Critical Comparative Analysis of UAS Legislative Developments

Anastasia Tsotra

Dept. of Surveying and Geoinformatics Engineers, Faculty of Engineering, University of West Attica, Athens, Greece - atsotra@uniwa.gr

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Abstract

High growth and subsequent additional risks of the UAS sector have attracted the interest of various researchers and state legislation makers across the world. This article aims to review the most important, recent developments in UAS regulations of three major countries (USA, Japan, Australia) and of European Union Aviation Safety Agency (EASA). A comparative analysis and critical thinking of six (6) factors (UAS classification, Flights over people-Crowds of people, Registration systems, UAS geographical zones, Private Data-Privacy, Law Enforcement System) are conducted, in order to define areas of improvement in the fields of UAS flight risks and safety. Our studies show that although major steps have been done forward by these regulatory frameworks, there are still deficiencies that should be overcome. Finally, we advocate some proposals that could be used in the prospective legislative amendments.

1. Introduction

The widespread use of Unmanned Aircraft Systems (UAS) or drones (a usual term), in a variety of applications and areas today, along with the development of their regulatory framework that mainly determines the operation, use, and operational restrictions, show their importance in the modern era. The evolution of the regulatory framework for UAS at a global level has been continuous and dynamic, and has been adapted to the technological requirements and innovations that have emerged. From Article 8 of the Chicago Convention that refers to the "pilotless aircraft" concept in 2003 and the regulatory provision that enforces authorization of the overflight of unmanned aircraft over a territory, to this day, where UAS regulatory frameworks have been developed, and continue to be developed around the world, at a national or multinational (European Union Aviation Safety Agency - EASA) level, UAS have come a long way. Without doubt, it seems to have even a long way to go (Hodgkinson, Johnston, 2018).

According to Kohler (2016), the US market for UAS is rapidly growing, and is expected to reach $92 billion by 2030. What is more, 100,000 new jobs will have been created by 2025. Federal Aviation Administration (FAA) first dealt with UAS in 1981, when it issued Advisory Circular 91-57. Since then and until 2000, the FAA's focus on unmanned aircraft has not been particularly strong. However, in the year 2000, fast-paced technological advancements in unmanned aircraft prompted the issuance of a new policy (AFS-400 05-01) on UAS. This policy set safety standards for UAS flights in US airspace, in order to minimize the risks of a collision with manned aircraft (Kohler, 2016).

In the EU area, the former Basic Regulation of the EASA, (EU) 216/2008, authorized the European Agency to set the regulatory framework only for UAS that weight more than 150 kgs, and actually followed the regulatory framework of manned aircraft.

Each EASA Member State adopted its own national regulations on UAS weighing less than 150 kg, and issued certificates and licenses, pursuant to the national UAS regulatory framework (if any), which were not recognized in other Member States. Furthermore, many Member States kept their own registration systems, and set their own conditions for UAS to be registered in them. Consequently, the EU market was fragmented, and UAS operations could not be carried out from one EASA country to another.

With the adoption of the new Basic Regulation (EU) 1139/2018 on "introducing common rules in the field of civil aviation and establishing the European Union Aviation Safety Agency", EASA has now been given the opportunity to introduce regulations on UAS weighing less than 150 kg, too. As a result of the adoption of a single regulatory framework for UAS to be phased in from 2020, it was set as an objective to develop a risk-based regulatory framework for all UAS operations across the EU. So far, seven UAS regulations have been introduced and adopted (https://www.easa.europa.eu/en/domains/drones).

The regulatory frameworks for the UAS flights are therefore under ongoing review, since they need to meet new technological requirements, fill emerging gaps in flight safety issues and reassure citizens who believe that these frameworks may serve as tools to violate their privacy and insult their personal data.

