

3. ARMED FORCES, MILITARY TECHNOLOGY

SELECTED SECURITY ASPECTS OF THE USE OF UAVS IN AIRSPACE¹

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ABSTRACT

The widespread use of civilian unmanned aerial vehicles (UAVs) has created a new threat for air traffic. This is why there is a requirement to initiate research in that domain as UAVs have already been seen flying too close to manned aircraft, including commercial and military flights. It was notified in airspace of many countries. Such incidents have occurred in many countries causing a need to conduct a multi-vector analysis of the matter. The issue is facilitated by very easy access to drones, lack of law regulations, and people's lack of understanding of the threat. Unidentified drones have already landed within area of nuclear power stations, military units and even highly secured interior of the White House. So, the challenge is rather significant. It could lead to undermining the security of air traffic, but at the same time to terrorists' attacks, the violation of privacy, and sabotage, including acts against critical infrastructure. It is necessary to study the issue and the paper could be a contribution to enhancing the understanding of the challenge and facilitator of further research.

KEY WORDS

Unmanned aerial vehicle, drone, air traffic security, aviation security threats, aviation law.

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Introduction

Modern technologies of the digital age influence all the domains of contemporary societies and they constantly offer new capabilities by endorsing new advanced solutions. They have both military and civilian applications with huge potential to influence the future because of continuous research. It is recognized especially in developed countries because of available funds and their science, technological

and innovation potential. The reasons are rather pragmatic as there is clear understanding that advanced technologies and equipment enable gaining advantage in the competitive world. The race is closely linked with the development of unmanned platforms with a significant role of aerial vehicles. There are many reasons for that as those could be used to support manned systems in the variety of roles in crowded

cities and huge remote areas. They are cheaper, reliable and as described in relation to military applications, "They don't get hungry. They aren't afraid. They don't forget their orders. They don't care if the guy next to them has just been shot. Will they do a better job than humans? Yes"¹. Unmanned platforms are, however, also a challenge due to security reasons as many accidents have happened in airspace of many countries because of the uncontrolled movement of such the devices. The main reasons were human mistakes, lack of skills and just carelessness. The future fully autonomous unmanned aerial vehicles (UAVs) will more effectively eliminate errors but it is still to come in the future. Currently, due to their growing presence, there is still a need to clearly formulate regulations and law to avoid incidents, especially in civilian air traffic. Another challenge is that those could be used to threaten security of societies by using UAVs as a tool in hands of terrorists and extremists. The role of drones increases 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.

The purpose of the paper is to provide an overview of the use of drones in civilian societies as a challenge for the security of air traffic. It will also analyse the term 'drone' and UAV 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 use and tasks will be also mentioned. The legal aspects of using unmanned flying vehicles will be discussed as the use of UAVs in air space is a growing threat for

manned platforms causing a real danger. It is assessed that the number of private users of UAVs will increase, probably expansively. It will be supported by the growing availability of new technologies, lowering costs so their purchase for the variety of application will be exploited for private and commercial purposes. It is ineffectual to try to limit the use of UAVs as they could not be fully controlled; it is rather requesting looking for building compromise allowing the development of that branch of aviation. At the same time, it is necessary to treat such the handlers and operators as another important group of air space users.

An overview of drones/ UAVs

Drones started to be well-known when such 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 the role of drones as they allow humans to focus only on those spots which are critically important and the rest should be covered by non-human assets like UAVs³. The Oxford Dictionary defines a drone as "a remote-controlled pilotless aircraft or missile"⁴ giving many option to recognize such platforms. The Collins Dictionary provides an extended definition linked with a remote control and it says that "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 com-

¹ Read also: R. Arkin, *Governing Lethal Behavior in Autonomous Robots*, Chapman & HALL/CRC, Boca Raton 2009, p. 7.

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.oxford-dictionaries.com/definition/drone> (accessed 22 February 2017).

