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UNMANNED AIRCRAFT AS A GROWING HAZARD FOR AVIATION SAFETY

Systematically growing use of unmanned aircraft (UA) creates new threat areas for air traffic, such as the dangerous approaching of UA to manned aircraft during flights with passengers on a board. Such situations have been observed many times not only in Poland, but also in other countries airspace. The reason for that, according to the author, is primarily the widespread availability of various types of drones, as well as lack of full legal provisions. The author in that article presents growing threats, coming from unauthorized usage of unmanned aerial vehicles in airspace, to other kinds of aviation (passenger aircrafts in particular) in airports vicinity. Unidentified drones appearing next to passenger airplanes, during its approach to landing, as well UA landing on sites of nuclear power plants, military units, and even on the White House interior square, today are not something extraordinary. Therefore drones are such a big challenge. Their unlawful use may threaten air traffic safety, or it can be used to carry out terrorist attacks, sabotage, including actions against critical infrastructure, or to violate people's privacy. The new situation creates the scientific need for a comprehensive analysis of the problems. Many aspects presented in the article may contribute to better understanding the new challenges, as well it may be helpful for further researches in that area.

Keywords: unmanned aircraft, air traffic security, aviation security threats, aviation law.

1. INTRODUCTION

The purpose of the paper is to provide an overview of drones' utilization within civilian societies as a challenge for the security of air traffic. It will also analyse the term 'drone' and UA within civilian terminology, and more precisely, to identify source elements which are critical to decide if a selected flying object could be classified as such. Their utilization and tasks will be also mentioned. The legal aspects of using unmanned flying vehicles will be discussed as utilization of UA in air space is growing threat for manned platforms causing a real danger. It is assessed that the number of private users of UA will increase, probably expansively. It will be supported by growing availability of new technologies, lowering costs so their purchase for variety of application will be exploited for private and commercial purposes. It is ineffectual to try to limit UA utilization as they could not be fully controlled; it is rather requesting looking for building compromise allowing the develop-

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ment of that branch of aviation. Parallel, it is necessary to treat such the handlers and operators as another important group of air space users.

The future fully autonomous unmanned aerial vehicles will more effectively eliminate errors but it is still to come in the future. Currently as of their growing presence there is still a need to clearly formulate regulations and law to avoid incidents especially toward civilian air traffic. Another challenge is that those could be used to threaten security of societies by using UA as a tool in hands of terrorists and extremists. The drones' role is increasing every year and for example "by 2020, the Federal Aviation Administration (FAA) expects to have as many as 30,000 drones flying over the United States"².

2. AN OVERVIEW OF DRONES/UA

Drones started to be well-known when such the type of aerial vehicles supported US forces in Iraq and Afghanistan by conducting combat missions; UAV 'Predator' was a symbol of their employment. They were equipped with artificial intelligence, equipment and armament allowing conducting tasks in all weather conditions. Norman Friedman highlighted drones role as they allow concentrating and focusing humans only in those spots which are critically important and the rest should be covered by non-human assets like UAVs³. The Oxford Dictionary is defining a drone as "a remote-controlled pilotless aircraft or missile"⁴ giving many option to recognize such the platforms. The Collins Dictionary is providing extended definition linked with a remote control as "a drone is a type of aircraft that does not have a pilot and is controlled by someone on the ground" and another as "a pilotless radio-controlled aircraft"⁵. Based on commonly known definitions it could be acknowledged that a 'drone' is an aerodynamic flying system to conduct multiple tasks and those could be remotely controlled by using joystick or digital interface backed by a device used for automatic control. UA could be equipped in blades or wings, and original intentions of their utilization were to replace people/crews when conducting high risk aerial missions. The armed aerial vehicles designed to conduct combat missions are currently rather common and they are known as *Unmanned Combat Air Vehicles (UCAVs)* and they could perform variety of tasks⁶. The important factor is that many military solutions are transferred into civilian aviation. Terms 'drone' and UA are often treated as interchangeable and used as equivalent.

