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UNMANNED AERIAL VEHICLES AS A CHALLENGE FOR AIR TRAFFIC CONTROL

Abstract

Widespread utilization of civilian unmanned aerial vehicles (UAVs) is a new challenge for air traffic control. The reason to initiate research in that domain was a series of UAV’s flights near manned aircraft, including commercial ones, which happened in the airspace of many countries. In Poland, such an incident caused the need to conduct a deep analysis of the matter in the study. The incident occurred on 21st July 2015 at the Okęcie airport in Warsaw causing amazement but also a real threat in particular as drones are easily accessible. The unidentified drones have already landed within the area of nuclear power stations, military units and even a highly secured interior of the White House. Therefore, a challenge is rather significant. It could lead to undermining the security of air traffic, but at the same time also to terrorists’ attacks, violation of privacy, sabotage including acts against critical infrastructure. It is necessary to study the issue and this paper could be the basis for further research.

Keywords: unmanned aerial vehicle, drone, air traffic security, aviation security threats, aviation law.

Introduction

According to the Polish law, there is no clear and unambiguous definition of an unmanned aerial vehicle and there is also a lack of a precise description of such a device. Usually, the most commonly used term in a variety of jargons is calling them drones. Such a term has been especially widely used by media during recent years, particularly as violation of airspace caused by them is more frequent. Within academic community and among specialists in the domain, such devices are mainly recognized as Unmanned Aerial Vehicles (UAVs) and in the context of using wider technologies they are defined as Unmanned Aircraft Systems (UASs). In general, the term drone is directly connected with an armed unmanned aerial vehicle and is recognized in such a configuration. On the basis of the commonly known definitions, it could be acknowledged that a drone is an aerodynamic flying system for a multiple use and those could be remotely controlled by using a joystick or a digital interface supported by a device used for automatic control. UAVs could be equipped with blades or wings, and original intentions of their utilization were to replace people/crews during performing aerial missions of a high risk. Currently, armed aerial vehicles designed to conduct combat missions are rather common and are known as Unmanned Combat Air Vehicles (UCAVs).

The definition of a drone found in dictionaries is rather general - a drone is defined as an unmanned remotely controlled aerial vehicle or a missile designed for the precision
attack. However, just a preliminary analysis of the definition reveals two contradictory pieces of information. Firstly, it is questionable if the device of a single use designed for a single mission (for example, destruction of a pre-planned target) could be named as a ‘drone’. Secondly, to be recognized as a ‘drone’ such a device should be remotely controlled or be able to perform a fully autonomous flight (according to a previously intended route). Drones’ users, especially fans of modelling, expand the definition by including two more elements: a range of UAVs and necessity of locating advanced devices and sensors on the UAVs board which are to be used to operate the device using a control system. Nevertheless, in such a case, it is not just a Remotely Piloted Vehicle (RPV). If such a UAV is equipped with camera in order to discover what could be seen by a pilot of manned aircraft, we could possess a modern and popular version of entertainment known as First-Person View (FPV) or a remote - person view. Some people are calling it as a video piloting and it is not a drone in classical understanding of the term. Though, as soon as it achieves the option of a remote control, for instance, using a personal computer, working and ‘land based control station’ which allows to start an autopilot and to switch into a mission of an automatic control mode, then undoubtedly we are dealing with UAV which refers to the actual drone.

The UAVs include a subgroup called Autonomous UAVs, which are the vehicles completely controlled by computers excluding the option of a manual control by an operator (for instance, performing missions according to a pre-planned route within a designated area). It raises the question, like: could more and more popular RPVs be equipped with a camera allowing FPV flights, recognized as UAVs? It can be acknowledged that rather no, as those are still remotely piloted aerial vehicles. Thus, following the available data, it could be assumed that they are not drones and should not be the subject of detailed law regulations but rather they should be exposed to strict limitations regarding their access to airspace, especially as the number of such devices will increase rapidly. Consequently, it will be impossible to control or identify all of them and those will ‘litter’ the airspace, therefore, the only solution is to learn how to deal with them.