In this study, we conduct a qualitative research, which is based on regulations, laws, and published researches. More specifically, a critical comparative analysis of the most recent developments in UAS regulations takes place, which were introduced in the largest countries (or unions of countries) of four continents (USA in America, EASA in Europe, Australia in Oceania, and Japan in Asia), in terms of six (6) factors of these frameworks (UAS classification, flights over people-assemblies of people, UAS registration systems, UAS traffic zones, privacy and personal data, and implementation of a regulatory framework) (Kröger, 2021).

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These factors were detected using the heuristic method. Experience of the researcher was the main instrument to understand the fundamental legislative topics, by comparing the latest UAS regulations of the above mentioned countries (Brisola & Cury 2016).

As these regulations at the global level stand major modifications the recent years, our research makes a comparison of the directions of these modifications and suggests corrective actions, in order to ensure the safety of unmanned aviation. The aim is to point out any similarities and differences, as well as good practices, which could be adopted by other countries and implementation gaps that have been identified, which will make necessary to amend the existing regulatory frameworks.

2. Background

As it can be seen from reviews of the existing literature, in recent years, and especially after 2019, international researches have been conducted to compare the regulatory frameworks between USA and EASA countries. Ilker (2016) examines the US regulatory framework considering its weak points, long before its implemented amendments up to 2023, proposing the adoption of a risk-based US Regulation. In 2017, the survey of Stöcker, Bennett, Nex, Gerke, and Zevenbergen is conducted on the UAS regulatory frameworks of nineteen (19) countries, in terms of six (6) key criteria, indicating that risk minimization is the main goal of all the regulations.

The survey of Tsiamis, Efthymiou & Tsagarakis (2019) reviews the UAS regulatory frameworks of the thirty-five (35) countries, as members of the Organization for Economic Cooperation and Development (OECD), against fourteen (14) criteria, illustrating similarities, differences and the need for an homogenous framework.

The new regulatory framework of EASA and the wave of changes that it creates(including the relevant documentation), are examined by Alamouri, Lampert, & Gerke (2021). In the survey of Lee, Hess, & Heldeweg (2022), a comparison takes place between the regulatory frameworks of the US, Japan, and the European Union, with emphasis placed on the regulatory arrangement of privacy and flight safety issues. That same year, a research by Škultéty, Šajbanová, Janovec, & Rostáš compares the US and the UK regulatory frameworks, with the emphasis on the use of UAS airspace and the risk of such use.

Through this article, a broad review of all the latest developments in the regulatory frameworks of USA, EASA, Australia and Japan is carried out, regarding aspects that have not been studied so far. On top of that, there is a critical consideration of gray areas in these regulations, some of which have been examined, while others have not, in other surveys, in order to come to conclusions and make useful proposals.

The review was focused mostly on researches about UAS legal framework, conducted from 2016 to date and have been published on Google Scholar. Our research is focused on analysis and critical consideration of the most recent UAS regulations, as presented on the official websites of the national UAS enforcement bodies of these countries.

3. Findings

3.1. Analysis of UAS regulatory frameworks in terms of six (6) factors

3.1.1. Drones classification – Criteria and rules for their operation

According to FAA, the classification of UAS in the USA is based on: **a)the maximum take-off weight of the drones, b) their kinetic energy, and c) their permitted level of operation.** Category 1 (less than 0.55 lbs = 455 grams) can fly over people; Category 2 (more than 0.55 lbs=455 grams), which, in the event of an impact, can transfer kinetic energy to a human that is less than 14.9 joules; Category 3 (between 55 lbs and 1,320 lbs), with operation below 18,000 feet above mean sea level; Category 4 (more than 1,320 lbs, but with operation below 18,000 feet); and Category 5 (more than 1,320 lbs, but above 18,000 feet).