ICAO, in general, for unmanned aerial platforms uses terms: Remotely Piloted Aircraft (RPA) or in the broader sense Remotely Piloted Aircraft System (RPAS) . Based on that terminology are created legal regulations at the global (ICAO) and regional level (EASA,

² P. Paganini, *Hacking Drones... Overview of the Main Threats*, General Security 4 June 2013, <http://resources.infosecinstitute.com/hacking-drones-overview-of-the-main-threats/> (accessed: 22 February 2017).

³ N. Friedman, *Unmanned Combat Air Systems*, Naval Institute Press, Annapolis 2010, p. 46.

⁴ The Oxford Living Dictionaries, <https://en.oxforddictionaries.com/definition/drone> (accessed: 22 February 2017).

⁵ The Collins Dictionary, <https://www.collinsdictionary.com/dictionary/english/drone> (accessed: 22 February 2017).

⁶ See in details in: L. Cwojdzński, *Zadania wykonywane przez systemy platform bezałogowych i powody ich stosowania*, Program „Pięć żywiołów. Wolność – informacja – bezpieczeństwo”, 2014, p. 2–3, <http://www.5zywiolow.pl/wp-content/uploads/2014/02/zasady-uzycia-uav-leszek-cwojdzinski.pdf> (accessed: 25 January 2017).

EUROCONTROL, European Commission) levels. In the practical meaning the very popular terminology is of Unmanned Aircraft (UA) and Remotely Piloted Aircraft (RPA). Distinguish these terms is very important in the context of the safety of air operations, especially in connection with the future integration of manned and unmanned aviation systems.

The drone definition is rather general as they are described as: an unmanned, remotely controlled aerial vehicle or a missile designed for precision attack. However, just preliminary analysis of the definition is discovering two contradictory pieces of information. First, it is questionable if a single use device designed for a single mission (e.g. destruction of pre-planned target) could be named 'drone'. Second, to be recognized as 'drone' such a device should be remotely controlled or should be able to perform fully autonomous flight (according to pre-planned route). Drones' users, especially fans of modelling, are extending the definition by including two more elements. Those are: range of UA and necessity of locating advanced devices and sensors on UA board to operate a device using control system; however in such the case it is not just a *Remotely Piloted Vehicle (RPV)*. *RPVs* are also known as of military operations as those were used by Israel already in 1982 during operations in Lebanon; Israel is one of leading nations in such technologies⁷. Such UA are equipped with cameras, to see what is seen by a pilot of a manned aircraft, and they possess modern version of tool known as *First-Person View (FPV)* or remote-person view; some are naming it as a 'video piloting'. So, it is not a drone in classical understanding. Though, as soon as it is achieving an option of remote control e.g. using personal computer, working and 'land based control station' allowing to start autopilot and to switch into an automatic mission control mode, we are undoubtedly dealing with UA; it means an actual drone following the extended definition.

The UA include a subgroup called *Autonomous UAVs*, which are vehicles completely controlled by computers excluding an option of a manual control by an operator (e.g. performing missions according to pre-planned route within designated area). It is causing a question: Could be *RPVs*, equipped with camera allowing *FPV* flights, recognized as UA? The answer is that rather no; those are still remotely piloted aerial vehicles and not drones. As such those should not be a subject of detailed law regulations but rather they such be exposed toward strict limitations regarding their access to air space, especially as the number of such devices will grow very rapidly.

Consequently, it will be impossible to control or to identify all of them and those will 'litter' the air space so only solution is to learn how to deal with them as there is no other choice. According to James Hing, currently there are three modes of operating UAVs: external piloting (EP) controlling flight by line of sight; internal piloting (IP) using ground station and on board camera and autonomous flight⁸. An example of full autonomy is advanced US Global Hawk⁹ or Airbus Group's (former *European Aeronautic Defence and*

⁷ M. Pardesi, *Unmanned aerial vehicle: missions, challenges, and strategic implications for small and medium powers* [in:] B. Loo (ed.), *Military Transformation and Strategy. Revolutions in Military Affairs and Small States*, published by Routledge, New York 2009, p. 102.

