 June 2025.

Friesen Garth, ‘Trump’s AI Push: Understanding The $500 Billion Stargate Initiative’ (Forbes, 23 January 2025) https://www.forbes.com/sites/garthfriesen/2025/01/23/trumps-ai-push-understanding-the-500-billion-stargate-initiative/?utm.

Johnson et al Anna M, ‘Impact of Using Drones in Emergency Medicine: What Does the Future Hold?’ (Open Access Emergency Medicine, 2021) https://pmc.ncbi.nlm.nih.gov/articles/PMC8605877/ accessed 15 June 2025.

Hartmann Jacques, Benjamyn I Scott, Steven Truxal, Andrea Bertolini and Anna Masutti (eds), Civil Regulation of Autonomous Unmanned Aircraft Systems in Europe (Edward Elgar Publishing 2024) 157–175, DOI: https://doi.org/10.4337/9781035312344.

Haye Kesteloo, ‘Ukraine’s Kitchen-Top Drone Revolution: Citizens Join the Fight Against Russian Invasion’ (DroneXL, 16 October 2024) https://dronexl.co/2024/10/16/ukraines-drone-revolution-citizens-join-fight-against-russian-invasion/ accessed 24 May 2025.

Hloba Danilo, ‘Адаптація – не клонування: як депутати хочуть витратити мільярди на захист персональних даних’ [‘Adaptation – Not Cloning: How Deputies Want to Spend Billions on Personal Data Protection’] (Mind.ua, 23 May 2024) https://mind.ua/openmind/20273976-adaptaciya-ne-klonuvannya-yak-deputati-hochut-vitratiti-milyardi-na-zahist-personalnih-danih accessed 19 June 2025.

International Civil Aviation Organization, DRONE ENABLE, ICAO's Third Unmanned Aircraft Systems Industry Symposium (DRONE ENABLE/3) (ICAO, 12–14 November 2019) https://www.icao.int/Meetings/DRONEENABLE3/Pages/default.aspx accessed 19 June 2025.

International Civil Aviation Organization, Advanced Air Mobility Symposium 2024 (ICAO, 9–12 September 2024) https://www.icao.int/Meetings/AAM2024/Pages/default.aspx accessed 19 June 2025.

Ishveena Singh, ‘‘They Were Tomatoes’: Ukrainian Woman Who Took Down Spy Drone with a Can’ (DroneDJ, 8 March 2022) https://dronedj.com/2022/03/08/ukrainian-woman-russian-drone-cucumbers-tomatoes/ accessed 21 May 2025.

Janke Christian and Maarten Uijt de Haag, ‘Progress and Challenges with the Implementation of European Drone Regulation – Status Quo and Outlook’ (paper presented at 2022 International Conference on Unmanned Aircraft Systems (ICUAS), Dubrovnik, Croatia, 21–24 June 2022) IEEE https://doi.org/10.1109/ICUAS54217.2022.9836165.

Kennedy John, Simone Garruccio and Kai Cussen, 'Modelling and Mitigation of Drone Noise' (2021) Vibroengineering Procedia https://doi.org/10.21595/vp.2021.21988 accessed 14 June 2025.

Kozatskyi Sania, ‘Ukrainian Kamikaze Drone "Grim" Passed Flight Tests’ Militarnyi (3 October 2021) https://militarnyi.com/uk/news/ukrayinskyj-dron-kamikadze-grim-projshov-lotni-vyprobuvannya/?utm accessed 25 May 2025.

Leicester John, ‘Tried and tested in war: For European drone manufacturers, Ukraine is the place to be’ Associated Press (online, 19 June 2025) https://apnews.com/article/5ff2ac41e931538258ede7b39571ef3f accessed 23 June 2025.

Lovells Hogan, 'Rising to New Challenges – The EU’s Legal Framework for Widespread Commercial Drone Operations' (1 April 2022) https://www.hoganlovells.com/en/publications/rising-to-new-challenges-the-eus-legal-framework-for-widespread-commercial-drone-operations accessed 31 May 2025.

Mamka Hryhoriy (Мамка Григорій), ‘Drones During the War: Legislative Regulation and Liability for Airspace Violations’ [‘Безпілотники під час війни: законодавче врегулювання та відповідальність за порушення повітряного простору’] (Business Development Fund [Фонд розвитку підприємництва], 25 June 2023) https://bdf.gov.ua/bezpilotnyky-pid-chas-viyny-zakonodavche-vrehuliuvannia-ta-vidpovidalnist-za-porushennia-povitrianoho-prostoru/ accessed 17 June 2025.

Mandourah Ammar & Hartwig Hochmair, ‘Analyzing the violation of drone regulations in three VGI drone portals across the US, the UK, and France’ (2024) 27 Geo-spatial Information Science 364 https://doi.org/10.1080/10095020.2022.2072240.