In the case of the FAA, there are five categories **based on three categorization criteria, but the maximum take-off weight always being the key criterion.**

UA category	Maximum Takeoff Weight (lbs)	Normal Operating Altitude (ft)	Speed (kts indicated airspeed)
Group 1	0–20	<1200 AGL[1]	100kts
Group 2	21-55	<3500AGL	<250
Group 3	<1320	<18000MS[2]	<250
Group 4	>1320	<18000MSL	any
Group 5	>1320	>18000MSL	any

Table 1: FAA classification of UAS

In addition, FAA follows another categorization, distinguishing between recreational flyers and commercial operators. Recreational flyers follow safety guidelines, while commercial operators should adhere to Part 107 of the federal aviation framework (https://www.faa.gov/uas).

When it comes to the EASA in the EU, there are **three categories (open, specific, certified)**, with various criteria for distinguishing between them, but **the main categorization is based on the level of risk and its mitigation potential**. Thus, risk is correlated to maximum take-off mass, flights over people and assemblies of people, the visual line of sight, the altitude above or below 400 feet, and finally, the carriage of hazardous materials or passengers.

[1] AGL: Above ground level

[2] MSL : mean sea level

Maximum Take off mass (kg)	Open Subcategory
<250 g	A1
<900 g	Not over assemblies of persons
<4 kg	A2 Fly close to people
<25 kg	A3 Fly far from people

Table 2: Subcategories of the open category according to EASA

The operation of flights with an increasing risk in EU requires that a) the UAS operator/pilot in the EU has been granted the appropriate licence, b) he/she knows the undertaking level of risk and c) he/she can prove to the competent authority that he/can can take all the appropriate measures to mitigate that risk. This may mean that he/she has hired the right staff and developed the appropriate procedures to ensure the flight safety. Alternatively, he/she may declare to the competent authority that he/she follows a standard scenario (from the standard scenarios that have been published by EASA) and has taken the appropriate actions, with the aim to the safety, as well (https:// www.easa.europa.eu /en/domains/civildrones).

In Australia, drones are categorized **into five categories**: micro (less than 250 grams), very small (between 250 and 2 kg), small (between 2 and 25 kg), medium (between 25 and 150 kg) and finally, large (more than 150 kg). This distinction was made according to the criterion of **maximum take-off weight,** while taking into account **the type and method of operation** that defines the certifications or/and authorizations required (https://www.drones.gov.au/).

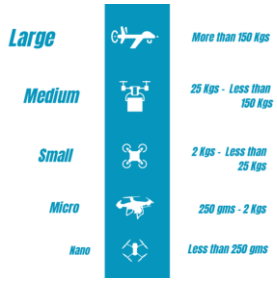

Table 3: Australian drones classification(source:CASA[3])

The classification of drones in Japan is based on **criteria that are referred to the way an UAS is controlled (from manual to automated), visual contact of the pilot (from VLOS to BVLOS) and area of operation (from uninhabited to densely populated areas).** Therefore, there are the following categories: **Level 1 (manual control and VLOS); Level 2 (automated control and VLOS); Level 3 (BVLOS over an uninhabited area); and Level 4 (BVLOS over a densely populated area)** (https://www.mlit.go.jp/en/koku/uas.html).

[3] Civil Aviation Safety Authority

3.1.2. Flights over uninvolved people - assemblies of people

According to FAA, flights over people are distinguished according to the undertaking risk. More specifically, it proceeds with the following categorization:

- As it has been mentioned in the previous paragraph, Category 1 refers to micro UAS (less than 0.55 lbs=250 grams) that are allowed to fly over people. However, they are not allowed to fly over assemblies of people, unless they can transmit identification information that can be tracked by the FAA and other authorities.
- Categories 2 and 3 may fly over people, provided that they follow their operational restrictions. On the other hand, Category 2 may fly over assemblies of people, as long as they can transmit identification information, while Category 3 may not operate such flights.
- Category 4 may operate flights over people, if they hold a FAA part 21 certificate of airworthiness, and may fly over assemblies of people, when transmitting identification information.
- In any case, a drone operator may request a waiver from the FAA according to part 107, and, if they get it, operate flights over people or assemblies of people.