⁸ J. Hing, P. Oh, *Development of Unmanned Aerial Vehicle Piloting System with Integrated Motion Cueing for Training and Pilot Evaluation*, in K. Valavanis, P. Oh, L. Piegł (eds.) *Unmanned Aircraft Systems, International Symposium On Unmanned Aerial Vehicles, UAV'08*, Springer Science & Business Media 2008, p. 6-7.

⁹ *Global Hawk*, Website Northrop Grumman Corporation, <http://www.northropgrumman.com/capabilities/globalhawk/Pages/default.aspx> (accessed: 26 January 2017).

Space Company – EADS) system *Eagle* (French: *Système Intérimaire de Drone Male* – SDIM)¹⁰; both systems could support maritime and air traffic, internal national security, search and rescue operations and many other tasks. There are many UAVs with an option to switch between modes. All the modes must have close integration with any platform security, remote piloting and payload management (Fig. 1).

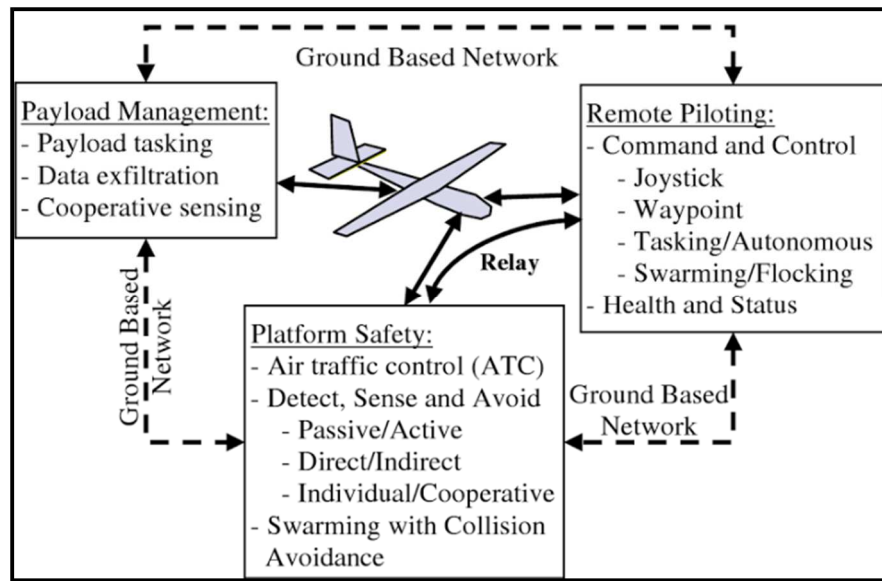


Figure. 1. Different types of communication in Unmanned Aircraft.

Source: E. Frew, T. Brown, *Networking Issues for Small Unmanned Aircraft Systems* [in:] K. Valavanis, P. Oh, L. Piegl (eds.) *Unmanned Aircraft Systems, International Symposium On Unmanned Aerial Vehicles, UAV'08*, Springer Science & Business Media 2008, p. 25.

At the present it is not so easy to fully predict to what purposes drones could be used in the future. The society is usually considering them as unmanned platforms to be used by armed forces or national law enforcement services to enhance their capabilities to create safe and secure environment. Is it to be continued in the future? The answer is given every day as we can observe them for new applications. We could say, with high degree of certainty, that in next one or two decades those devices will be even more ordinary element of people's daily life. However, it should not be forgotten that drones are not only supporting security as those are also real threat for overall security systems, including personal security. Unmanned solutions are linked with some "systemic gaps" and they could become challenging for security and it is not only linked with terrorism. As a result, technological development within unmanned solutions sphere must be closely interconnected with accelerating study also in such the fields as: law, teleinformatics systems, crisis management,

¹⁰ *Eagle MALE System Medium Altitude Long Endurance UAV*, Defense Update, as of 9 December 2006, <http://defense-update.com/products/e/eagle-UAV.htm> (accessed: 30 January 2017).

defence and security including internal security of each single nation. It should be followed by companies operating on an insurance market taking into account common accessibility of drones based on lowering costs causing a risk of unexpected incidents. Such the UAV type systems must be treated with great importance within an air space management system with the focus on security. According to US Department of Defence some 70% of manned aircraft catastrophes¹¹ are caused by human errors and further autonomy will not eliminate it as still a human will be controlling them. But now “pilots” being outside of cockpit will have increased tendency to make more risky decisions with lower situational awareness and limitations to face unexpected emergencies and situations.