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

monly 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 a joystick or digital interface backed by a device used for automatic control. UAVs could be equipped with blades or wings, and original intentions of their use 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 the variety of tasks⁶. The important factor is that many military solutions are transferred into civilian aviation. Terms 'drone' and UAV are often treated as interchangeable and used as equivalent.

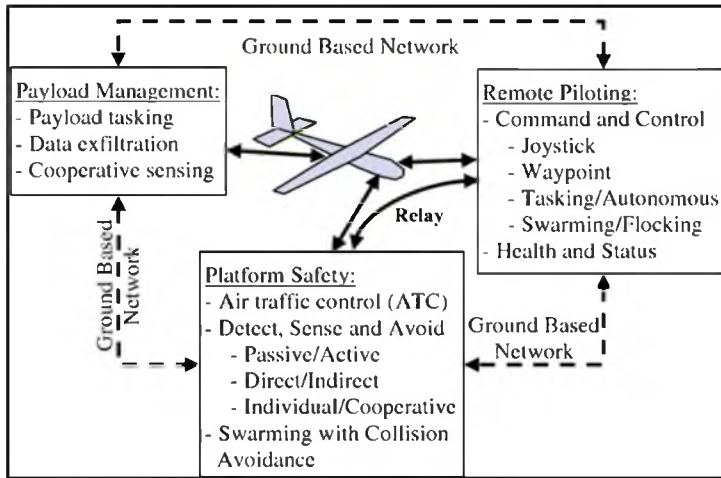
The definition of a drone is rather general as it is described as an unmanned, remotely controlled aerial vehicle or a missile designed for a precision attack. However, just preliminary analysis of the definition discovers two contradictory pieces of information. First, it is questionable if a single use device designed for a single mission (e.g. the destruction of a pre-planned target) could be named 'a drone'. Second, to be recognized as 'a drone' such a device should be remotely controlled or should be able to perform fully autonomous flight (according to a pre-planned route). Drone users, especially the fans of modelling, extend the definition by including two more elements. Those are: a range of UAVs and necessity of locating advanced devices and sensors on UAVs board to operate a device using a control system; however, in such a case, it is not just a *Remotely Piloted Vehicle (RPV)*.

RPVs are also known as a result 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 UAVs are equipped with cameras to see what is seen by a pilot of a manned aircraft, and they possess a modern version of tool known as *First-Person View (FPV)* or remote-person view; some call it 'video piloting'. So, it is not a drone in classical understanding. Though, as soon as it achieves an option of remote control e.g. using a personal computer, working and 'a land based control station' allowing for starting an autopilot and switching into an automatic mission control mode, we undoubtedly deal with an UAV; it means an actual drone following the extended definition.

⁶ See in details in: L. Cwojdzinski, 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).

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.

Figure 1. Types of communication in UAVs



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. 26.

UAVs 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 a pre-planned route within a designated area). It raises a question: Could a FPV, equipped with a camera allowing FPV flights be recognized as an UAVs? 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 instead they should be subject to 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 identify all of them and those will 'litter' the air space so the 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 Space Company – EADS*) *Eagle* system (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).

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. Piegl (eds.) *Unmanned Aircraft Systems, International Symposium On Unmanned Aerial Vehicles, UAV'08*, Springer Science & Business Media 2008, p. 6-7.

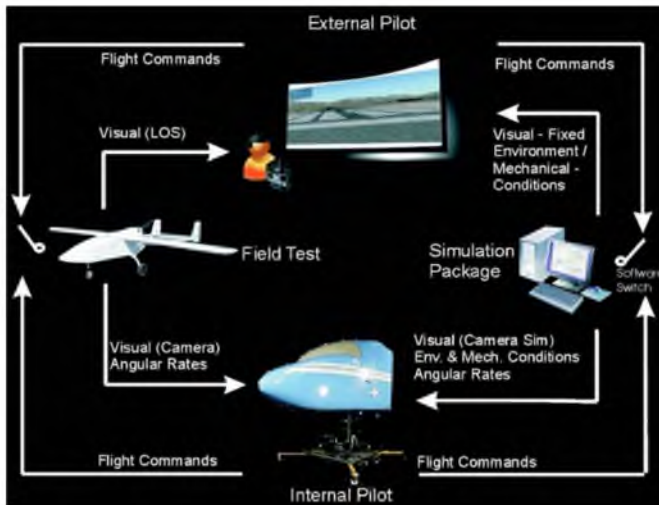
⁹ Global Hawk, Website Northrop Grumman Corporation, <http://www.northropgrumman.com/capabilities/globalhawk/Pages/default.aspx> (accessed 26 January 2017)