According to the EU Regulations, UAS – private built of less than 250 grams or open-category with C0 or C1 compliance labels, can fly without restriction over uninvolved people or assemblies of people. Drones with a C2 compliance label, fly at a specific horizontal or vertical distance from people. Drones with a C3 or C4 label must fly 150 meters away from urban publics and at least 30 meters from assemblies of people. In general, operators of drones with a C3, C4, C5, or C6 label must ensure that there are not any uninvolved people in their flights. The same categorizations exist for drones according to the British CAA, as well.

In Australia, the flights of drones over people, and more so, over beaches, parks, events, or/and sports meetings, etc. are strictly prohibited. These prohibitions can be overcome by applying for an exemption to the Australian CASA. More precisely, insurance, drone registration, training, etc. are required. Carrying out such flights without the CASA's authorization can impose severe penalties and fines. It is characteristic that the penalties also apply to illegal flights with ecological implications, such as over protected parks and forests.

Similar rules also apply to Japan, where flights over assemblies of people, as well as over events (e.g. sports events), are prohibited. Special exemption can be granted here, as well, by applying to the Japanese Ministry of Land, Transport, and Infrastructure.

3.1.3. UAS registration systems – Conditions and usefulness

According to the FAA regulations, drones should not be registered only if their weight is equal to or less than 0.55 pounds(=250 grams) and fly for recreational purposes. The drones that must be registered, are required to transmit remote identification information.

According to the new EASA Regulations, drones are not registered. Only operators (who can be owners or pilots) are registered, and for one time, regardless of the number of drones that they operate. There is no need for operators to register, if they operate a drone weighing less than 250 grams or if it has a camera or other sensor or if it is a toy. The only case that a drone has to be registered is when it holds a certificate of airworthiness.

In Japan, all drones weighing more than 100 grams must be registered, for being allowed to fly. They must be given a registration ID that must be affixed to the drone. In Australia, drones are registered in case they fly for business purposes or as part of a job. UAS that fly for recreational purposes do not have to be registered.

3.1.4. Air traffic – UAS flight zones

FAA has developed a B4UFLY safety app for recreational UAS flyers that provides real-time information on flight areas of the US, through the GPS of users' mobile phone. There are also designated areas for recreational flyers. Besides, there are designated geographic areas (FRIA, i.e. FAA-Recognized Identification Areas), where drones can fly without carrying equipment to provide identification information that can be recognized remotely. Finally, FAA provides a digital toolkit, through which, drone operators know which restricted flight areas are.

On the other hand, when it comes to commercial operators, FAA has developed the Low Altitude Authorization and Notification Capability (LAANC), and relies on cooperation between the FAA and the private sector. It is an exchange of airspace data between the FAA and FAA-approved companies for providing LAANC information.

Pursuant to the new EU Regulations, each EASA Member State issues maps designating geographic zones where UAS may not be flown, or where pre-flight clearance is required. For the convenience of operators, there are mobile apps that determine where these zones are located. The Member State designates the providers of services for drones (these services include flight authorizations, geo-fencing, weather and traffic information, etc.). Thus, there are: a) excluded geographic zones, where UAS may not be flown, b) restricted geographic zones (pre-flight clearance), c) facilitated zones (open-category areas), and d) the U-Space airspace, where UAS flights are operated under air traffic management.

In Australia, there are additional safety apps for drones that have been approved by the Australian CASA, where, for a price, they provide information on areas where UAS may fly, or not. The areas where drones may not fly (such as airports, prisons, infrastructures, etc.), along with the fines imposed in case of trespassing them, are listed on the digital map of the Australian CASA.

In Japan, exemptions for flights over unauthorized areas are granted to operators by the Ministry of Land, Transport, and Infrastructure. These are mostly around airports, airspace above 150 meters, and finally, densely populated areas.

