DEVELOPMENT OF THE CIVIL USE OF UNMANNED AERIAL VEHICLES

Abstract

The following article focuses on the capabilities of unmanned structures and the possibility of using them in many areas from the commercial use to the fully professional operation. The areas in which the potential provided by UAVs can be used, have been described. The article also refers to the changes in the production of new technologies, the regulations relating to their functioning and innovative plans for their future use.

Keywords: UAV, operation, safety, development, civilian use.

Introduction

Dynamic progress in the field of new technologies has led to the development of both global and the European market in the field of remote-controlled aircraft systems. Currently, it is developing not only in the direction of the military, but, above all, the civilian one. Formerly, unmanned air systems were operated by the military. However, with the passage of time, owing to new projects and a process of improving the design of unmanned aerial vehicles, drones have been used not only as before in the armed forces but also in the civilian sector.

Due to the possibilities given by UAVs, their development broadens the range of their use. Because of their easy accessibility, the variety of models, relatively low cost of purchase and operation, drones have gained increasing popularity on the civilian market. Due to the increase in operators using RPAS both for recreational purposes and those related to a specific business, many countries recognized the need to introduce appropriate legislation to regulate matters relating to the training of drone operators and their use.

According to experts, in the future, new airspace users, that is, systems of unmanned aerial vehicles will perform comparably the same number of air operations as

---

1 Unmanned Aerial Vehicle.  
2 Remotely Piloted Aircraft.  
manned planes and can even significantly outperform their number. According to data from the FAA\(^4\) in the United States, the number of registered UAVs exceeded 325 thousand, while in comparison the number of aircraft and helicopters is 320 thousand\(^5\). This proves the fact that unmanned flying vehicles are permanently present in our airspace. The development of civil applications of UAVs is facilitated by the aforementioned newly established regulations and an ongoing integration process of the European aviation system. One of the elements of the New Strategy of the European Aviation - an Aviation Strategy for Europe project is a new regulation, which will replace the current EU Regulation No. 216/2008. The main objective of the new regulation is to adapt the European aviation safety scheme to future challenges, among others, through the creation of adequate, separate regulations for the operation of the dynamically growing market for unmanned aerial vehicles.

The domestic aviation authorities shall also bring into force new rules on a flying unmanned aircraft. New regulations precisely distinguish an aircraft used for recreational or sports purposes from an unmanned aircraft used for other purposes. Different applications have required different legislation\(^6\).

According to the new rules, recreational and sports UAV flying can be performed at a distance of not less than 100 meters from the built-up town, towns, settlements or gatherings of people outdoors and 30 meters from individuals, vehicles and buildings. On the other hand, in order to be allowed to conduct commercial activities, operators of drones used for commercial purposes must hold a certificate that can be obtained after passing a relevant examination. UAVs performing flights at night will have to be equipped with an identification plate with the name of the owner and adequate lighting.

The activities undertaken by the national and European aviation authorities, such as the inclusion of UAVs to the existing legislation, raising awareness among society related to the safe operation of drones contribute to the fact that drones became applied in many fields such as transport, agriculture, marketing, entertainment, search and rescue and they are treated as a new working tool.

**Research and science**

The development and the presence of unmanned systems were included in the New European strategy in the field of Aviation of 7 December 2016 - the Aviation Strategy for Europe. In the section on "progress in terms of innovation, digital technology and investment" the issue of releasing the potential offered by unmanned aerial vehicles was addressed. The strategy proposes a legal framework in order to ensure the safety of the industry and includes privacy concerns, data protection, security and the environment.

By 2020, the European Union plans to spend 430 million EUR per year on the ATM research project within the single European sky (SESAR\(^7\)). Appropriate investment in new technologies and innovation can provide Europe with a leading role in the field of international air transport.

---

\(^4\) Federal Aviation Administration.  
\(^7\) Single European Sky ATM Research - a program with a techno-logical pillar of the Single European Sky. Its aim is to develop and implement a modern air traffic management system.
UAVs play an increasingly significant role in the field of science. Owing to a number of beneficial functions, they become an appropriate tool to conduct research. The European Council for Scientific Research has awarded a research grant in the amount of 1.7 million EUR to a research group from the UK, which will use drones to screen swathes of the Amazon Forest in search of geometric patterns left behind in the soil.

The Institute of Geography and Regional Development at the University of Wroclaw is using an unmanned aircraft for a continuous monitoring of rivers, inaccessible ground and performing photogrammetric and remote sensing measurements.

The National Administration for Oceanic and Atmospheric Administration (NOAA) in cooperation with the Vancouver Aquarium, which is the center of research on marine animals performed first measurements and mapping the behavior of killer ocean whales. Due to photogrammetry, researchers are able to determine the exact height, changes in animal behaviour. Additionally, they have the opportunity to observe animals in their natural environment. An important aspect of the operation of drones are also meteorological measurements such as examining the upper layers of the atmosphere. Studying the issues which constitute a big threat to peoples’ lives, such as hurricanes, tornadoes and floods by means of drones is becoming increasingly important.