Drones, similarly to any airspace apparatus, are functioning as a system composed of two major elements: man and machine. A machine, in that sense the air element of the system, is similar to any type of aircraft; the only real difference is its size. The ground element is a control station, stationary or mobile, considered as a working space for the land based controllers/operators. As such, a drone should be interpreted as a typical airship, which is remotely controlled in real time when possessing software to control all the flight parameters and also modules and interfaces to enable exchange of data. Typical UA is also equipped in a variety of sensors connected with software avionics and also optionally with weapon systems and autopilot. Such the broad range of equipment is causing that a drone is not so different when compared with a manned air platform. The only major and typical difference is related to the location of a crew. A ground based control station, used to control drones, consists of software, interface modules and designated and trained personnel. It is worth to notice, that from security point of view, every air and land component of a drone could be a subject of terrorist or cyber-attack; in specific conditions it could cause a danger for air traffic and aviation in general. It is also relatively easy to overtake control of a drone. Todd Humphrey, professor at the University of Texas at Austin’s Radio navigation Laboratory, has demonstrated that hacking a civilian drone is relatively easy. He presented for the Department of Homeland Security that using a limited budget and some persons, he is able to “send signals to an UAV’s GPS receiver, hijack the aircraft in mid-air, and control its route”¹². He spent some 1,000 USD on equipment and designing an application. This example confirms the magnitude of the terroristic threat associated with the use of UAVs and how low costs are needed to take over control another UAV to perform a terrorist attack on the passenger aircraft for instance.

3. UA AS AIRSPACE’S SECURITY CHALLENGE

The US Congress has adopted an act regarding modernization and reform of the Federal Aviation Administration (FAA). The focus of the reform has been to execute government actions to speed up an integration of all the drones within US airspace, which is recognized to be the most overcrowded airspace in the world. It was forced by enormous number of requests the FAA has been receiving to grant certificates for variety of commercial activities using new capabilities; it was mainly linked with certificates to use drones for videoing. One of reasons was that even “model aircraft may pose a safety hazard to full-scale aircraft

¹¹ J. Hing, P. Oh, *Development of Unmanned...*, p. 5–6.

¹² P. Paganini, *Hacking Drones ... Overview of the Main Threats...*

in flight and to persons and property on the ground”¹³. However, such the permissions were treated as precedents; the situation has changed as for now and those permissions are rather norm than precedent. The applications are mainly related to different branches of industry and economy, as: agriculture, energy sector, health care, protection of natural environment, postal services and also tourism. US Congress recognizing a challenge related to drones was concerned that those are violating right to privacy and imposed some limitations e.g. they cannot be weaponized, surveillance only in public spaces, collected videos must be deleted in 24 hours (judge could extend it)¹⁴. There is also a law against ‘drone stalking’ and ‘peeping drones’ to avoid spying or track individuals. Among others reasons, the request of the Amazon Company to be granted approval to deliver post using drones has grasped the attention of government. Similar project had been considered by the German DHL Company and finally the company was permitted to deliver such the drone based services as the first provider in Europe¹⁵. Also other global multinational technology companies e.g. Google and Facebook have expressed their interest in exploitation of options offered by drones.

Currently, the most challenging issue related to aviation security is drones’ unexpected presence in the vicinity of airports, and even within their controlled zone. In that case the creativeness of amateur pilots is unlimited crossing often the line of stupidity, which could have very serious consequences. Many cases of such the approach of senseless drones’ pilots (or rather pseudo-pilots) could lead to air catastrophes, especially when closing to manned aircraft (e.g. passenger airliners). Similar instances are happening more often and they are publicized by mass media. 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 high speed is dangerous; so what could be consequences of similar crash with metal drone which weight is usually reaching a few kilograms. It is adequate to mention famous landing of a crippled US Airways jetliner (Flight AWE1549) on the Hudson River in January 2009¹⁶. It was the result of a clash with a skein of flying Canada geese and the result both jet engines lost power. It caused pilot to 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 a member of the US National Transportation Safety Board called it “the most successful ditching in aviation history”¹⁷.