3.1.5. Personal data - Privacy and UAS – Insurance obligations

The EASA requires third-party liability insurance, when a drone weighs more than 20 kg. Most Member States, however, require insurance even for smaller drones.

In general, flying with an open-category UAS is prohibited over uninvolved people, for reasons of privacy and personal data protection. The only subcategory of the open category, in which, it is allowed to fly close to people, is A2 (in any case, at a horizontal distance of not less than 30 meters).

The protection of privacy is, of course, ensured by the mandatory registration of the operators in the national system of each EASA Member State, as well as by the regulatory requirement for operators to affix their unique identification number to their UAS. In general, the Personal Data Protection Act requires the minimum collection of personal data (as it is necessary), and the subjects' consent to the processing of their personal data.

In the US, the obligation to protect personal data and privacy requires drones to get a Remote ID, so that they can transmit information for tracking them via decryption standards, while compliance protocols ensure that drone operators respect privacy and personal data. By contrast, FAA has not made third-party liability insurance for drones mandatory for all the drones.

In Japan, drone flights (for drones weighing more than 100 grams), even for recreational purposes, are required to have Remote ID equipment to monitor flight safety, but more importantly, to protect personal data. However, drone insurance is not mandatory, but it is recommended to all operators.

In Australia, part 3 of the Privacy Act 1988 states that the operators of drones for recreational purposes shall not publish or distribute personal data, obtained with their drones without the prior consent of the subjects. Regarding insurance, it is mandatory for drone operators to have third party liability insurance, insure the UAS itself, and insure personal data protection and privacy violation related risks.

3.1.6 Implementation of UAS regulations - penalties/fines

In the USA, FAA sends out the "Notice of Proposed Civil Penalty" with the proposed penalty to the summoned party. Both the summoned party and their legal counsel (if requested) reaches an agreement with FAA on the final fine. The highest fine that has been imposed by the FAA on drones is $1.9 million. FAA may also proceed with suspension or revocation of a license, a certificate, etc.

According to EASA, each Member State may introduce and implement its own penalties/fines system for breaching the EU regulations that are mandatory to apply. Hence, Greece, in accordance with its National Regulation that was in force prior to the implementation of the EU regulations, has set out penalties and fines. Following violation of drone regulations, HCAA may impose the fines of par. 1, article 153 of the Aviation Law Code (ranging from 500 to 250,000 euros). Furthermore, in repeated violations, it may suspend or revoke any licenses and certificates. Finally, it is stipulated that administrative penalties do not waive criminal liability.

In Japan, violating drone regulations can result in fines of up to 3,000 euros. A drone operator under the influence of alcohol or drugs may be sent to prison for one year or/and get a fine of up to 2,000 euros.

In Australia, a fine of up to $1,500 can be imposed in each event. In this case, as well, the CASA may suspend or revoke licenses,

certificates, etc. In the event that a drone poses a risk to another aircraft (manned or unmanned), a fine of up to $37,900 or imprisonment of up to two (2) years may be imposed.

3.2. Critical consideration of regulatory frameworks for UAS in terms of specific factors

a. The risk level remains the common denominator of all the criteria for categorizing UAS in various countries around the world. Risk can be expressed as take-off weight or kinetic energy or area of operation or drone control automation level. All UAS flight regulations have the main objective of ensuring flight safety, so that UAS flights are operated in the most efficient and safest way.

The previous regulations, mostly at national level, proceeded to categorizations based on the maximum take-off weight, type of use, altitude and flight area, technical capabilities of the UAS or the complexity of the operating environment. Out of all of these criteria, the flight type (recreational or commercial) no longer seems to play a dominant role in recent regulatory amendments.

Therefore, FAA regulations rather wrongly link the type of use to the risk level of the operated flight. In specific, a distinction is made between recreational flyers and commercial operators. As stated on the FAA website on drones, whether there is compensation or not, is not a criterion for this distinction (e.g. one can fly on behalf of a non-profit organization without compensation; however, this is considered as a commercial flight).