The American NASA owns a Global Hawk UAV type which is called the Hurricane Hunter. The aircraft can stay in the air more than a day taking photos and making important measurements. National Centre for Nuclear Research intends to use UAVs to study air quality in low emissions and many other areas of activity of this research unit in collaboration with other centers of scientific research.

The development of unmanned aircraft is invariably connected with science, not only through their use for research purposes but also for training and construction.

**Transport**

Transport by air with the use of drones is one of the most common area of using these devices. The more advanced the development of UAVs, the more varied the range of transported products – from basic items like medicine, food substances requiring specific conditions for transport, as for instance blood.

Dariusz Werschner, a graduate of the Academy of Mining and Metallurgy in Cracow is the creator of a project called AirVein, which aims at creating a system of medical transportation, whereby drones are used to transport substances such as blood, serum and drugs. In the trial period blood and other medical supplies are to be transported to selected hospitals from one of the regional blood centers. The main objective of the project is to shorten the waiting time for blood supply for patients in crucial moments when human lives being at risk depend on the duration of transport.

In San Francisco, there is a company which works with local pharmacies. At their request, it delivers drugs to the clients for a symbolic dollar.

Companies such as Amazon, DHL and Deutsche Post have decided to permanently include the transport of goods by means of drones in their offer. Amazon’s UAV has a range of 16 km and capacity of 2.3 kg. Additionally, the time of delivery of

---

a package is expected to be 30 minutes starting from the moment of purchase in the online shop\(^9\).

In Philadelphia, laundry is transported by means drones. One of the local laundry services offers such a possibility. Currently, only light clothes are delivered to customers. Nevertheless, this is bound to change in the future since the owners are working on a new model of the device that will be able to carry up to 4.5 kg of clothes.

![Image 1. Amazon Prime Air Drone used for transport shipment](http://rb.ru/opinion/log-tech/, 16.11.2016)

During the Oppikoppi music festival, held in the Republic of South Africa, a participant can order free food by using a specially prepared for this purpose application. The food will then be transported by a UAV. When the device is 15 m above the person who has made the order, the meal will be dropped by a parachute.

In the future, drones might be used to transport people. The Chinese company Ehang Inc. at CES in Las Vegas presented the world's first electric drone designed to carry people. Ehang 184 is a machine equipped with 4 electric motors that propel 8 rotors. Its speed limit is 100 km/h. The drone is made of super-light materials. In addition, it is fully automatically controlled and thus it can perform the entire trip. To complete the planned journey, the passenger must indicate the landing site on the tablet screen installed inside the machine and press the start button. The flight altitude ranges from 300 to 500 meters, up to 3.5 kilometers. The travel time includes 23 minutes while charging the battery takes 2 hours.

Companies performing their services by using drones are competing among each other as regards the possibilities of using UAVs in every area of our lives. Owing to the above-mentioned use, unmanned aerial vehicles are increasingly being referred to as "transport taxis".

---

Security

UAVs are also increasingly used in the field of security and monitoring of objects from their property to the strategic objects such as power lines, gas pipes, heating networks and other transmission lines, wind turbines and solar panels spread over large areas\(^\text{10}\).

The PKP Cargo, the largest Polish cargo rail operator uses unmanned aerial vehicles for the additional security of transported goods. Drones record the image depots and send it in real time to the headquarters of the Operations Team. Due to the cameras mounted on them with high-quality optical zoom lens, it is possible to obtain the evidence, which allows the police to identify the perpetrators of theft. In the air, the machines are practically inaudible. Additionally, due to the small size and colors, they are difficult to be noticed by a potential perpetrator. The device also works preventively, scaring people staying illegally in on railway premises near trains. Drones can also be used at night and during bad weather conditions since they are equipped with thermal imaging cameras which detect the man from a distance of over a kilometer. PKP CARGO uses two types of drones "Phantom III" and "Eagle".

The first one is equipped with a 4K camera and has about half a meter arm span. It is used to perform surveillance flights which support PKP CARGO trains and helps to protect the trains stopped by thieves. The average flying hours performed by the "Phantom" in the quarter of the year is about 3 thousand minutes. The second type of drone "Eagle" has an arm span of about one meter. Primarily, they are used to patrol large areas from a high altitude. Drones are equipped with two cameras. The first one has a large optical zoom, which allows for recording the faces of thieves in a very good quality, even from the distance of a few hundred meters. The average total flying time of the "Eagle" is about 1.8 thousand minutes. The maximum speed of the PKP CARGO drone is 60 km/h.

