

# Unmanned Aircraft Systems – Successful usage Limited by the Regulation?

Vlado Cetl<sup>1</sup>, Goran Jurakić<sup>1</sup>, Mario Mađer<sup>1</sup>, Hrvoje Tomić<sup>1</sup>, Tomáš Kliment<sup>1</sup>

<sup>1</sup>Faculty of Geodesy, University of Zagreb, Kačićeva 26, Zagreb, Croatia, vctl@geof.hr, gjurakic@geof.hr, mmadjer@geof.hr, htomic@geof.hr, tkliment@geof.hr

**Abstract.** *In the last several years, with mass appearance of the unmanned aircraft systems (UAS), we have been witnessing a new revolution in geodetic profession. The potential of UAS in different areas of geodesy is very big and probably the phrase “only sky is the limit” fits perfectly. However sometimes the UAS are misused for illegal purposes which puts a negative light to their usage. Many countries started to regulate the usage of UAS. Even on the EU level there is ongoing process regarding UAS regulation. The question is how much it limits their usage and where the appropriate balance is. In this paper we give an overview of the existing regulation and a possible answer to the posted question.*

**Keywords:** *regulation, unmanned aircraft systems, usage.*

## 1. Introduction

The transfer of various techniques from military to civilian use and rapid development of technology enabled the production of different types of unmanned aircrafts for various purposes throughout the world. An Unmanned aircraft is an aircraft made to perform flights without a human pilot on board. It is remotely controlled or programmed and autonomous [OG 49/2015]. The literature often refers to it by the name - the Unmanned Aerial Vehicle (UAV) [Kolarek 2010; Gašparović and Gajski 2015]. Unmanned Aircraft System (UAS) is a system for conducting flights by aircraft without a pilot. It consists of the unmanned aircraft and other components for managing or programming that are necessary to control an unmanned aircraft by one or more persons. Unmanned aircraft system operator is a natural or non-natural person performing flight operations using the unmanned aircraft system.

Small unmanned aircrafts have experienced rapid development in the last ten years [Medić 2015]. The main driver for this comes from the improvement of the sensor technology, miniature computers and electric power source or battery. Commercialization of technology enabled the unmanned aircrafts to become smaller and at the same time much more accessible. The adjective “smaller” or “small” refers to all aircrafts that can be carried and successfully managed by only one person.

Small unmanned aircrafts are the flying platforms equipped with numerous sensors and a small computer used to autonomously control their flight. The flight can be completely independent or guided by the operator. Today they occur in a large variety of shapes and sizes. The main division of small unmanned aircrafts is into so-called Fixed wing aircrafts and Multirotors or popularly known as drones [Figure 1.1].



**Figure 1.1** Example of Multirotor (left) and Fixed wing aircraft (right)

Small unmanned aircrafts have found their application in many military and civilian tasks. Some of these include finding and rescuing injured people, controlling certain areas (e.g. the state border), accessing dangerous areas without endangering human lives (crew) and many other purposes. The application can also be found in many engineering fields including the engineering surveying and geoinformatics. They are used primarily for aerial photogrammetric survey in different spectral bands and more recently for laser scanning from the air (i.e. Light detecting and ranging – LIDAR). In the near future their use in physical geodesy is also expected. The final products of such collected data are numerous. They are mostly used for making orthophoto maps, 3D models of objects, digital elevation model, control and inspection of various structures and the development of multipurpose maps. The potential of unmanned aircraft in various fields of geodesy is huge and probably only the “sky is the limit”.

Apart from all the positive and useful things and benefits, expanding the civilian use of unmanned aircrafts is unfortunately followed by many risks [Nikolić 2015]. So far, the illegal use of unmanned aircrafts that have endangered human lives and that were not in compliance with certain regulations, such as the Law on Protection of Personal Data, is reported around the world. One of the bad examples of the illegal use which even turned to a political incident, was the one during the football match between Serbia and Albania in 2014. During the match an unmanned aircraft appeared carrying a flag of “Greater Albania”, which was the trigger for the riot among the players and fans. A very recent one happened when Austrian skier Marcel Hirscher was nearly hit by a falling drone camera in the World Cup slalom 2015. There are many similar examples around the world. An additional fact that helps the illegal use is the purchase of unmanned aircrafts which has nowadays become much simpler and cheaper. In many countries these facts initiated development of legal regulations in the field of use of the UAS. The

next chapter provides an overview of the regulations on national, regional and international levels.

