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Article · January 2020

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A Harmonized European Drone Market? – New EU Rules on Unmanned Aircraft Systems

Anna Konert*, Tadeusz Dunin

¹Faculty of Law and Administration, Łazarski University, Warsaw 02-662, Poland

ARTICLE INFO

Article history:

Received: 17 February, 2020

Accepted: 10 April, 2020

Online: 03 May, 2020

Keywords:

Air law

BVLOS operations

Drones

EU law

European Union drone market

Polish law

UAS

UAV

Unmanned aircraft systems

VLOS operations

ABSTRACT

The European drone market has been showing steady growth year after year. New EU drone rules will come into force as of July 1st, 2020, with the European Union setting itself the target to replace national rules with a common regulation with the ultimate goal of creating a harmonized European drone market. This study will clarify that the EU's regulatory framework covers all types of existing and future drone operations, creating an international market for unmanned aircraft services. This move will facilitate the enforcement of citizen's privacy rights and address security issues and environmental concerns to the benefit of the EU citizens. Moreover, this study will show that national legislators are now faced with the difficult task of replacing their national regulations with EU rules, however these were drafted so fast that they still leave a number of issues to be decided on by national legislators. The method of this study comprised of content analysis of existing legislation. The current doctrine were confronted with existing regulations, documents, and materials.

1. Introduction

The UAV and UAS markets have been showing steady, increasing growth year after year in Europe. Some of the world's top drone service providers are based here, and their results are proof of continuous and considerable market growth [1]. Some forecasts predict that the European drone market will more than double in size between the years 2018 and 2024 [2]. Others predict that revenues generated from commercial drone use in Europe will grow from USD 251 million in 2020 to USD 3 billion in 2025 [3]. Different estimates see the region's drone market bringing in EUR 10 billion annually by 2035, and over EUR 15 billion annually by 2050 [4], with countries like Germany, France and the UK representing the lion's share of this total mainly due to their regulatory structure and the sheer size of their economies.

This predicted growth will most likely stem from an increase in popularity in commercial drone usage in many areas. According to SESAR (Single European Sky ATM Research), there are presently around 10,000 commercial UAV's in use in Europe – with forecasts for this number to rise to 200,000 in 2025, and up to 395,000 in 2035.

The non-military use of drones is already significant and extensive, spreading to areas never before though possible just a decade or so ago. UAVs are presently being used by the media (TV), in law enforcement and policing activities, in border patrols, for agricultural and environmental monitoring, by fire services, for power line surveying, aerial photography, and in security management systems (mostly in autonomous and semi-autonomous locomotion). For practical applications of UAVs in security management systems, please see “A Cyber-Vigilance System for Anti-Terrorist Drives Based on an Unmanned Aerial Vehicular Networking Signal Jammer for Specific Territorial Security” [5], “Design and implementation of a cyber-vigilance system for anti-terrorist drives based on an unmanned aerial vehicular networking signal jammer for specific territorial security” [6], “An Aerial Landmine Detection System with Dynamic Path and Explosion Mode Identification Features” [7]. Moreover, SESAR predicts that the application of UAVs will be more diverse as we move forward, with rising numbers of drones employed in the energy sector, public safety and security, mobility and transport, the media, insurance, e-commerce and delivery, real estate, academic research, telecommunications, and mining and construction [8].

*Corresponding Author: Anna Konert, a.konert@lazarski.edu.pl

It is no surprise that authorities across the Old Continent are scrambling to make Europe a powerhouse in terms of unmanned aerial business and a global first with regards to the mainstream and commercial use of UAVs. Take, for example, the U-Space initiative and its goal to implement a future air traffic management system that is open to and even capable of monitoring and directing drones (UAS Traffic Management, UTM [9]. Ambitious as this may sound, such initiatives get the ball rolling for a future that is integrated with unmanned vehicles.