The purpose of the research, of which major results are included into the paper, was to study the legal status of the UAVs’ presence in the airspace according to the Polish and international law. The specific purpose was to analyse the term ‘drone’ within a civilian terminology, and more precisely, to identify source elements which are critical to decide if a selected flying object is classified as a ‘drone’. Detailed problems were specified within law and technical requirements, which should be fulfilled by UAVs to operate and conduct missions in the Polish airspace. To continue, a notion has been assumed that the number of private users of UAVs will probably greatly increase which will be supported by growing availability of new technologies, lowering costs or their purchase along with growing domains and opportunities in which UAVs could be used for private and commercial purposes. It is ineffectual to try to limit their utilization as they could not be fully controlled. It rather requires to look for building compromise allowing the development of that branch of aviation. At the same time, it is necessary to treat such handlers and operators as another important group of airspace users.

Nowadays, it is difficult to predict entirely what kind of purposes drones could be used for in the future. The society usually considers them as unmanned platforms to be used by armed forces or national security related services to enhance their capabilities to create a safe and secure environment. Another question is whether it is going to be continued in the future? It can be assumed that rather not. Even now, it can be certainly admitted that in the next one or two decades such devices will be an ordinary element of people’s everyday life. However, it should not be forgotten that drones do not only support
security as they also constitute a real threat for entire security systems, including personal security. Unmanned solutions are connected with some “systemic gaps” and they could become vulnerable to the security and it is not only associated with terrorism. As a result, a technological development within unmanned solutions area must be closely interconnected within increasing research on law, computer technology systems, crisis management, defence and security including internal security in each country. It should be followed by companies operating on the insurance market taking into account common accessibility of drones based on lowering costs causing a risk of unexpected incidents. Therefore, such UAV type systems should be treated with great importance within airspace management system with focus on security.

The aviation regulations distinguish a few categories of such devices classified according to their weight or impact of kinetic energy caused during flight. The main areas of utilizing UAVs include: observation (using a variety of sensors to measure parameters of environment) and transport (transport of freight including heavy cargo). Moreover, there are new domains and areas emerging in which drones could be easily used. They are exploited in remote and hardly accessible zones as using manned aircraft could be risky creating a real threat for crew security.

Drones, similarly to any airspace apparatus, function as a system composed of two major elements: man and machine. A machine, in that sense, air element of the system, is similar to any type of aircraft which only differs in its size. The ground element is a control station, a stationary or a mobile, considered as a working space for the land based controllers/operators. As such, a drone should be considered as a typical airship, which is remotely controlled in a real time when possessing software to control all flight parameters and also modules and interfaces to enable exchange of data. Typical UAV is also equipped with a variety of sensors connected to software avionics and also to weapon systems and an autopilot optionally. Such a broad range of equipment causes that a drone does not differ greatly when compared with a manned air platform. The only major and typical difference is related to the location of the crew. A ground based control station, used to control drones, consists of software, interface modules and a designated and trained personnel. It is worth noticing that, from security point of view, every air and land component of a drone could be the object of a terrorist or cyber-attack. In general, in particular conditions, it could cause a danger for air traffic and aviation.

The US Congress has adopted the act regarding modernization and reform of the Federal Aviation Administration (FAA). The main aim of the reform was to execute the government actions to accelerate integration of all drones within the US airspace, which is recognized to be the most overcrowded airspace in the world. It was forced by an enormous number of requests that the FAA has been receiving to grant certificates for a variety of commercial activities using new capabilities. It was mainly connected with the certificates to use drones for videoing. However, such permissions were treated as precedents. The situation has changed as for now and those permissions are rather a norm than a precedent. Such applications are mainly related to different branches of industry and economy, such as: agriculture, energy sector, health care, protection of natural environment, postal services and also tourism. In particular, the request of the Amazon company to be granted an approval to deliver post using drones drew governments’ attention. A similar project was considered by the German DHL company and finally the company was permitted to deliver such drone based services as the first provider in
Europe. Also, other global multinational technology companies, for instance, Google and Facebook have expressed their interest in exploitation of options offered by drones.