This distinction causes problems for two reasons. Firstly, it is highly possible for UAS to be used for both professional – commercial and recreational purposes. The concept of a professional and/or commercial purpose is quite difficult to define, since FAA does not use the objective parameter of payment or non-payment of compensation. Secondly, the type of use cannot be linked to the level of risk that it poses. The flight safety risk of drones is the same, regardless of whether a flight is commercial or recreational.

On the contrary, EASA, by categorizing them into three categories (open, specific, certified), has actually distinguished among various risk levels, and has made this distinction easier for the public to understand, along with the rights and obligations of drone operators arising from it.

Similar to the categorization of drones in the US, is the categorization in Australia, which takes into account the maximum take-off weight and type of operation. On the contrary, Japan distinguishes various categories depending on the automation level of the drone and its area of operation, taking into the consideration the issue of risk taken during a UAS flight, but from a different perspective.

Flight with visual contact (Visual line of sight-VLOS) is a condition that has been set in all regulatory frameworks as a way to ensure safety, reckoning that, in this way, a human eye ensures safe flights and avoidance of air traffic disruption. In any case, emphasis should be placed on the limited scope of human control (through vision), and the current possibility of using, for example, a camera with strong technical features (not ignoring the issue of privacy though). It is argued that flights beyond the visual line of sight (BVLOS) can be much safer than flights with visual line of sight (VLOS) (Calandrillo, & Webb, 2020).

b. While there are apparently strong similarities between the two regulatory frameworks (the FAA's and the EASA's) on flights over uninvolved, non-participating people, this is not the case for flights over assemblies of people. Regarding open-category UAS in Europe, even if they have remote identification devices, they are not allowed to fly over assemblies of people. In contrast, in the USA, RI devices are a requirement for such flights to take place in US airspace.

Australia's regulations prohibit flights over beaches, parks, events, or sports games, while no flights are allowed over people or assemblies of people. Even the smallest drones (the category weighing less than 100 grams) must be flown 30 meters in each direction from people. Authorization for violating the restriction of 30 meters can only be obtained from the Australian CASA. Similar laws are also in force in Japan, where UAS flights over densely populated areas and assemblies of people are not allowed, without permission from the competent authority.

Although US drone regulations have been criticized for following a bureaucratic logic, it is generally believed that, after the latest changes (in 2023), FAA has shifted to a more “open” policy. Furthermore, since March 2024, it has taken a step closer to harmonizing with EU regulations, making the remote identification device mandatory in the USA, as well. Within EASA, from 01/01/2024, all open-category drones flying over the EU area must have Remote Identification (RI) devices. At this point, both the EU authority and the US authority have taken a step forward to enhance flight safety, implement and monitor regulations by imposing penalties and fines. However, this date seems to be constantly postponed, at least for FAA, since there are issues with the adequacy of broadcast modules in the market or the readiness of FAA, as a competent authority to perform the necessary checks.

c. It is too early to draw conclusions on the registration of operators, rather than UAS, on the European continent (as it has been reported, relevant regulations entered into force in 2020). The transition from drones to operators was quite difficult, and caused confusion to operators, since they could not understand why their new drone should no longer be registered. So far, it has been difficult to determine whether a drone carries its operator's unique ID. And even more so, without the number affixed, it cannot be ascertained to whom the drone belongs, and whether it holds the statutory licenses or flies within the designated operational restrictions.

It is important to mention that, normally, after a collision or fall, it is almost impossible to read the unique registration number on the drone, and identify the drone pilot. Therefore, the countries' registration systems may not provide the information for which they were developed. On the other hand, in this case, remote access systems (if available on drones) are highly effective.