As with every new technology, unmanned aircraft vehicles or systems possess their own regulatory and legal constraints. However, the main legal issue is of a regulatory nature, as the central aim of aviation regulations is to provide an adequate level of safety. In the case of UAVs, regulations aim to protect third parties on the ground and in the air, as there are no crew or passengers on board.

In order to enable the safe operation of remotely-controlled aircraft, or their operation by automated flight control systems, it is essential to develop detailed solutions for a number of technical and operational aspects.

This includes but is not limited to the following issues:

- airworthiness standards for UAV and UAS elements,
- data transmission standards for remote pilot stations, including protection against unauthorized interference etc.,
- collision avoidance systems, including motion and obstacle detection,
- emergency systems (e.g. loss of communications),
- unmanned traffic management systems,
- operator competences and training [10].

Drafting regulations that would enable the safe operation and development of unmanned aviation is no easy task. These need to be developed with a thorough understanding of the technology involved and with detailed knowledge of the risks that come with UAV operations. The scope of integration of UAVs with manned aviation is especially significant, as both operate within the same airspace. This is a long-term challenge for UAS, however it is co-dependent on improvements made in the field of manned aviation in the future [11].

From a regulatory point of view, the first step on the road to the integration of manned and unmanned flight is to allow for Visual Line of Sight Operations (VLOS). Most countries have already taken the appropriate steps for this by adopting or developing their national legislation to include drones, usually with weight limits up to 25 kg, in VLOS operations.

The next step forwards is for a regulator to allow Beyond Visual Line of Sight Operations (BVLOS) outside of segregated airspace or autonomous operations – which is now the case in Poland and some other EU countries.

When thinking about the European Union, it is all too convenient to think of its constituents as a single uniform marketplace. In reality, the EU is a group of drone technology markets each with their own regulations, and all of these have distinct specifications characteristic to their respective countries. Over the years, these regulations have been a barrier for the adoption of commercial drone technology across the region, with EASA (European Union Aviation Safety Agency) even claiming that they stifle business development and innovation [12]. But this is about to change with

the agency's publication of a set of common, Pan-European regulations for UAV operations [13].

This paper will analyze current regulations in Poland and new EU regulations, showing how the region's drone market will change in the nearest future.

2. EU Regulations

"Europe will be the first region in the world to have a comprehensive set of rules ensuring safe, secure and sustainable operations of drones both, for commercial and leisure activities. Common rules will help foster investment, innovation and growth in this promising sector" – Patrick Ky, Executive Director of EASA [14].

In 2014, the European Commission published a communication entitled "A new era for aviation. Opening the aviation market to the civil use of remotely piloted aircraft systems in a safe and sustainable manner" [15].

Next, a legislative process aimed at extending the EU's competences in terms of safety regulations for drones and their operations was launched in 2015. In the opinion of EU institutions, the differences that exist between national regulations of Member States hamper market growth for the entire UAS sector.

By adopting Regulation (EC) No 216/2008 of the European Parliament and of the Council on common rules in the field of civil aviation, and by establishing the European Aviation Safety Agency [16] (through the so-called Basic Regulation on EASA), the EU set out to regulate matters related to the operation of civil unmanned aircraft with an operating mass of less than 150 kg. The establishment of regulations that concern unmanned aircraft used by the military, governmental services, average citizens, those designed for experimental purposes, and all other unmanned aircraft with an operating mass of no more than 150 kg fall within the competences of EU Member States. Such a state of affairs resulted from the fact that EASA's competences were extended in 2008 with the adoption of Regulation 216/2008, however the EU did not take into consideration the then unpredictable and rapid development of the unmanned aircraft sector [17].

On September 11th, 2018, Regulation (EC) No 216/2008 was repealed with the purpose of the new regulation establishing and maintaining a high and uniform level of civil aviation safety in all Member States, including the harmonization of regulations on the use of UAVs in all EU countries. Some of the main changes that were introduced included the obligation for operators to register their UAVs online (those weighing over 250 g) and common standards for UAV certification. However, these EU regulation serve as guidelines and do not contain specific provisions on the implementation of UAV operations, which were introduced by the Commission's delegated and implementing regulations.