Drones related incidents are increasingly common in Europe and in the world. In October 2014 the UK Airprox Board¹⁸ (the agency responsible for safety in aviation) revealed that when an aircraft (AT72) was on the final approach to land on the Southend airfield the

¹³ D. Marshall, *U.S. Aviation Regulatory System*, in D. Marshall et al. (eds.), *Introduction to Unmanned Aircraft Systems*, CRC Press Boca Raton 2011, p. 40.

¹⁴ H. Gusterson, *Drone. Remote Control Warfare*, the MIT Press, Massachusetts 2016, p. 155.

¹⁵ 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), Bellona Quarterly No 4, Warsaw 2014, p. 35.

¹⁶ The catastrophe of the US Airways Flight 1549 (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.

¹⁷ J. Olshan, *Quiet Air Hero is Captain America*, New York Post 17 January 2009, <http://nypost.com/2009/01/17/quiet-air-hero-is-captain-america/> (accessed: 12 March 2017).

¹⁸ The Home Page of the UK Airprox Board (UKAB) website available at: <http://www.airprox-board.org.uk/>

crew noticed a drone flying “in the very close vicinity” of the aircraft’s right wing¹⁹. What was noticeable, there were as many as 75 passengers on the board. According to incident report “the object, believed to be a quadcopter, came within 25m of the AT72” and the co-pilot “formed the impression that the quadcopter had been flown deliberately close”²⁰. Moreover, “air traffic controllers at Southend airport told the pilot ‘a couple’ of quadcopters had previously been reported in the area”²¹. A number of similar incidents have already happened in US. In 2014 during just a single month there were dozens of air space episodes involving drones. Among them, two were very serious as pilots were forced to suddenly change flight settings and in a few cases, UAVs were flying very close to passenger aircraft. The main perpetrators of these problems, similarly to European countries, have been small machines remotely operated by civilian persons. It is a side effect of increased number of unmanned flights in US and in Europe. Those are used for variety of purposes, primarily for civilian applications to provide aerial picture of selected areas, but also for other domains as meteorology.

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

4. LEGAL ASPECTS OF REGULATING USE OF UA

According to the Polish law there is no clear and unambiguous definition of an unmanned aerial vehicle and there is also lack of precise description of such the device. Typical term used in variety of jargons is naming them as ‘drones’. Such the term is widely used by media, particularly as violations of air space by drones is more frequent. Within academic community and among specialists such the devices are mainly recognized as *Unmanned Aerial Vehicles (UAVs)* and in context of using wider technologic approach, they are defined as *Unmanned Aircraft Systems (UASs)*. Polish aviation law is rather restrictive regarding drones, as those devices’ commercial use requires 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 the users possess such certificates or are considering applying for them. This is important factor, as the number of certificates is not following the growing quantities of drones. As for now, there are plenty of advertisements on various types of networks offering business type services as commemorative photos and videos from the sky by employing drones. Next, it is necessary to consider what to do with other drones users who are declaring non-commercial exploitation as it is not easy to verify such the declarations. Is it not purposeful to

¹⁹ Based on: *Życie 75 ludzi na włosku przez zblakowanego drona...*, Portal Dron.pl 29 October 2014, <http://info.dron.pl/zycie-75-ludzi-na-wlosku-przez-zblakowanego-drona/> (accessed: 12 January 2017).

²⁰ *Quadcopter drone flew ‘too close’ to Southend-bound plane*, BBC News 27 October 2014, <http://www.bbc.com/news/uk-england-esssex-29785322> (accessed: 15 January 2017).