Moreover, operators who want to use their drones e.g. for terrorist purposes, are not expected to register them in the official system of each country. Another important aspect that can increase the limited usefulness of registration is the availability of geofencing on drones, that prevents their entry into unauthorized areas and altitudes (Calandrillo, & Webb, 2020).

d. Creating geographic zones in the airspace of EASA Member States (the so-called U-Space) has as its goal the future integration of the entire airspace, where UAS are either allowed

Legislation factors	PROS	CONS
a. UAS Classification	-According to the level of risk (EU)	-According to the type of the flight or of the operator/flyer(US-Au) -Human visual control (VLOS) (US-EU)
b. Flights over persons/assemblies of persons	-Permitted in case of RI possession (US) - RI possession is mandatory (US-EU)	-Not permitted even in case of RI possession (EU) -Not readiness of the Rem.Identif.industry (US) -Not readiness of the UAS Enforcement Authority to commit inspections over RI function (US)
c.Registration Systems	-Registration of drones (US-Au-J) -Registration of operators (EU)	-Difficult to identify ID in case of UAS destruction (EU-US-Au-J) - Difficult to identify malicious UAS pilots without registration(EU-US-Au-J)
d.UAS Geographical Zones	-Certification of UAS Service Providers (US)	- No willingness to certificate UAS Service Providers (EU) - Geofencing not mandatory (EU-UAS)
e.Private Data-Privacy	-Mandatory ID (US-EU) -Mandatory RE(US-EU)	-Free Flights in neighbourhood (US) -Hacking of registrations systems(US-EU-Au-J)
f. Law enforcement System		-Not homogenous (EU) - Segmented (EU) -Multi-legislations (EU)

Table 4: Critical Comparative Anaslysis of UAS Legislations in terms of six (6) factors in four regions (US, EU, Au, J)

or prohibited to fly. More specifically, at a later stage, it aims at providing certification for UAS air traffic service providers, according to FAA standards (the American authority has already certified these providers). The integrated system (U-Space) has the ultimate goal of creating a safe air navigation environment for both manned and unmanned aircraft, and is expected to be completed by 2025.

Nevertheless, a large number of Member States are reluctant to proceed with the completion of this system in their airspace, and that could be caused by the European Union' decision that the commercial companies and not the government agencies, offer these services (EU Monitor, 2021).

The US have a strict air traffic policy on UAS, since they believe that it contributes to flight safety, and more importantly, to safety against terrorist attacks. Thus, there are "No drone zones", in which airspace areas, drones are not allowed to fly.

The ban on flying drones near airports is a safety mechanism, since it is believed that there is a risk of collision with manned aircraft or obstruction of their air traffic, which results in delays for these flights (Calandrillo, & Webb, 2020).

Flight delays became a serious incident on the 19th and the 20th of December 2018, at London Gatwick Airport, when drones were spotted on an airport runway. This incident affected 1,000 flights and 140,000 passengers (Incident at Gatwick Airport, 2018).

e. The presence of a unique registration number that is affixed to the drones according to the US system, or of the operator according to the system in the EASA Member States, is the main way of protecting privacy, since the authorities that are competent for the implementation of drone regulations, can promptly identify the violators and proceed with imposing the statutory penalties. The remote access system, which is mandatory in both the EU and the USA, will also contribute to this.

The US Civil Code (Section 1708.8) prohibits UAS from recording videos or audio, without the consent of the participants. However, it is legal to fly a drone in your neighborhood (VLS and below 400 feet).

The FAA's federal regulatory framework does not restrict flights over inhabited areas. Therefore, an operator can fly their drone with visual contact, and up to 400 feet, in an inhabited area, without any problem. This can cause privacy and personal data violation issues. Such prohibitions exist at a state level in USA, e.g. in California or New York (Calandrillo, & Webb, 2020).

On the other hand, flying a drone freely in a neighborhood is not something that is accepted by EU drone regulations. On the contrary, the Personal Data Protection Act is the same for all EASA countries, which have a common safety net against illegal drone flights that violate the privacy and safety of EU citizens.