As of July 2020, national rules in EU Member States will be replaced by a common EU regulation. Since neither the EU Parliament nor the EU Council had any objections, both Implementing and Delegated Acts (Commission Delegated Regulation (EU) 2019/945 [18] and Commission Implementing Regulation (EU) 2019/947 [19]) were published in mid-June of last year and entered into force 20 days later. These regulations will become gradually applicable one year from their date of publication, giving Member States and UAV operators time to prepare with the transitional period being fully completed by 2022. However, UAV operators will be obliged to register in the Member

State of their residence or there where they have registered their main place of business by as early as July 2020.

The new EU regulatory framework will cover all types of existing and future drone operations, enabling operators – once authorized in their state of registration – to freely circulate between Member States.

The purpose of introducing these new regulations is to ensure the safety of UAV operations, as well as protect the privacy of EU citizens, with respect to personal data protection, and the environment while allowing free access to airspace. The new regulations establish technical and operational requirements, provisions for UAS operations and personnel (minimum requirements and operator training), including both pilots and any organizations.

While maintaining its primary aim to ensure safe UAV operations, the new pan-EU regulatory framework will facilitate the enforcement of citizens' privacy rights and address security issues and environmental concerns. As touched on earlier, these new rules include both technical and operational requirements for UAVs and their operators. They define UAV capabilities, types of operations, and label these into three broad risk-based categories. These three categories of operations are based on the levels of risk involved per UAV flight and each adopts a varied regulatory approach, with UAV flight operational limitations decreasing with the requirement for greater authorization from a Member State's national aviation authority [20].

Regulation 2019/947 presents a comprehensive system of unified legal regulations which classifies UAVs into three categories based on the risks involved in their operations, their mass, and their application:

- Open. Operations in this category do not require official permission but are subject to a number of restrictions including those on UAV weight (up to 25 kg), types of operations (only VLOS, except when an unmanned aerial vehicle observer is involved), safety requirements (through the use of product safety regulations), obligations for operator registration, and geo-fencing systems. During Open operations, an operator must maintain a safe distance from other people and cannot fly over crowds, at a height of over 120 m, and cannot transport or drop hazardous materials. Open operations are further divided into three subcategories. (Article 4 of Regulation 2019/947);
- Specific. Operations in this category require authorization from aviation authorities based on a risk analysis of the proposed operations. This authorization can either concerns a single operation or a series of operations specified by time or place. Operation authorization must contain a relevant detailed list of risk mitigation measures. (Article 5 of Regulation 2019/947).
- Certified. Operations in this carry the highest risk. This category requires drone certification under Regulation (EU) 2019/945 as well as operator certification, which may, in some cases, include obtaining a drone pilot license. Certified operations include those performed under any of the following conditions: over crowds or gatherings, or involving the transport of persons or dangerous goods. In addition, the competent authority may, based on a risk assessment (Article 6 of Regulation 2019/947).

This new set of common rules (summarized in Table 1 and presented as a visual representation in Figure 1) will provide both

professional and recreational drone operators with a much clearer understanding of what they are and are not allowed to do. Continent-wide and uniform regulations, especially the requirement that UAVs be registered and individually identifiable, will surely prevent events similar to the ones that took place in the UK at Gatwick and Heathrow airports back in 2018 – which grounded aircraft for up to 36 hours, affected over 140,000 passengers and cost airports an estimated GBP 50 million [21] – from occurring again.