²¹ *Ibidem*.

seriously approach such the topic before some negative consequences would happen? Are there any proper solutions to the issue? Especially as it is the real threat from one side but also infringement of the personal liberties and freedoms from the other. Generally, it is a real problem requiring reliable arrangements.

In Poland, similarly to other countries, many intrusions into airports' controlled zones have been noticed and as a consequence dangerous attempts to get as close as possible to manned aircraft. Many accidents have not been published by media to avoid panic and threat of using air mode of travelling. However, unauthorized intrusion into the airspace of the Warsaw Okęcie Airport initiated wide discussion as it was rather close to a serious incident. It happened on 20 July 2015 when a crew of an Embraer 195 aircraft, flying from Munich to Warsaw, noticed a flying object at a 700 meters altitude. Based on the crew assessment it was probably a drone located on the landing approach some 10 kilometres from the beginning of the airport runway. Therefore the aircraft with more than 20 passengers on board was forced to change its landing direction. Similar incident happened the same week in Łódź. Typical drone was observed in the vicinity of an airport and it caused a threat for a small aircraft performing training flight²². More serious accident occurred in Krakow when a flare was dropped from an unidentified vehicle, which landed among military aircraft located on the airport apron. It could be a warning regarding a possibility to conduct a terrorist attack using similar methods.

According to applicable and current regulations, it means within international law, all the civilian airships (manned and unmanned) are operating based on the Convention on International Civil Aviation (or the Chicago Convention) signed on December 7, 1944 in Chicago. The Convention is rather outdated and it has been transitory law which have to be updated. It is worth noting that the annexes to the Convention are kept up-to-date. However, the full integration of unmanned aerial vehicles and manned aircraft requires updating almost all annexes (18 of 19). The International Civil Aviation Organization (ICAO) is recognizing that complexity of the challenges and has established a few deadlines:

- until 2018 – initial integration with air traffic in airspace, excluding designated areas;
- until 2028 – full integration, allowing creation of full picture of all the operations within airspace; all the unmanned platforms will be visible for air traffic controllers and it will be possible to communicate with them.

The European Commission (EC) is currently working on a draft of law regulations regarding exploitation of UA by civilian persons. The main objective of such the regulation is to develop cohesive system of safety certificates for unmanned platforms. The new instructions will cover both data transfer channels to remotely control such the unmanned platforms and also the dilemmas of protecting privacy of data collected by unmanned systems. Is expected that Commission finishes the activities related to integration of RPAS in European airspace up to 2028. In this timeframe, besides the evolution of technical and operational rules, which will lead to alleviation of restrictions for operations of RPAS in European airspace, together mixed with manned aviation, following the same air traffic management procedures and ensuring the same level of safety and security. Furthermore, in the future, after year of 2028, the operators RPAS, based on common rules and mutual recognition that roles by the states, could fly cross border operations intra EU, avoiding the

²² Based on: *Kolejny dron w pobliżu lotniska? Tym razem w Łodzi*, TVN 24, 23 July 2015, <http://www.tvn24.pl/lodz,69/kolejny-dron-w-poblizu-lotniska-tym-razem-w-lodzi,562579.html> (accessed: 12 January 2017).

administrative burden. Similarly acts the European Defence Agency, which conducts highly advanced research in relation to the future of unmanned platforms; however the focus is mainly on developing unified rules of using military drones when conducting missions within civil owned airspace. In the similar way is acting EASA. That institution currently (since 2016) works on establishing common security principles for all RAPS, without dividing on commercial and no - commercial.

In Poland, analogously 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 from 3 July 2002 titled the Aviation Law Act published in the Journal of Laws of 2002, pos. 933, 951 and 1544 and the 2013 pos. 134 (Polish: ustawa z dnia 3 lipca 2002 r. Prawo lotnicze, Dz.U. z 2012 r., poz. 933 ze zm.)²³ with further amendments. A revised set of regulations in Poland was adopted in on 30 June 2011 and it entered into force on 19 September 2011 allowing use of unmanned systems only when meeting some requirements including equipment of systems and also qualification of personnel. Moreover, „according to the article 126 of Polish Aviation Act each UA operation in controlled airspace is possible after receiving the permission from the President of the Civil Aviation Office”²⁴. More detailed arrangements for UAV were created in 2013 and updating in the follow-on amendments as well as the regulations for the implemented Act. The regulations are allowing conducting UAVs flights but some criteria must be fulfilled:

- It is recreational/sport flight in character;
- A flight is performed within uncontrolled airspace²⁵;
- A flight is conducted within eye sight of an operator;
- possible destruction by state services in the event of suspected unauthorized use against persons or critical infrastructure (Article 126 to that act);
- the total weight of a UAV, including all equipment, must be below 25 kilograms.