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)

At the present it is not so easy to fully predict what purposes drones could be used for in the future. The society usually regards 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 their applications. We could say, with high degree of certainty, that in next one or two decades those devices will be even an ordinary element of people's daily life. However, it should not be forgotten that drones not only support security as those are also a 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 the sphere of unmanned solutions must be closely interconnected with accelerating research, also in such fields like law, tel-

informatics systems, crisis management, 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 types of UAV 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 catastrophes¹ are caused by human errors and further autonomy will not eliminate it is still a human who will control 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. This requires the proper training of operators including software and hardware interface for a mission capable system (Fig. 2).

Figure 2. The setup to evaluate effectiveness of motion cueing for UAV control.



Source: 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. Piegl (eds.) Unmanned Aircraft Systems, International Symposium On Unmanned Aerial Vehicles, UAV'08, Springer Science & Business Media 2008, p. 5.

¹¹ J. Hing, P. Oh, op. cit p. 5-6.

The aviation regulations distinguish a few categories of such devices classified according to their weight or impact kinetic energy caused when flying. The main areas of using UAVs are mainly observation (using the variety of sensors to measure parameters of environment) and transport (transport of freight including heavy cargo). Moreover, new domains and areas emerge 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 crews' health and even life.

Drones, similarly to any airspace apparatus, function 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. A typical UAV is also equipped with a variety of sensors connected with software avionics and also optionally with weapon systems and an autopilot. Such a broad range of equipment makes a drone not so different when compared with a manned air platform. The only major and typical difference is related to the location of crew. A ground based control station used to control drones, consists of software, interface modules and designated and trained personnel. It should be noted that as regards security, 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, demonstrated that hacking a civilian drone is relatively easy. He showed 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 1,000 USD on equipment and designing an application.

UAVs as a challenge to the security of airspace

The US Congress adopted an act on the modernization and reform of the Federal Aviation Administration (FAA). The reform focuses on executing 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 an enormous number of requests the FAA had received to grant certificates for the variety of commercial activities using new capabilities; it was mainly linked with certificates to use drones for videoing. One of the reasons was that even "a model aircraft may pose a safety hazard to full-scale aircraft in flight and to persons and property on the ground"¹³. However, such permissions were treated as precedents; the situation has changed as for now and those permissions are rather a norm than a precedent. The applications are mainly related to different branches of industry and economy such as agriculture, an energy sector, health care, the protection of natural environment, postal services and also tourism. US Congress, recognizing a challenge related to drones, was concerned that those

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

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.

violate the right to privacy and imposed some limitations, for example they cannot be weaponized, surveillance only in public spaces, and 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 tracking individuals. Among others reasons, the request of the Amazon Company to be granted approval to deliver post using drones attracted the attention of government. A similar project was considered by the German DHL Company and finally the company was permitted to provide such 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 using options offered by drones.