Table 1: Authorization and regulations applicable to each of the adopted three categories of UAV operations [22]

Category of operations	Open low risk	Specific medium risk	Certified high risk
Authorisation needed	None	Authorisation from NAA based on operational risk assessment or specific scenario	Authorisation from NAA/EASA
UAS	Compliant with Commission Delegated Regulation on UAS	Compliant with requirements included in the authorisation	Certified UAS
Operations allowed	Restricted to: <ul style="list-style-type: none"> ▪ VLOS ▪ Altitude < 120 m ▪ Other limitations defined by: <ul style="list-style-type: none"> - Commission Regulation on UAS operations - National airspace zones 	Restricted to: <ul style="list-style-type: none"> ▪ Operations specified in the authorisation ▪ Limitations defined by national airspace zones 	Controlled airspace U-Space
Regulations	Commission Regulation on UAS operations in open and specific		Revision of existing aviation regulation
	Commission Delegated Regulation on UAS	No regulatory requirement (UAS requirements included in the authorisation)	

The benefits of facilitating uniform UAV operation requirements across all Member States seem clear. This is an unprecedented step forward, as even the United States are facing problems with UAV regulation unification due to the fact that individual states prefer to enforce local regulations [23].

Also, Member States will be able to define zones, most probably through satellite geo-location, where UAVs will not be permitted to enter or where they will be allowed more freedoms such as BVLOS flights [24], allowing countries to cater to their individual national specificities.

3. Discussion

This section starts with an analysis of Poland's national regulations. The first national regulations for UAVs were adopted in the country in July of 2011, in the Act of 3rd July 2002 – Aviation Law (Aviation Law Act) [25].

However, the very first implementing rules only concerned VLOS operations. The Regulation of the Minister of Transport, Construction and Maritime Economy of March 26th, 2013, on the exclusion of certain provisions of the Aviation Law Act – for certain types of aircraft and the specification of conditions and requirements for the use of these aircraft [27], was the Polish government's very first attempt to regulate general requirements for UAV operations, becoming the first national regulation for UAVs in Europe. This regulation was widely amended in 2016 [28], with the amendments being based on the practical aspects of unmanned operations.

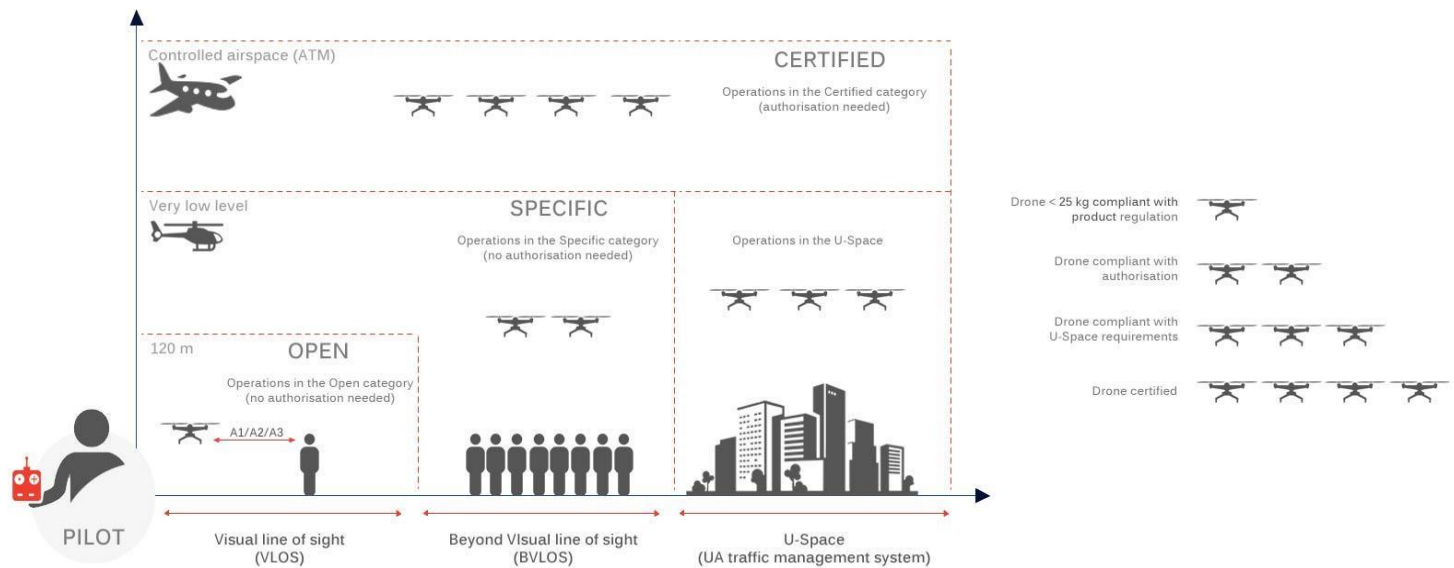


Figure 1: A visual representation of the adopted three categories of UAV operations [26]