Finally, the possibility of registering recreational flyers/commercial operators of drones from the age of 13 in the US, and 16 (or younger) in EASA countries, is a sensitive issue. The IT system for their registration can always be "hacked" or personal data of minors can be publicly disclosed.

f. Not only administrative penalties (fines, revocation of licenses, etc.), but also criminal penalties with hefty fines and imprisonment are stipulated for those who fail to register their drones in the US registration system. It is therefore a rigorous system that imposes penalties to violators; at the same time, however, the mandatory system of remote access will now help authorities to be able to identify violators.

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In the EU, as it has been reported, the system is not integrated, so penalties and fines vary by Member State, and arresting violators is particularly difficult. Since the system is fragmented, with different fines that apply (from very low to very high), it cannot be considered effective or even dissuasive. It is extremely difficult to identify an illegal operator who was illegally flying their drone, that was destroyed and caused damage, for example.

From 2019 to date, EASA has adopted seven regulations on UAS, several of which have already amended existing ones (as the postponement of the entry of provisions into force, due to the health crisis). Therefore, it can be argued that it is a labyrinthine regulatory framework, which makes it difficult even for field experts to understand. This applies even more to commercial operators, who need to understand the various licenses that they must obtain, or the areas where they are allowed to fly. This multiplicity of laws with continuous amendments, may be caused by non-readiness of the relevant industry to meet the requirements of the new legislation (e.g. compliance with CE marking, RI systems).

4. Discussion

With the adoption of the strong points of the regulatory frameworks, we may pose proposals to formulate an optimum framework, as follows:

- Development of a holistic approach in an equal way, to address UAS-related risks both for commercial operators-recreational flyers and other stakeholders and the authorities involved in establishing it
- Disassociation of flight safety risks, with the type of flight (i.e. whether it is conducted for recreational or commercial purposes)
- Change of the culture of print and online press and the mindset of people influencing public opinion, as well as development of aviation literacy to foster a positive attitude towards UAS
- National (or EU) Privacy and Personal Data Regulations need to be adapted to the new landscape for UAS. At the same time, the authorities must inform the public in advance for the purpose of collecting personal data in the operation of UAS. On the other hand, lawmakers need to develop transparent procedures for collecting such data, storing them in securing software, and destroying them, when they are no longer needed (Ninkov & Mester, 2020).
- Consolidation and homogenization of standard regulatory compliance measures to make them effective.
- Distinction between, as well as coexistence of unmanned and manned aircraft in the airspace, stronger involvement of air traffic authorities in handling them. Mandatory geofencing and remote access systems.
- Simplification of a labyrinthine and bureaucratic legislative framework that makes implementation by authorities and application by stakeholders almost impossible, whereas technological advancement and innovation are hindered.

5. Conclusions

The use of UAS for military – warfare purposes has created, and keeps on creating, a negative image of the operation of UAS, as they have inevitably been associated with military operations, or suicide attacks in peacetime. However, it is in no way possible to ignore the rapidly expanding UAS industry, with a growing variety of applications, and even their operation for humanitarian purposes, citing as an example the rescue of people in emergencies or the protection of forest resources from fire. In many cases, their operation means saving resources (financial, human, etc.) for private and public organization, while manned flights could not be operated (due to lack of landing fields or due to their location in dangerous areas, etc.).

In this article, the author has elaborated on the latest US, European Union, Japanese, and Australian regulatory frameworks in terms of specific factors, taking a critical look and pointing out gaps and room for improvement. Without doubt, it should be stressed that the new EU regulatory framework, as well as the new amended US regulatory framework go a long way towards UAS legislation, always aiming at flight safety and protecting the public. Moreover, both Japan and Australia have taken major steps in this area. Further research can be conducted on the effectiveness of these new regulations in both the US and the European Union. This effectiveness can be measured by an increase in the numbers of registered UAS or their operators (according to the EASA) or in the number of UAS authorizations or in the number of violations recorded and enforced actions of the relevant regulations.

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