It was recognized that the broad employment of civilian UAVs was linked with some negative side effects. For instance, they could be destroyed, damaged or involved in accidents, so when performing emergency landing they could trigger collateral destructions being a subject of judicial procedures when trying to recognize who was responsible for them. Drones could be a real threat for aviation and airspace security management as every single drone flight could be a source of lack of respect toward the aviation law, including the violation of the designated flying sphere, conducting flight above the designated altitude or performing flights within an airport control zone (Controlled Traffic Region – CTR), which is absolutely unacceptable. So, following regimes being in force very strictly, 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 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 an approach of senseless drone pilots (or rather pseudo-pilots) could lead to air catastrophes, especially when closing to manned aircraft (e.g. passenger airliners). Similar instances happen 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 the consequences of a similar crash with a metal drone whose weight usually reaches a few kilograms be? It is adequate to mention the famous landing of a crippled US Airways jetliner (Flight AWE1549) on the Hudson River in January 2009¹⁶. It was the result of a collision with a skein of flying Canada geese and a consequent loss of power of both jet engines. 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 a member of the US National Transportation Safety Board called it "the most successful ditching in aviation history"¹⁷.

Drone – related incidents are increasingly common in Europe and in the world. In October 2014, the UK Airprox Board¹⁸ (the agency responsible for safety in avia-

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

¹⁵ J. Simonides, *Prawnomędzynarodowe 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.airproxboard.org.uk/>

tion) revealed that when an aircraft (AT72) was on the final approach to land on the Southend airfield, the 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 an 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 that 'a couple' of quadcopters had previously been reported in the area"²¹. A number of similar incidents also happened in US. In 2014, for 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 flew very close to a passenger aircraft. The main perpetrators of these problems, similarly to European countries, were small machines remotely operated by civilians. It is a side effect of increased number of unmanned flights in the USA and in Europe. Those are used for a variety of purposes, primarily for civilian applications to provide an 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 – suppliers of goods and services) are considering the innovative ways of the delivery of goods all other

the world. If they are 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 on the one hand and civil rights and sovereignty of business practices on the other hand.

Legal aspects of regulating the use of UAVs

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 a device. A typical term used in a variety of jargons is 'a drone'. Such a term is widely used by media, particularly as the violations of air space by drones is more frequent. Within academic community and among specialists, such devices are mainly recognized as *Unmanned Aerial Vehicles (UAVs)* and in context of using a wider technologic approach, they are defined as *Unmanned Aircraft Systems (UASs)*. 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 whether all the users possess such certificates or consider applying for them. This is an important factor, as the number of certificates does not follow 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 declare non-commercial use as it is not easy to verify such declarations. Is it not purposeful to seriously approach such a topic

¹⁹ Based on: Życie 75 ludzi na włosku przez zblakane go drona..., Portal Dron.pl 29 October 2014, <http://info.dron.pl/zycie-75-ludzi-na-wlosku-przez-zblakane-go-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 Ibid.

before some negative consequences could happen? Are there any proper solutions to the issue? Especially, as it is a real threat on the one hand but also the infringement of the personal liberties and freedoms on the other. Generally, it is a real problem requiring reliable arrangements.

In Poland, similarly to other countries, many intrusions into airport controlled zones have been noticed and in consequence, dangerous attempts to get as close as possible to a manned aircraft. Many accidents have not been published by media to avoid panic and a threat of using an 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 the crew of Embraer 195 aircraft, flying from Munich to Warsaw, noticed a flying object at an altitude of 700 meters. Based on the crew assessment, it was probably a drone located on the landing approach about 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. A similar incident happened the same week in Łódź. A typical drone was observed in the vicinity of an airport and it caused a threat for a small aircraft performing a training flight²². A more serious accident occurred in Crakow 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 of conducting a terrorist attack using similar methods.

According to applicable and current regulations, it means within international law, all the civilian airships (manned and unmanned) operate based on the Conven-

tion on International Civil Aviation (or the Chicago Convention) signed on December 7, 1944 in Chicago. The Convention is rather outdated and it is transitory law which has to be updated. The International Civil Aviation Organization (ICAO) recognizes 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 the creation of a 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 is currently working on a draft of law regulations regarding the use of UAVs by civilian persons. The main objective of such regulations is to develop a coherent system of safety certificates for unmanned platforms. New instructions will cover both data transfer channels to remotely control such unmanned vehicles and also the dilemmas of protecting the privacy of data collected by unmanned systems. Similarly, the European Defence Agency is conducting highly advanced research into the future of unmanned platforms; however, the focus is mainly on developing the unified rules of using military drones when conducting missions within civil owned airspace to avoid accidents (Fig. 3).