A new regulation was adopted on December 20th, 2018 and entered into force on February 1st, 2019. This regulation amended previous rules from 2013 on the exclusion of certain provisions of the Aviation Law Act and included a new set of rules for BVLOS operations (MTOW of up to 25 kg, a maximum height of 120 m, and BVLOS operations outside of segregated airspace) [29].

This created new possibilities for the country's UAV sector, but also led to a series of safety challenges for manned aviation. It is still too early to make an assessment of the new regulation, as the first three months in which it has been in force saw the performance of just 20 UAV BVLOS flights under the new rules. However, this period has led to serious doubts on the risk that such UAV operations pose to manned aircraft operating at lower altitudes.

It must be underlined that the new regulation allows for BVLOS UAV operations outside of segregated airspace. Similar regulations were adopted in other European countries, but these include much stricter limitations. For instance, in France and Spain, such operations are only allowed for UAVs that weigh less than 2 kg [30]. In Spain, however, UAVs with a mass up to 25 kg can operate in BVLOS operation outside of segregated airspace when equipped with an approved detection and avoidance systems [31]. Similar regulations apply in the UK, where operators are required to implement an approved method of aerial separation and collision avoidance as a prerequisite for BVLOS operations [32]. Under Polish law, such systems are not considered as mandatory for BVLOS UAV operations outside of segregated airspace. And this is the main concern regarding the new regulation, even though it also creates the legal framework for the introduction of a UTM system [33].

While operating under national regulations (the details of which may vary between countries), UAV operators are required by law to be prepared for the new EU regulations that will apply across all Member States. The approach, terminology and the requirements used at an EU-level are quite different to national regulations as they are drafted for all EU Member States.

EU countries having their own rules are now obliged to make the transition from old regulations to new as smooth and seamless for drone operators as possible. One example is that the Civil Aviation Authorities will be obliged to transform the current UAV VLOS and BVLOS “licenses” into European equivalents, but it is currently unknown whether operators will be required to undergo supplementary training. The transformation of operator qualification certificates is not the only problem. Poland needs to decide whether new BVLOS regulations will stay in force for operations other than civil.

Due to the fact that EU law applies uniformly in all Member States, it is advisable to discuss the regulations that apply in non-EU countries, and to compile EU countries' own regulations to the extent that EU law allows the state's competence to regulate. Below is a table that outlines how individual national regulations shape UAV flight and ownership in selected European Union countries.

As shown in the few examples included in Table 2, national regulations concerning UAV operations vary widely from country to country. These differences only hamper the growth of this sector and should be unified in accordance with the EUs Pan-European regulations for UAV operations explained earlier.

4. Results

The EU's new set of UAV rules for the European market which will facilitate the development of drone technologies and create plenty of job and business opportunities. Besides addressing vital issues such as citizen's privacy, security and environmental topics, a far-sighted vision sees this harmonization lead to the creation of a functioning UTM system through U-Space, enabling the large-scale performance of UAV operations in low-level airspace, beyond visual line of sight and in congested areas.