## 2. Current UAS Regulations

The unmanned aircraft system, as quite a new component of the civil aviation branch, is constituting a rapidly evolving sector. Due to the progressive development of the UAS and their integration into the civil airspace, there is an urgent need to regulate their use. UAS sector has huge potential for growth which could only be unleashed if an appropriate regulatory framework is established. The regulatory framework is being developed at three different levels – international, regional and national [Table 2.1].

**Table 2.1** Civil aviation regulatory authorities

International	International Civil Aviation Organization
Regional (European Union)	European Aviation Safety Agency
National (Croatia)	Croatian Civil Aviation Agency

### 2.1. UAS regulation at the international level

The International Civil Aviation Organization (ICAO) as the civil aviation regulatory authority operates at the international level. It is a specialized agency of the United Nations, established in 1944 upon the signing of the Convention on International Civil Aviation. The ICAO’s main aims are to codify the principles and techniques of the international air navigation and foster the planning and development of the international air transport to ensure safe and orderly growth of the international civil aviation throughout the world [OG 69/2009].

All UAS, regardless of size, are subject to the provisions of Article 8 of the Convention, according to which an aircraft capable of being flown without a pilot will not be flown without a pilot over the territory of a contracting state and without having a special authorization by that state and in accordance with the terms of the authorization. Each contracting state is obligated to ensure that the flight of the aircraft without a pilot in regions open to civil aircrafts, is controlled in a manner to obviate a possible danger to civil aircrafts [ICAO 2011].

The ICAO has recognized the need to change the existing regulations and has started providing the fundamental international regulatory framework for UAS. In the period 2016-2018, the ICAO intends to introduce standards and recommended practices with supporting procedures for air navigation and the guidance material for UAS, covering aircraft, users, patenting, sense and avoid, communication and air traffic control regulations [URL 1].

### 2.2. UAS regulation at the regional level

The European Aviation Safety Agency (EASA) is an agency of the European Union (EU) with regulatory and executive tasks in the field of civilian aviation safety and environmental protection. EASA develops common rules and basic standards at the European level and monitors their implementation [URL 2]. As

an EU member state, the Republic of Croatia has the obligation to complete harmonization of the national legislation in the air traffic field with the legislation systems on the European level.

EU Regulation 216/2008 of the European Parliament and of the European Council provides that EASA is responsible for civil UAS with an operating mass over 150 kg, leaving the use of UAS with an operating mass below 150 kg and model aircraft as the responsibility of the national aviation authorities of the EU members. However, as the use of drones has significantly grown in recent years, member states had to react quickly, potentially leading to a fragmented market. In order to enable the creation of the European single market for UAS, EASA has been tasked by the European Commission to develop a set of common European safety rules for operating UAS regardless of their weight [EC 2014].

In December 2015 EASA published Technical Opinion on the operation of UAS. This opinion lays down the foundation for all future work for the development of rules and the guidance material. It serves as a guidance for member states that have no rules or a plan for UAS to modify their existing ones to basically ensure the consistency with the intent of the future EU rules.



**Figure 2.1** UAS operation category according to the EASA Technical Opinion

The opinion includes 27 concrete proposals for a regulatory framework for low risk operations of all UAS irrespective of their mass. It establishes 3 categories of operation [Figure 2.1]: ‘Open’, ‘Specific’ and ‘Certified’ with different safety requirements for each, proportionate to the risk [EASA 2015].

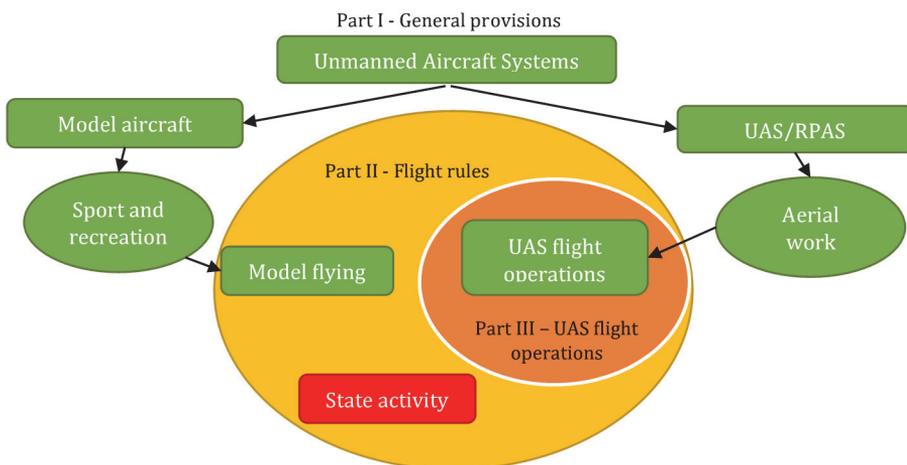
In 2016 and 2017 EASA intends to develop new rules or amend existing ones within the framework described in the Technical Opinion.