A drone flight within a controlled area or sphere of an airfield (*Controlled Traffic Region* – CTR or *Terminal Manoeuvring Area* – TMA) is possible, however only if that drone will strictly follow exactly the same rules as other airships. It is especially linked with standard equipment (navigation devices, communication assets allowing movement and control) analogous to manned aircraft operating based on one of two sets of regulations governing all aspects of civil aviation aircraft operations, namely IFR (Instrument Flight Rules) or VFR (Visual Flight Rules). In the case the 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 UAV must be equipped into navigation and communication tools (transported, radio communication) and the flight must be con-

²³ Available in Polish language: *Obwieszczenie Marszałka Sejmu Rzeczypospolitej Polskiej z dnia 22 maja 2012 r. w sprawie ogłoszenia jednolitego tekstu ustawy – Prawo lotnicze*, Journal of Laws of the Republic of Poland, Warsaw 16 August 2012, <http://www.dziennikustaw.gov.pl/DU/2012/933> (accessed: 19 March 2017).

²⁴ See in details in: M. Polkowska, *Latest National Regulations on Unmanned Aircraft Systems in Military and Civil Aviation in Poland*, Polish Civil Aviation Authority, published in ESPI Perspectives No. 60, May 2012, p. 1-4.

²⁵ Polish classified airspace is divided into: controlled airspace – Class C (from FL095 – FL660) in which flight 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.

ducted based on previously pre-planned route. It is important to notice, that if the flight is commercial in character, an appropriate *Unmanned Aerial Vehicle Operator* (UAVO) certificate have to be obtained from the Polish Civil Aviation Authority²⁶. In other words, very popular FPV flights, being the most excited for pilots, are to be operated only in designated zones. It could be conducted only when the Polish Air Navigation Services Agency (Polish: Polska Agencja Żeglugi Powietrznej – PAŻP), based on application of a person concerned, designates a special *Exercise Area* (EA) for flights following the Instrument Flight Rules. Utilization of UAVs caused many experiences allowing their upgrade for better synchronization, enhanced capabilities, specialization, resistance for unauthorized control etc.²⁷. This is important as there are new solutions to support such the modifications to have better characteristics of UAVs and supplemented by better software and skills of operators²⁸. It is linked with their endurance and constant readiness to act in short notice²⁹. According to Maryann Lawlor it is possible that “autonomous, networked and integrated robots may be the norm rather the exception by 2025”³⁰.

5. CONCLUSIONS

The trend to use more UA for private and commercial purposes is in constant raise and this is an issue to be faced by agencies responsible for air traffic. The new technologies are offering more advanced solutions and now a drone or UA is available for average person to be used of variety of purposes. The desire to limit is not to be successful requiring rather creation of tools to ‘civilize’ and legalize those emerging capabilities. The air accidents involving UA are asking for decisive and purposeful steps to merge that group of air space users into overall system. If it will not happen more hazards will happen especially among radical elements of societies having new ‘tools’ to play with. It should not be even excluded that UA will be armed by amateur “pilots” to conduct air combat and to attack ground targets similar to military UCAVs. The desire to challenge manned aircraft or utilization by extremists could be unavoidable. Further development and functioning of unnamed aviation will be strictly dependent on properly structured law regulations. Nevertheless, the legislation effort should take into consideration both small and large size flying platforms as the latter are slowly dominating civilian market. The law must include such the 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 the aspects as flights out of designated zones, full integration with other users of airspace and complete compatibility with aviation law must be distinguished.