It is therefore critical that these new rules were created by EASA, as this organization is responsible for European air safety and is capable of holding extensive stakeholder consultations. Although it is too early to assess the new EU regulations in practice, since they will only enter into force later this year, this

Table 2: National regulations in selected EU countries

UAV Classification	UAV Requirements	Pilot Requirements	Permits
Austria – Austro Control [34]			
Austria classifies drones by joules of kinetic energy	<ol style="list-style-type: none"> 1. No flying over crowds (e.g. events, sports events, concerts, etc.) without special permission 2. No flying in the immediate vicinity of airports without special permission 	<ol style="list-style-type: none"> 1. Drone pilots must be 16 years of age or older 2. Liability insurance is mandatory for all drone operators 3. Only Austro Control may grant an aviation permit to an operator 	<ol style="list-style-type: none"> 1. A permit is required if 79 joules are exceeded or if a drone is flown above 30 m 2. A permit is also required to fly a drone for commercial purposes or to take photos or record video regardless of operating mass
Belgium – Belgian Civil Aviation Authority (BCAA) [35]			
Belgium has three different classes of operations, with licensing requirements for each class	<p>Class 1a and 1b Operations Definition:</p> <ol style="list-style-type: none"> 1. Up to 300 ft (around 90 m) above ground outside of controlled airspace. 2. Operations can only occur in daylight conditions. 3. Drone must weigh less than 330 lbs. (150 kg). <p>Class 2 Operations Definition:</p> <ol style="list-style-type: none"> 1. Flying height limit of 150 ft (around 45 m) outside of controlled airspace and outside of cities or communities. 2. Operations can only occur in daylight. 3. The drone must weigh less than 11 lbs. (5 kg). 	<ol style="list-style-type: none"> 1. The pilot must maintain a visual line of sight with the drone at all times. 	<p>Licensing Requirements:</p> <ol style="list-style-type: none"> 1. Class 1a and 1b Operations – require a remote pilot license issued by the BCAA. To obtain this license, UAV pilots need to pass both a theoretical examination and a practical skill test. 2. Class 2 Operations – UAV pilots need a certificate of competence issued by the BCAA. To obtain this certificate, UAV pilots need to follow a theoretical course and pass a practical skill test.
France – French Civil Aviation Authority (DGAC) [36]			
Commercial and Recreational	<ol style="list-style-type: none"> 1. Drones may not be flown at night (unless with special authorization from the local prefect). 2. Drones may not be flown over people; over airports or airfields; over private property (unless with owner's authorization); over military installations, prisons, nuclear power plants, historical monuments, or national parks. Drones may also not be flown over ongoing fires, accident zones, or around emergency services. 3. Drones may not be flown above 150 m (492 ft), or higher than 50 m (164 ft) above any object or building that is 100 m (328 ft) or more in height. 	<ol style="list-style-type: none"> 1. Drone pilots must maintain a visual line of sight with their drones at all times. If a visual observer is tracking the drone, the pilot may fly out of his or her own range of sight. 	<ol style="list-style-type: none"> 1. Commercial – commercial drone pilots must pass a theoretical exam to receive a theoretical telepilot certificate. The pilot must have this printed and with them during all flights. Commercial drone pilots must also undergo basic practical training. Recreational – recreational drone pilots do not need a training certificate when UAV mass is less than 800 g. They must undergo training if UAV mass exceeds this. 2. All drones of 800 g or more must be registered by their owner on AlphaTango, a public portal for users of remotely piloted aircraft. The drone then receives a registration number that must be affixed on the drone.
Italy – Italian Civil Aviation Authority (ENAC) [37]			
Commercial and Recreational	<ol style="list-style-type: none"> 1. Drones being flown for recreational purposes may not fly more than 70 m (230 ft) above the ground. For commercial purposes it is 150 m (492 ft). 2. Drones must be identified by a plate showing the identification of the system and of the operator. An identical plate shall be installed also on the remote ground pilot station. 3. UAVs must be equipped with an Electronic Identification Device. 4. Drones may not be flown within 5 km (3 miles) of any airport or airfield. 5. Drones may not be flown at night. 6. Drones are not allowed to fly over people or crowds, including sports events, concerts, and other large events. 	<ol style="list-style-type: none"> 1. Drone pilots must maintain a direct line of sight with their drone during operations. 	<ol style="list-style-type: none"> 1. Commercial drone pilots conducting low-risk operations must submit a statement of compliance with specific requirements to ENAC along with a 94 EUR processing fee. For higher-risk operations, commercial drone pilots must obtain training and an operating certificate as well as a health certificate.
Netherlands – Netherlands Directorate General of Civil Aviation (DGCA) [38]			
Commercial and Recreational	<ol style="list-style-type: none"> 1. Flying a drone is only allowed in category G airspace. 2. Drones may not fly more than 120 m (394 ft) above the ground. 3. Drones must fly at a safe distance from people and buildings and may not be flown at night. 5. The maximum weight for private drones is 25 kg. 6. UAV pilots may use drones to make aerial films and photographs for their own personal use. This is regarded as recreational use. 	<ol style="list-style-type: none"> 1. Drone pilots must give priority to all other aircraft, such as airplanes, helicopters, gliders, etc. 2. Pilots must maintain a visual line of sight with their drone during operations. 	<ol style="list-style-type: none"> 1. Commercial drone operations in the Netherlands require the drone pilot to hold a pilot's license, and the company/organization overseeing the operation to hold an ROC permit to fly. 2. If UAV pilots operate a drone weighing no more than 4 kg, then they may apply for a light permit. 3. Drone insurance is required for commercial drone operations in the Netherlands.
Spain – Spanish Aviation Safety and Security Agency (AESA) [39]			
Recreational, Model Aircraft, Professional	<ol style="list-style-type: none"> 1. Drones may be flown up to 120 m (394 ft) above the ground. 2. Drones may only be flown during the day. 3. Flights may be carried out at night for drones with a take-off weight of less than 2 kg (4.4 pounds) as long as a flight altitude of 50 m (164 ft) above the ground is not exceeded. 4. Drone pilots must maintain a distance of 150 m (492 ft) from buildings, and a distance of 50 m (164 ft) or more from people not involved in the flight. 5. Drone pilots must maintain a distance of at least 8 km (5 miles) to airports in uncontrolled airspace, or 15 km (9.3 miles) on approved BVLOS flights. 	<ol style="list-style-type: none"> 1. Drone pilots must maintain a visual line of sight with their drone at all times. 2. BVLOS allowed if a second visual observer monitors the drone and is in direct eye contact with the pilot 	<ol style="list-style-type: none"> 1. A permit is required for commercial drone flights. 2. Liability insurance is required for commercial drone pilots. 3. For flights in national parks, UAV pilots need permission from AESA. 4. The use of drones in no-fly zones must be approved by the Spanish Ministry of Defense.