![Drone "Phantom III" during the flight patrol](Source: http://dlapilota.pl/wiadomosci/pkp-cargo/drony-pkp-cargo-wylataly-setki-godzin/, 16.11.2016.)

\(^{10}\) http://resources.infosecinstitute.com/privacy-security-issues-usage-civil-drones/.
Owing to the cooperation with WB Electronics, Railway Security Guards have at their disposal flying unmanned systems used in ongoing surveillance of railways, which will help to reduce the destruction and theft of railway infrastructure.

In the sector of environment protection, they monitor air pollution, illegal fishing, volcanoes and valuable natural sources from which minerals are obtained.

The Japanese company Secom, an industry leader in technical security created a drone for the industry to protect people and property. Designers ensure that it is able to replace traditional guards in situations that do not require a direct human involvement. After receiving a signal from the detector connected to the alarm system, the drone takes off autonomously and after reaching the place, it transmits the captured image to the control panel where the employee can assess the situation and possibly send support to the crime scene. The security sector is increasingly supported by new technologies that are designed to increase efficiency and reduce the risk of exposing workers to danger.

**Entertainment**

In recent years, the market of services has recorded a large increase in the emergence of companies whose business activity is based on the use of unmanned aircraft for purposes such as recording and taking photos. Nowadays, drones are widely used to record music videos or commercials. Moreover, they broadcast important celebrations as well as major events such as matches, festivals and concerts. Using footage from drones ensures the best quality. What is more, recording videos takes place in the air, which provides extremely attractive panorama shots. Drones are operated for the purpose of recording events of various topics ranging from advertising cars, tourist resorts to wedding photos.

**Img. 3. UAV taking the wedding photography**

Drone racing is becoming an increasingly popular form of entertainment throughout the world. In the United States, an organization called the Drone Racing League was established. The quantity of videos from the shows, training events or ordinary recreational flights recorded by means of drones is growing rapidly in the network. Fans of the sport distribute the videos among each other and share them on social media which increases the number of fans of UAV flying. Many professional operators have also recognized the need to use the structural possibilities of these devices, which is not allowed by commercial flights.

In Poland, there are a lot of projects related to RPAS such as the Drone Film Festival and Drone Show held in Rzeszów. In their programs, such events include educational elements related to training UAV operation for children, young people and experienced operators.

In the USA, the Walt Disney Company intends to create a Sky Show with the use of drones, which will be supposed to project the most famous fairy-tale characters. However, this is not the first innovative idea of using UAVs. The world Guinness record in the category for “the largest number of airborne drones” was set by means of drones. Intel used hundreds of drones controlled by computers to present a light show during which the drones performed a synchronized dance in the rhythm of Beethoven's Fifth Symphony.

The entertainment, film and music industries are the areas in which drones gained the biggest popularity and became widely used for the first time in the civilian sector since they are operated on a larger scale in this area.

Agriculture and forestry

Another important area of using UAVs is agriculture and forestry. The BioCarbon Company intends to use drones for planting trees. The drones are supposed to weigh up to 8 kg. Each of them will be equipped with guns which will fire small biodegradable containers filled with seeds. The decision was made to adopt this solution because of the economic advantages as well as reducing the traditional way of sowing applied by foresters.

In agriculture, drones are able to analyze the state of the field, assist in care activities such as fertilization, developing maps and measuring fields. The possibilities of UAVs allows for spreading the substance more precisely, which makes them more environmentally friendly than traditionally used farming machines. Farming UAVs equipped with a special multispectral camera are able to take pictures from the air in two modes, thus creating two types of maps: the classic orthophotomap in natural colors and a map of the so-called. "Near-infrared". The imposition of both types of maps allows to locate the health of crops. This information is extremely useful when planning fertilization. It enables field owners to save up to 30% of expenditure on fertilizers. If drones are used for spraying, they can conduct pre-programmed tasks autonomously. They are capable of choosing the amount of the spray depending on the speed of their movement. Furthermore, they can recognize the type of weeds or the type of substrate and determine the dose needed for spraying. Currently, UAVs allow for assessing the state of crops in terms of nitrogen and potassium content. This is possible by taking soil samples to assess its condition and composition.

Lancaster's Precision Hawk can fly around 120 hectares in 40 minutes, collecting accurate information and recording crops. Drones are also used for protecting crops against wild animals which can cause substantial damage. Drones equipped with a variety of sensors are able to detect plant diseases before they become visible. Timely detection of threats allows farmers to adopt an active approach to farm management, reduce the application of pesticides and fertilizers. Thereby, the efficiency of their production is increased.

For decades, the Lindbergh Foundation has dedicated to preserve the balance between technological progress and the natural environment developed a program called Air Shepherd. It is intended to use drones to combat poaching and protect endangered animals. Equipped with GPS and infrared cameras, they will be able to monitor the herds of animals. In case of detecting poachers around, drones will immediately notify special armed services to fight them. The researchers from the University of Maryland have prepared a special computer that analyzes their flights and camera images. The created algorithms can autonomously locate areas most vulnerable to poachers.