The broad employment of civilian UAVs has been also connected with some negative side effects, for instance, they could be destroyed, damaged or involved in accidents. Thus, when performing emergency landing they could cause collateral destructions while being the subject of judicial procedures when trying to investigate takes the responsibility for those. As it has been mentioned before, drones could be a real threat for aviation. Such a situation may create some challenges related to airspace security management as every single drone flight could be the source or lack of respect towards the aviation law including violation of designated flying sphere, conducting flight above designated altitude or performing flights within an airport control zone (Controlled Traffic Region - CTR) which is absolutely unacceptable. Therefore, following very strictly valid regimes, it is critical to eliminate such dangers related to any airspace.

Currently, the most challenging issue related to aviation security is the unexpected presence of drones near airports, and even within their controlled zone. In that case, creativeness of amateur pilots is unlimited crossing often a line of unawareness, which could have very serious consequences. Many cases of such an approach of foolish drones’ pilots (or rather pseudo-pilots) could lead to air catastrophes, especially when approaching manned aircraft (e.g. passenger airliners). Similar instances happen more often and they do not only occur in Poland, although in Poland they were broadly published by media.

The Polish aviation law is rather restrictive regarding drones, as the commercial use of such devices requires a special certificate which is awarded by the Civil Aviation Authority (CAA) of the Republic of Poland (Polish: Urząd Lotnictwa Cywilnego – ULC). Unfortunately, there is no certainty if all users possess such certificates or consider obtaining them. This is an important factor as the number of certificates does not correspond to the increasing amount of drones. At the moment, there are many advertisements on various types of networks offering business type services such as commemorative photos and videos from the sky by employing drones. Moreover, it is necessary to consider what to do with other drones users who declare non-commercial exploitation as it is not easy to verify such declarations. The following questions arise: is it not purposeful to seriously approach such a topic before some negative consequences would happen? Are there any proper solutions to the issue? In particular, as it is a real threat from one side but also infringement of personal liberties and freedom from the other. In general, it is a serious problem which requires reliable arrangements.

In Poland, similarly to other countries, many intrusions into airports’ controlled zones were noticed and as a consequence, dangerous attempts to get as close as possible to manned aircraft. As for now, such accidents were not published by media in order to avoid panic. However, unauthorized intrusion into airspace of the Warsaw Okęcie Airport initiated a great discussion as it was rather close to a serious incident. It happened on 20th July 2015, when the crew of Embraer 195 aircraft flying from Munich to Warsaw, noticed a flying object at the 700 meters altitude. Based on the crew assessment, it was probably the drone located on landing approach about 10 kilometres from the start of the airport runway. As a consequence, the aircraft with more than 20 passengers on board was forced to change its landing direction. A similar incident happened on the same day in Łódź. A typical drone was observed near the airport and it caused the threat for small aircraft performing training flight. A more serious accident occurred in Kraków when a flare

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1 J. Simonides, Prawnomiędzynarodowe problemy użycia dronów w walce z terroryzmem. Debaty i kontrowersje (Legal and international problems of using drones to fight terrorism. Debates and controversies), [in:] Bellona Quarterly No 4, Warsaw 2014, p. 35, ISSN 1897 7065.
2 Based on: http://www.tvn24.pl, accessed on: 23th July 2015, 16.00 hours, at 4 p.m.
dropped from an unidentified vehicle landed within military aircraft located at the airport apron. It could be a warning regarding the possibility to conduct a terrorist attack by using similar methods.