²⁶ UAVO certificate is a license proving a drone pilot qualification permitting operating such the devices for commercial purposes – other than sport or recreational reasons.

²⁷ L. Haulman, *U.S. Unmanned Aerial Vehicles in Combat, 1991-2003*, Air Force Historical Research Agency, Maxwell Air Force Base 9 June 2003, p. 16.

²⁸ K.P. Valavanis et al., *Unmanned Aircraft System*, ed. Springer, Philadelphia 2009, p. 184.

²⁹ N. Friedman, *Unmanned Combat Air Systems*, Naval Institute Press, Annapolis 2010, p. 3, annex II p. 69–248.

³⁰ M. Lawlor, *Robotics Concepts Take Shape*, The Armed Forces Communications and Electronics Association (AFCEA), Fairfax 2003, <http://www.afcea.org/content/?q=robotics-concepts-take-shape> (accessed: 12 March 2017).

At the same time, it is necessary to remember that unmanned flights are requiring specifically adjusted regulations as there is no need to implement all the rules concerning manned flights. It is especially true in the case of small flying objects used for recreational purposes. The detailed consideration should be conducted e.g. in relation to 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 law definition of such the flying object and it should allow precise distinction between a ‘toy’ and professional equipment. Such the definition must be profoundly thought as it will have long-term consequences and will influence future regulations and also the rules of unmanned platforms integration with air traffic. Moreover, there is no need to cumulate all the traffic within controlled airspace as it could cause it to be ‘overcrowded’ and dangerous. Another aspect in the need to do deep research regarding protection of citizens’ privacy and utilization of UA by 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 UA, and although some gaps could be expected, it could be good and reasonable step forward for further legislative efforts. Civilian drones, even if it will not be fully assembled ones, are not necessarily intruders in the Polish airspace when conduction their missions as long as the law will precisely define what is and what is not allowed. This is the direction toward which the aviation law should aspire.

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BEZZAŁOGOWE STATKI POWIETRZNE JAKO ROSNĄCE ZAGROŻENIE BEZPIECZEŃSTWA W LOTNICTWIE

Systematycznie rosnące wykorzystanie bezzałogowych statków powietrznych tworzy nowe obszary zagrożenia dla ruchu lotniczego, takie jak niebezpieczne zbliżanie się do załogowych statków powietrznych podczas lotów z pasażerami na pokładzie. Takie sytuacje wielokrotnie obserwowano nie tylko w Polsce, ale także w przestrzeni powietrznej innych krajów. Powodem tego jest, według autora, przede wszystkim powszechna dostępność różnych typów dronów, a także brak pełnych przepisów prawnych. Autor w tym artykule przedstawia rosnące zagrożenia, wynikające z nieuprawnionego użycia bezzałogowych statków powietrznych w przestrzeni powietrznej, do innych rodzajów lotnictwa (w szczególności samolotów pasażerskich) w pobliżu lotnisk. Niezidentyfikowane drony pojawiające się obok samolotów pasażerskich, podczas podejścia do lądowania, a także lądowanie tych platform na terenach elektrowni jądrowych, jednostek wojskowych, a nawet na placu wewnętrznym Białego

Domu, dziś nie są czymś nadzwyczajnym. Dlatego drony są tak dużym wyzwaniem. Ich bezprawne wykorzystanie może zagrozić bezpieczeństwu ruchu lotniczego lub może być wykorzystywane do przeprowadzania ataków terrorystycznych, sabotażu, w tym działań przeciwko krytycznej infrastrukturze lub naruszania prywatności ludzi. Nowa sytuacja stwarza naukową potrzebę kompleksowej analizy problemów. Wiele aspektów przedstawionych w artykule może przyczynić się do lepszego zrozumienia nowych wyzwań, a także może być pomocne w dalszych badaniach w tym obszarze. Jest to zasadniczy cel prezentowanego artykułu.

Słowa kluczowe: bezzałogowe statki powietrzne, bezpieczeństwo ruchu lotniczego, zagrożenia bezpieczeństwa lotniczego, prawo lotnicze.

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