Rescue

The possibility of a comprehensive use of drones in the rescue is gaining popularity. Small, agile aircraft can efficiently navigate the dangerous terrain, reaching inaccessible locations and searching for victims in places where a fast arrival of rescue teams becomes difficult. The German company Definetz has built Defikopter which is able to quickly deliver an AED (defibrillator) to people affected by a heart attack or an accident. Defikopter can be activated at any time by the application, which will be installed in the smartphone beforehand. The GPS located in the phone helps to locate

---

the scene of the accident. Shortly after the activation, the drone soars into the air and arrives to the indicated location. The defibrillator is dropped to the ground with a special parachute. The entire rescue operation continues rapidly, which gives a much greater chances to the victim. Alec Momont, an engineering student in the Belgian city of Delphi, has created a prototype of a medical emergency drone called the Ambulance Drone. The machine is to prove its effectiveness while rapidly providing a medical aid to the injured person until the arrival of the ambulance. The drone ambulance is able to reach the patient located within the area of 12 km² within 1 to 3 minutes from the take-off time, at a speed of 100 km/h per minute. Such capabilities increase the chances of survival from 8 to 80 percent. Launching the flying ambulance is to be performed by using a smartphone and GPS tracking system. Moreover, the person who will be able to handle the defibrillator should be on the site.

The potential of unmanned aircraft is also used by the Tatra Mountain Rescue. In cooperation with the FlytTech, UAVs are aimed at creating an innovative system supporting rescue actions. Drones communicate with a mobile command center equipped with specialized GIS software to support the planning and conduct of rescue and Terrestrial Flight Control Station for an unmanned aircraft. Owing to drones, specific areas can be accurately searched faster and the actions of rescuers can be better coordinated.

UAVs prove also to be useful in water rescue. The Iranian company RTS Lab developed the drone based on Quadrocopter that can save lives of drowning people faster than a lifeguard. The Pars drone has attached lifebuoys that are discharged near the drowning person. It can fly at a progressive speed of approx. 7.5 m / s and float in the air for approx. 10 minutes, which gives it a range of 4.5 km. Pars can easily operate even at night since it is equipped with a thermal camera to detect a human body in the water. It has adequate lighting using LED lights, camera with the current preview of the deck, autopilot and GPS. It is stabilized by means of a triaxial gyroscope, barometer and compass as well as a water platform on which it remains in the period between emergency actions.

![Iranian drone „Pars” used in maritime rescue](http://textually.org/drones/cat_lifesaving_dro.html)
As a part of the "RYPTIDE" project, the researchers from the University of Stanford built a drone - rescuer which is able to reach the drowning victim in less than a minute, provided that the person is not more than approx. 1 km from the shore. It is equipped with special floats, which upon a contact with water will automatically be filled with air. As a result, the drowning person can get out on the shore much easier.

The aforementioned use of drones for rescue purposes is one of the few ones that are currently available. It is caused by the fact that works conducted on improving and adapting UAVs for the purpose of broad rescue, both in the winter, at sea and in the air are still in progress.

Conclusion

The development of civilian unmanned airborne platforms has led to the emergence of a new type of technology and branch of transport. European authorities compare the development of the industry of civilian drones to the development of computers, the Internet and mobile phones that took place decades ago. Commercially available equipment yields an increasing number of opportunities. Nevertheless, the most vital fact is its availability to the average citizen. Due to the development of UAVs, not only new jobs but also new phenomena such as the use of drones in daily life are created. Over the years, a public interest in new technologies has also increased, which contributes particularly to the growth in the number of operators, drone enterprises and changing the perception of aviation safety. The development of civilian applications in various areas of life forced the aviation organizations, legislative bodies at national, European and world levels to undertake new initiatives in the field of aviation law, security, and many others. Nowadays, their efforts primarily are aimed at the integration of an unmanned aircraft into civilian aviation in the common airspace. In turn, the process of integration has a positive effect and stimulate the development of civil applications of drones. They are bound to increase because the developing legislation takes into account the particular issues associated with the release of the potential offered by unmanned structures.

BIBLIOGRAPHY

Riga Declaration on Remotley Piloted Aircraft (drones) "Framing the future Roadmap for the integration of civil Remotely - Piloted Aircraft Systems into the European Aviation System of aviation" Riga - 6 March 2015.
On-line resources
https://www.ces.tech/about-us
https://www.faa.gov/uas/
http://resources.infosecinstitute.com/privacy-security-issues-usage-civil-drones/
http://www rp.pl/Lotnictwo/302099952-FAA-w-USA-jest-juz-wiecej-dronow-niz-zalogowych-samolotow.html#ap-1