### 2.3. UAS regulation at the national level

The Croatian Civil Aviation Agency (CCAA) is a competent Croatian authority in the field of civil aviation. It is responsible for operating UAS with mass up to and including 150 kg, as well as for model aircraft.

UAS flight operations and model flying in the Republic of Croatia are regulated by UAS Ordinance [OG 49/2015]. In accordance with this Ordinance, UAS flight operations may be carried out by physical and legal persons who, depending on the risk intended operations posed to the area of operation, either declared regulatory compliance to CCAA or obtained CCAA authorisation to conduct such operations. Besides being registered, UAS operators are subject to the CCAA monitoring with the aim of determination of flight operations regulatory compliance [URL 3].

This Ordinance does not apply to UAS when they are used for state activity, when they cannot achieve kinetic energy greater than 79 Joules, or when they are used indoors. The concept of the Ordinance is shown in figure 2.2.



**Figure 2.2** The concept of the UAS Ordinance

The Ordinance classifies unmanned aircrafts into three weight categories: class 5 (up to 5 kg), class 25 (from 5 up to 25 kg) and class 150 (from 25 up to and including 150 kg).

In relation to the level of construction, population density and the presence of people, areas of performing UAS flight operations are divided into four classes:

- Class I – the area without buildings and people
- Class II – the area with outbuildings and no people
- Class III – the area with buildings intended for residential, business or recreation purposes and no people
- Class IV – the urban area.

According to a risk-based approach, the UAS flight operations are categorized into four groups: A, B, C and D [Table 2.2].

**Table 2.2** Flight operations category

UAS Class (Operating mass – OM)	Areas of performing UAS flight operations			
	I Unbuilt areas	II Built unpopulated area	III Populated area	IV Densely populated area
<b>5</b> OM < 5 kg	A	A	B	C
<b>25</b> 5 ≤ OM < 25 kg	A	B	C	D
<b>150</b> 25 ≤ OM ≤ 150 kg	B	C	D	D

The UAS handler must ensure that the flight of unmanned aircraft is carried out in a way that does not present danger to life, health or property of people due to shock or loss of control of an unmanned aircraft and that it does not endanger or interfere with public order. While performing the flight operations, the UAS handler is expected to have the documents listed in the table 2.3 available for the inspection.

**Table 2.3** Documents required during UAS flight operations

Flight operations category	
A	B C D
Flight manual or instructions for use	
Approval for UAS flight operations	
Insurance policy	
UAS operator declaration or medical certificate of good health	Medical certificate of good health
UAS operator declaration or pilot license or certificate of successfully passed theoretical exam	Pilot license or certificate of successfully passed theoretical exam
Proof of qualification for performing UAS flight operations	
Operating manual	

To obtain the approval of the CCAA to perform UAS flight operations, the owner or the operator of the UAS must comply with the safety requirements set out by the CCAA. Obtaining other necessary approvals and permits are not subject to the Ordinance on UAS [CCAA 2015].

Aerial photography or recording in the Republic of Croatia is regulated by the Regulation on defense [OG 73/2013] and the Regulation on recording from the air [OG 130/2012].

The regulation on recording from the air lays down the conditions under which it is possible to take aerial photographs of land areas or territorial waters of the Republic of Croatia. It also regulates the conditions under which aerial photographs may be recorded, distributed and published to the public.

Recording from the air is allowed only to physical and legal persons who are registered for aerial photography at the commercial court in the Republic of Croatia. The aircraft operator must have a valid certificate for the aerial work issued by the CCAA.

Furthermore, domestic physical and legal persons may record from the air only after obtaining approval for the processing of aerial photographs issued by the Croatian State Geodetic Administration (SGA) for each individual record, while those international must obtain the prior approval from the Ministry of defense.

After recording and before the use, aerial photographs or recorded material need to be submitted for review to the SGA no later than eight days after the end of recording. In case the recording is cancelled, the client must inform the SGA accordingly.

The SGA and the Ministry of defense will establish a Commission to examine the recorded material and determine whether the recordings may be used in accordance with the submitted request. Pursuant to the conclusion of the Commission, the SGA issues the approval to use the recordings.