Markiewicz Marek T, ‘The Legal and Organizational Aspects of Crisis Management in the Single European Sky’ (2023) 9(2) Safety & Defense 54 https://doi.org/10.37105/sd.202.

Mihelič Pika and Pozderec Franc, 'The Use of Unmanned Aircraft Systems for State Operations in the Republic of Slovenia: Between Legal Confines and Technological Progress' (2023) 2(26) *International Scientific Journal European Perspectives* 29 https://www.ceeol.com/search/viewpdf?id=1357653 accessed 1 June 2025.

Pagallo Ugo, Bassi Eleonora and Durante Massimo, ‘The Normative Challenges of AI in Outer Space: Law, Ethics, and the Realignment of Terrestrial Standards’ (2023) 36 Philosophy & Technology 23 https://doi.org/10.1007/s13347-023-00626-7 accessed 19 June 2025.

President of Ukraine, 'I Signed a Decree Initiating the Establishment of a Separate Branch of Forces – the Unmanned Systems Forces' (6 February 2024) https://www.president.gov.ua/en/news/pidpisav-ukaz-yakij-rozpochinaye-stvorennya-okremogo-rodu-si-88817 accessed 1 June 2025.

Samoilenko Vadym, 'Drone Regulations in Ukraine' (L2b Aviation, 10 October 2019) https://www.asterslaw.com/press_center/publications/drone_regulations_in_ukraine/ accessed 17 June 2025.

Spesivtseva Olena, 'Use of Drones During Wartime: Advice for Civilians [Використання дронів під час воєнного часу: поради для цивільних]' (Centre for Democracy and Rule of Law, 15 November 2022) https://cedem.org.ua/consultations/vykorystannya-droniv/ accessed 1 June 2025.

Struck Julia, ‘Ukrainians Deploy Heavy Vampire Drones to Transport Robot Dogs to Frontlines’ (Kyiv Post, 25 September 2024) https://www.kyivpost.com accessed 23 May 2025.

Velykyi Bohdan, 'What Was the Year 2023 for Ukrainian Business? The Results of the DroneUA Group' (DroneUA, 29 December 2023) https://drone.ua/en/blogs/news/what-was-the-year-2023-for-ukrainian-business-the-results-of-the-droneua-group?utm_ accessed 16 June 2025.

Wild Hornets, 'FPV Drones. Ukrainian UAV Manufacturer, Wild Hornets' https://wildhornets.com/en/ accessed 25 May 2025.

World Health Organization, 'How much does environmental noise affect our health? WHO updates methods to assess health risks' (WHO, 4 August 2024) https://www.who.int/europe/news/item/04-08-2024-how-much-does-environmental-noise-affect-our-health--who-updates-methods-to-assess-health-risks accessed 14 June 2025.

Yavtushenko Oleksandr, 'Drone and Technology Warfare: How Ukraine is Changing the Rules of War', The Ukrainian Review (online, 21 March 2025) https://theukrainianreview.info/drone-and-technology-warfare-how-ukraine-is-changing-the-rules-of-war accessed 18 June 2025.

Yedavalli P and Mooberry J, An Assessment of Public Perception of Urban Air Mobility (UAM) (Airbus UTM: Defining Future Skies 2019) https://www.airbus.com/sites/g/files/jlcbta136/files/2022-07/Airbus-UTM-public-perception-study%20-urban-air-mobility.pdf accessed 14 June 2025.

Zoria Yuri, ‘Ukrainian Drone Maker Ukrspecsystems Expands Internationally with Polish Representation Deal’ (Euromaidan Press, 3 September 2024) https://euromaidanpress.com/2024/09/03/ukrainian-drone-maker-ukrspecsystems-expands-internationally-with-polish-representation-deal/ accessed 25 May 2025.

Cases

United States v Causby 328 US 256 (1946) https://supreme.justia.com/cases/federal/us/328/256/.

Case C-212/13 *Ryneš v Úřad pro ochranu osobních údajů* EU:C:2014:2428, Judgment of the Court (11 December 2014).

Conseil d'État, ordonnance n° 440442, 440445 du 18 mai 2020, Association La Quadrature du Net et Ligue des droits de l'homme, ECLI:FR:CEORD:2020:440442.20200518, https://gdprhub.eu/index.php?title=CE_-_440442_%26_440445.

Conseil d'État, ord., 18 May 2020, req. Nos 440442 & 440445, La Quadrature du Net and Ligue des droits de l'homme, ECLI:FR:CEORD:2020:440442.20200518, https://www.conseil-etat.fr/fr/arianeweb/CE/decision/2020-05-18/440442.

Hellenic Data Protection Authority, Decision No 13/2024, Own-initiative investigation into the development and installation of the “Centaur” and “Hyperion” programmes by the Ministry of Migration and Asylum concerning the control of reception and accommodation facilities for third-country nationals (3 April 2024) https://www.dpa.gr/en/enimerwtiko/press-releases/ministry-migration-and-asylum-receives-administrative-fine-and-gdpr.