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-pobliżu-lotniska-tym-razem-w-lodzi,562579.html>, (accessed 12 January 2017).

Figure 3. The drones as a threat to air traffic (visualization)



Source: O. Kendler, *Staying ahead of upcoming restrictive drone regulations*, *The SysEne Blog* 14 June 2016, <http://www.engineeringnewworld.com/?m=201606> (accessed 19 March 2017)

In Poland, like in many other nations, comprehensive regulations for unmanned platforms flights have not been established yet. The first Polish laws regarding UAVs were included in the Act of 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, z późn. zm.)²³ as amended. A revised set of regulations in Poland was adopted on 30 June 2011 and it entered into force on 19 September 2011, allowing the use of unmanned systems only when some requirements are met, including the equipment of systems and also the qualifications of 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 Of-

fice”²⁴. More detailed arrangements were made in 2013 by follow-on regulations for the implemented Act. The regulations allow 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;
- The total weight of an 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

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.

– TMA) is possible, however only if that drone strictly follows exactly the same rules as other airships. It is especially related to standard equipment (navigation devices, communication assets allowing movement and control), like a manned aircraft operating based on one of two sets of regulations governing all the aspects of civil aviation aircraft operations, namely IFR (Instrument Flight Rules) or VFR (Visual Flight Rules). When a flight is controlled without visual control from the 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 an UAV must be equipped with navigation and communication tools (transported, radio communication) and the flight must be performed based on a previously pre-planned route. It should be noted that if the flight is commercial, an appropriate *Unmanned Aerial Vehicle Operator (UAVO)* certificate has to be obtained from the Polish Civil Aviation Authority²⁶. In other words, very popular FPV flights, being the most exciting 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 an application of a person concerned, designates a special Exercise Area (EA) for flights following the Instrument Flight Rules. The use 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 modifications to have a better description 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.

Conclusion

The trend to use more UAVs for private and commercial purposes is on the increase and this is an issue to be faced by agencies responsible for air traffic. New technologies offer more advanced solutions and now a drone or UAV is available for an average person to be used for a variety of purposes. The desire to limit their use is not to be successful, requiring rather the creation of tools to 'civilize' and legalize those emerging capabilities. Air accidents involving UAVs require decisive and purposeful steps to merge that group of air space users into an overall system. If it does not happen, more accidents will happen, especially among the radical elements of societies having new 'tools' to play with. It should not even be excluded that UAVs will be armed by amateur "pilots" to conduct air combat and attack ground targets similar to military UCAVs. The desire to challenge manned aircraft or the use by extremists could be unavoidable. The further development and functioning of unnamed aviation will depend 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 the civil-

²⁶ UAVO certificate is a license proving a drone pilot qualification permitting operating such devices for commercial purposes – other than sport of 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).

ian market. The law must include such aspects as the provision of services, licences for operators, technical arrangements, and, what is the most critical, 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 flights require 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 in Polish airspace. Therefore, there is an urgent need to distinguish a law definition of such a flying object and it should allow precise distinction between a 'toy' and professional equipment. Such a definition must be profoundly thought over as it will have long-term consequences and will influence future regulations, as well as the rules of unmanned platforms integration with air traffic. Moreover, there is no need to cumulate all the traffic within controlled airspace as it make it 'overcrowded' and dangerous. Another aspect is the need to conduct in-depth research regarding the protection of citizens' privacy and use of UAVs by state services such 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 could be a good and reasonable step forward for further legislative efforts. Civilian drones, even if not be fully assembled ones, are not necessarily intruders in the Polish airspace as long as the law precise-

ly defines what is and what is not allowed. This is the direction the aviation law should aspire for.

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