Reproduction, publication and taking recorded material out of the Republic of Croatia is allowed only after obtaining the approval of the SGA.

### **3. Restrictions**

Based on previous experience in the application of regulations, operators of UAS have the most objections to the general conditions of flying the unmanned aircrafts as defined in Article 11 of the Ordinance on UAS.

According to the Ordinance flights of the unmanned aircrafts should be carried out during the day, the unmanned aircraft must always be within the operator's line of sight at a distance of not more than 500 meters from the operator. During the flight, unmanned aircrafts should maintain a safe distance from people, animals, buildings, ground and other aerial vehicles, vessels, roads, railways, waterways or power lines. The distance must not be less than 30 meters, while the minimum distance from a group of people is 150 meters. It is particularly important that the flight of the unmanned aircrafts takes place outside of the controlled airspace and at a distance of at least 3 kilometres from the airport and its incoming or outgoing route. It should also be noted that during the flight of the unmanned aircrafts it is not allowed to drop any objects [OG 49/2015].

Safety of the air traffic is a top priority and therefore the justification for the above mentioned legal limits should not be brought into question. Nevertheless, it is possible to obtain the approval for almost all aforementioned restrictions. Thus, after submission of the proper request, the CCAA may issue the approval for flight operations at distances less than prescribed, at a distance greater than prescribed and out of the sight of the operator as well as approvals for the operations that include dropping the objects during the flight. Along with the application for such request, an acceptable assessment of risk for performing the flight operations by the unmanned aircraft systems needs to be submitted.

Flight operations of unmanned aircrafts are also possible in the controlled airspace, but one must first obtain the written approval of the Croatian Air Traffic Control. Each activity which the written approval is given for, is additionally required to obtain the approval of the responsible air traffic control. In case of cancelling the planned activities for which the approval has been received, it is required that a notice of termination of the activities be sent. Currently, the Croatian Air Traffic Control is in the process of finding solutions for flying the unmanned aircrafts within the controlled zones without having to ask for the approval for special use of the controlled airspace for each single flight. By the time this procedure will have been established, the requests will be granted only for commercial purpose flights [URL 4].

Perhaps less important, but certainly worth mentioning, is the limitation of the number of motors in unmanned aircrafts in the case of multicopters. According to technical requirements for flight operations, the number of motors directly determines the category of flight operations. At the same time, the standards and recommendations of ICAO as a global regulatory body, and EASA as a regional regulatory body, do not specify the number of motors as one of the conditions.

Major problems that operators of UAS are facing with, is the slowness of the procedure for obtaining approvals for aerial surveying and slowness of the system of authorization of recorded material usage, both of which are regulated by the Regulation on recording from the air [OG 130/2012].

#### **4. Conclusion**

Legal regulations following the UAS are undoubtedly necessary in order to guarantee security to the society and regulate the market regarding its production. In order to exploit the potential of unmanned aircrafts in surveying and other fields but equally to support their further development, it is necessary to modernize and simplify the existing regulations and harmonize them with the trends and needs of the market [Gašparović and Gajski 2015]. The trends are very clear and it is safe to say that the unmanned aircrafts will be more and more used in different areas. Some of the general benefits are their efficiency, cost-effectiveness, speed, easy access to the inaccessible areas without endangering people's lives and others. Regulations should never be an obstacle or limitation but an incentive for the use of these modern technologies that greatly facilitate and speed up the surveying task and geoinformatics profession. Finding the right balance that will enable fast, safe and easy usage of unmanned aircrafts in surveying tasks is strongly needed. The usage for commercial purposes by professionals should be clearly distinguished from other kinds of usage (e.g. for fun). It is expected that the future European regulations will go in this direction. From the geodetic aspect, special focus should be put on the quality of the product due to the potential purposes for which it can be used: cadastre, spatial planning etc.

At present in the Republic of Croatia, there are no obstacles for legal usage of unmanned aircraft systems for the purpose of surveying, though this is very often burdened by the administrative procedures with an uncertain outcome. The result is that the operators cannot deliver the requested product to parties within the agreed time. Thus in practice, surveyors very often fly and do the recordings without previously obtained approvals. This practice is certainly not good. It is therefore necessary to speed up and simplify the obtaining of all necessary permits and approvals for the flight operations as well as for the aerial surveying done by the UAS.

### **Acknowledgment**

This research was supported by the Croatian Science Foundation (HRZZ) under the grant I-2485-2014; the DEMLAS project.