study shows that certain EU countries (such as Poland) tried to stay ahead of the curve and adapt their national policies to developing and growing markets and technologies. Also, one of the greatest challenges lying ahead for all Member States is making the transition and replacing their current national rules – those that have been widely accepted by UAV operators in them – with an “unknown” set of regulations put forward by a supranational body. Adapting these to the specificity of each Member State’s legal framework will certainly be a difficult task.

It must not be forgotten that despite having a unifying nature, the EU’s regulations were created so quickly that they could not possibly cover all UAV-related issues, leaving many blank spaces to be filled in and questions to be answered by national legislators themselves.

5. Conclusion

As we enter the two-year transition period, EASA if aware of the difficulties that lie ahead. The agency even summed up at the recent High Level Conference on Drones, which was held during Amsterdam Drone Week this past December, that a common European vision in which UAVs can be used for emergency services, transportation or even parcel delivery will only become a reality if safety standards are met and solutions are found to pressing issues such as noise and privacy [40].

However, we can be quite certain that this unprecedented continental initiative to unify regulations will foster the growth of the UAV technology sector, allowing private businesses to drive the commercial market forward. May this example of European cooperation serve as a model for other nations around the world as we stand at the brink of a development that could revolutionize how drone technology is used across the region.

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgment

Research financed by National Science Center, Poland. Project No 2017/27/B/HS5/0008 Unmanned Aerial Vehicle. A New Era in Aviation Law.

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