Drones related incidents are increasingly common in Europe and worldwide. In October 2014, the UK Airprox Board (an agency responsible for security in aviation) revealed that when aircraft (AT72) was at the final stage to land on the Southend airfield, the crew noticed a drone flying near the aircraft’s right wing. As it was noticed, there were about 75 passengers on board. According to the incident report, “the object, believed to be a quadcopter, came within 25m of the AT72” and the plane’s co-pilot “formed the impression that the quadcopter had been flown deliberately close”. Moreover, “air traffic controllers at the Southend airport told the pilot that ‘a couple’ of quadcopters had previously been reported in the area”. A number of similar incidents have already happened in the US. In 2014, only during a month, there were dozens of airspace situations involving drones. Among them, two were very serious ones as the pilots were forced to change flight settings suddenly and, in few cases, UAVs were flying very close to the passenger aircraft. The main perpetrator of these problems, similarly to the European countries, have been small machines remotely operated by civil people. It is a side effect of the increased number of unmanned flights in the US and Europe. Those are used for a variety of purposes, primarily for military applications to provide an aerial picture of selected areas, but also for other domain as meteorology.

A collision with a small flying object could have a number of implications. For instance, a crash of a passenger aircraft with a bird at a high speed is dangerous. Thus, what could be consequences of a similar crash with a metal drone which weight is usually reaching a few kilograms? It is worth mentioning famous landing of seriously damaged the US Airways jetliner (Flight AWE1549) on the Hudson River in January 2009. It was a result of the clash with a skein of flying Canada geese and as a result both jet engines lost power. It made the pilot land on the river as the plane was not able to reach the closest airfield. The landing was a real miracle as nobody was injured and the member of the US National Transportation Safety Board called it “the most successful ditching in aviation history”.

As the presented above consequences of uncontrolled flights of drones could be rather dangerous for aviation security, therefore it is necessary to ‘civilize’ their use, especially as large multinational retail chains (for instance, Google and Amazon – supplies of goods and services) are considering innovative ways of goods’ delivery all over the world. If they are successful, the airspace will be soon overcrowded by unmanned flying suppliers. Therefore, very clear and precise regulations must be developed as soon as possible taking into consideration security from one side and civil rights and sovereignty of business practices on the other.

The European Commission is currently working on the draft of law regulations regarding the exploitation of UAVs by civil people. The main objective of such a regulation is to develop a coherent system of safety certificates for unmanned platforms.

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3 The Home Page of the UK Airprox Board (UKAB) website available at: http://www.airproxboard.org.uk/
6 The catastrophe of the US Airways Flight no1549 (AWE1549) took place on January 15, 2009 when an Airbus A320 piloted by Captain Sullenberger made an emergency water landing in the Hudson River in New York.
The new instructions will cover both the data transfer channels to control such unmanned vehicles form a long distance and also the dilemmas of protecting privacy of data collected by unmanned systems. Similarly, the European Defence Agency is conducting highly advanced research in relation to the future of unmanned platforms. However, the focus is mainly on developing combined rules of using military drones when conducting missions within civil owned airspace.

According to the applicable and current regulations, it means that within the international law, all civilian airships (manned and unmanned) are operated based on the Convention on International Civil Aviation (or the Chicago Convention) signed on December 7, 1944 in Chicago. The Convention is rather invalid and it has been a transitory law which should be be updated. The International Civil Aviation Organization (ICAO) recognizes the complexity of challenges and has established few deadlines: until 2018 - initial integration with air traffic in the airspace, excluding designated areas; until 2028 – full integration, allowing creation of entire view of all operations within the airspace, all unmanned platforms will be visible for air traffic controllers and it will be possible to communicate with them.

In Poland, similarly to many other nations, comprehensive regulations for unmanned platforms flights have not been established yet. The first Polish laws regarding UAVs have been included in the Act of 3th July 2002 entitled the Aviation Law Act published in the Journal of Laws of 2002, item: 933, 951 and 1544 and the 2013 item 134 (Polish: Ustawa z dnia 3 lipca 2002 r. Prawo Lotnicze, Dz. U. z 2012 r. poz. 933, z późn. zm.) with further amendments. A revised set of regulations in Poland was adopted on 30th June 2011 and was entered into force on 19th September 2011 allowing the use of unmanned systems, however relying on fulfilling some requirements including equipment of systems and qualified personnel. Moreover, „according to the article 126 of the Polish Aviation Act, each UAV operation in controlled airspace is possible after receiving the permission from the President of the Civil Aviation Office“. More detailed arrangements were created in 2013 by follow-on regulations for the implemented Act. The regulations allow to conduct UAVs flights however some essential criteria must be fulfilled such as: it is a recreational/sport flight; flight is performed within uncontrolled airspace; flight is conducted within eye sight of the operator; a total weight of a UAV, including all equipment, must be below 25 kilograms.