### **References**

- CCAA (2015). *Prihvatljivi načini udovoljavanja odredbama Pravilnika o sustavima bespilotnih zrakoplova (Acceptable Means of Compliance with the Regulations on Systems of Unmanned Aircrafts)*, Zagreb.
- EASA (2015). *Technical Opinion, Introduction of a Regulatory Framework for the Operation of Unmanned Aircraft*.
- Europska Komisija (2014). *Komunikacija Komisije Europskom parlamentu i vijeću, Nova era za zrakoplovstvo, Otvaranje zrakoplovnog tržišta za sigurnu i održivu civilnu uporabu daljinski upravljanih zrakoplovnih sustava (European Commission 2014 Communication of the Commission with the European Parliament and Council, New Era for the Aviation, Opening the Aviation Market for Safe and Sustainable Civil Use of Remote Controlled Systems)*, Bruxelles.
- Gašparović, M.; Gajski, D. (2015). *Bespilotni sustavi za zračno snimanje - propisi i regulativa (Unmanned Systems for Air Photography – Rules and Regulations)*, Proceedings of 8. Symposium of Chartered Engineers of Geodesy, Zagreb.
- ICAO (2011). *Unmanned Aircraft Systems (UAS)*, Cir 328.
- Kolarek M. (2010). *Bespilotne letjelice za potrebe fotogrametrije (Unmanned Aircrafts for the Needs of Photogrammetry)*, Ekscentar, 12, pp. 70-73.
- Medić, T. (2015). *Izmjera nepristupačnih područja pomoću bespilotnih letjelica. (Surveying of Inaccessible Areas Using Unmanned Aircrafts)*, Graduate Thesis, Faculty of Geodesy, University of Zagreb, Zagreb.
- Nikolić, V. (2015). *Ispitivanje mogućnosti bespilotnih letjelica i pravna regulativa (Testing the Possibilities of Unmanned Aircrafts and Legal Regulations)*, Graduate Thesis, Faculty of Geodesy, University of Zagreb, Zagreb.

Official Gazette (2009). Zakon o zračnom prometu (NN 69/09) (The Law on Air Traffic [National Gazette] 69/09)

Official Gazette (2012). Uredba o snimanju iz zraka (NN 130/12) (Rule on Air Photographing Official Gazette. 130/12)

Official Gazette (2013). Zakon o obrani (NN 73/13) (The Law on Defence ONational Gazette 130/12)

Official Gazette (2015). Pravilnik o sustavima bespilotnih zrakoplova (NN 49/15) (Legal Regulations on Systems of Unmanned Aircrafts National Gazette 49/15)

URL 1: International Civil Aviation Organization, [www.icao.int](http://www.icao.int), (28. 2. 2016).

URL 2: European Aviation Safety Agency, [www.easa.europa.eu](http://www.easa.europa.eu), (1. 3. 2016).

URL 3: Hrvatska agencija za civilno zrakoplovstvo (Croatian Agency for Civil Aviation), [www.ccaa.hr](http://www.ccaa.hr), (2. 3. 2016).

URL 4: Hrvatska kontrola zračne plovidbe (Croatian Control of Air Traffic), [www.crocontrol.hr](http://www.crocontrol.hr), (5. 3. 2016).

## Sustavi bespilotnih zrakoplova – učinkovita uporaba ograničena zakonskom regulativom?

**Sažetak.** U posljednjih nekoliko godina, s masovnom pojavom bespilotnih zrakoplova, svjedoci smo nove revolucije u geodetskoj struci. Potencijal sustava bespilotnih zrakoplova u različitim područjima geodezije je ogroman i vjerojatno je „samo nebo granica“. Ipak pojavljuju se slučajevi u kojima se sustavi bespilotnih zrakoplova koriste za ilegalne radnje, a što baca negativno svjetlo na njihovu uporabu. Većina zemalja pokrenula je zakonsku regulativu u području uporabe sustava bespilotnih zrakoplova. Trenutno je i na Europskoj razini u procesu donošenje direktive o sustavima bespilotnih zrakoplova. Pitanje koje se samo po sebi nameće je u kojoj mjeri zakonska regulativa ograničava uporabu sustava bespilotnih zrakoplova i koji je prihvatljivi balans? U ovom radu dan je pregled zakonske regulative kao i mogući odgovor na postavljeno pitanje.

**Ključne riječi:** sustavi bespilotnih zrakoplova, uporaba, zakonska regulativa.

*\*professional paper*