A drone flight within a controlled area or sphere of airfield (Controlled Traffic Region - CTR or Terminal Manoeuvring Area - TMA) is possible, however only if that drone strictly follows exactly the same rules as other airships. It is especially combined with standard equipment (navigation devices, communication assets allowing movement and control) analogous to manned aircraft operating on the basis of one of two sets of regulations managing all aspects of civil aviation aircraft operations, namely IFR (Instrument Flight Rules) or VFR (Visual Flight Rules). In the case when a flight is controlled without visual control from ground using FPV (First Person View) equipment, its rules are the same as for other air objects lying within IFR/VFR regimes. It means that

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10 Polish classified airspace is divided into: controlled airspace – Class C (from FL095 – FL660) in which fright control assistance, emergency and information services are provided and uncontrolled airspace Class G (from GND - FL095) in which emergency and information services are provided but excluding CTR, TMA, MCTR and MTMA.
UAV must be equipped with navigation and communication tools (transported, radio communication) and flight must be conducted based on the previously pre-planned route. It is worth noticing, that if flight is of a commercial type, an appropriate Unmanned Aerial Vehicle Operator (UAVO) certificate has to be obtained from the Polish Civil Aviation Authority. In other words, very popular FPV flights, being the most exciting for pilots, are to be operated only in designated zones. The flight could be only conducted when the Polish Air Navigation Services Agency (Polish: Polska Agencja Żeglugi Powietrznej - PAŻP), based on the application of the person concerned, designates a special Exercise Area (EA) for flights following Instrument Flight Rules (IFR).

Conclusion

Further development and functioning of UAV’s in Poland will be strictly dependent on properly structured law regulations. Nevertheless, legislation effort should take into consideration both small and large size flying platforms as the latter are gradually dominating civilian market. The law must include such aspects as: provision of services, licences for operators, technical arrangements, and, what is the most critical, also the rules of flights. In the future, also such aspects as flights out of designated zones, full integration with other users of airspace and complete compatibility with aviation law must be distinguished. At the same time, it is necessary to remember that unmanned fights require specifically adjusted regulations as there is no need to implement all the rules concerning manned flights. It is especially true in case of small flying objects used for recreational purposes. The detailed consideration should be conducted, for example, in relation to the Article 126 of the Aviation Law, mentioned before, which is the foundation for unmanned flights within Polish airspace. Therefore, there is an urgent need to distinguish the law definition of such a flying object and it should allow to distinguish precisely between a ‘toy’ and professional equipment. The definition must be profoundly thought as it will have long-term consequences and have an impact on future regulations and also the rules of unmanned platforms integration with air traffic. Moreover, there is no need to include all the traffic within controlled airspace as it could cause it to be ‘overcrowded’ and dangerous. Another aspect is the need to perform extensive research regarding protection of citizens’ privacy and utilization of UAVs by the state services as: police, fire brigade, border services, etc. Taking into consideration the complexity of the problem, the regulations will be the first attempt to formalize civilian exploitation of UAVs, and although some gaps could be expected, it might be a good and reasonable step forward for further legislative efforts. Civilian drones, even if they are not assembled, they do not necessarily disturb Polish airspace while performing their missions as long as the law defines precisely what is allowed and what is not. This is the direction towards which aviation law should aspire to.

BIBLIOGRAPHY

Jancelewicz B. red., Bezpieczeństwo i niezawodność w lotnictwie (Security and reliability in aviation) published by A. Marszałek Company, Toruń, 2009.

11 UAVO certificate is a license providing a drone pilot with a qualification permitting operating such devices for commercial purposes – other than sport of recreational purposes.


**Internet sources:**


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