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CHALLENGES AND THREATS OF UNMANNED AERIAL VEHICLES FOR AVIATION TRANSPORT SAFETY

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Abstract – The research problem of the article is formulated as follows: How do unmanned aerial vehicles (UAV) influence on aviation safety? New trends in the use of unmanned aerial vehicle technology have been correlated. The attention was paid to the most modern solutions of the battlefield. In each case of the implementation of drones in selected areas, an analysis of the risk for aviation was made. Bearing in mind the priority of using drones in a responsible and legal manner, taking into account the absolute safety of airspace zones, the hypothetical risk of the development of a given UAV branch should be assessed each time. In the paper the theoretical methods were used: analogy, system analysis, statistical, analytical and comparative method. Moreover, diagnostic survey carried out by aviation institutions was used. Analysis of the potential of unmanned aerial vehicles with an indication of development directions that are safe for aviation, bringing clear benefits from implementation in relation to standard, commonly used solutions. The results of the analysis performed, combined with the synthesis of selected facts and data from statistics, are to prove the necessity to apply remedial measures in the process of dynamic development of UAVs. The multidirectional opportunities created by the dynamics of UAV development is undeniably a challenge for companies producing specific unmanned utility devices. Risk assessment at every stage of the development of a new technology - in this case unmanned aerial vehicles is a key issue of implementation success.

Key words – UAV, drone, pseudo-satellite, aviation transport safety, smart city

JEL Classification – K42, R41

INTRODUCTION

Unmanned Aerial Vehicles (UAVs) are used in many different applications and created opportunities for the dynamic development of many industries [1]. Novel Unmanned Aerial Vehicle (UAV)-based Thermal Infra-Red (TIR) imagery technologies provide an opportunity to assess riverscape stream temperature [2].

The development of new technologies requires the appropriate selection, commensurate with risk analysis, of electronic assistive devices, including equipment, methods, technical means, and their maintenance in a proper technical condition.

The implementation of drones in everyday life creates an inherent element of the air traffic flow system. These, in the opinion of some amateur users, relatively inconspicuous devices can, with all their invaluable potential, create a serious threat to aviation. In the aspect of aviation safety, the legal awareness of operators, knowledge about the basics of using airspace and the purpose of using drones should be correlated. Risk assessment is gradually becoming the essence of the correct use of unmanned ships. Along with the dynamics of the development of the technology implemented by UAV, the demand for threat analysis tools, and thus for a specific system of remedial measures, is growing. The indicated statistical data are used to show the seriousness of the situation and the scale of threats faced by the aviation industry in terms of maintaining an adequate level of safety.

The article deals with the topic of opportunities in terms of challenges and potential threats, resulting from the construction of autonomous tools, such as weapon in the hand of a man. Future directions of development were indicated against the background of the requirements of maintaining an uninterrupted process of maintaining aviation safety at an appropriate level. The merits of replacing well known satellite systems with technology that reduces costs and is environmentally friendly were emphasized.

Aviation safety is undeniably essential. Each one air operations are carried out according to strictly defined regulations and procedures. The enormous progress of civilization is the result of a very rapid development of technology, unfortunately it leads to an increase in the problems associated with the threat. It is obvious that the effects of disasters are also estimated with an economic measure - the generated high costs are also one of the negative factors affecting the possibilities of using aviation.

Acceptable level of safety performance (ALoSP) is defined as the level of safety agreed by the State authorities to be achieved in civil aviation in a given State, defined in the national safety program, expressed in the form of safety target levels and safety performance indicators. On the other hand, aviation safety itself is defined as the state in which the risks associated with various types of aviation activities related to or directly supporting the operation of an aircraft are reduced to an acceptable level and controlled ULC [3].

In relation to the implementation of tasks in the aviation sphere, flight safety is understood as the totality of the properties that prevent the occurrence of emergency (dangerous) situations and the creation of prospects for the maximum reduction of the effects of such situations. The process of achieving the above-mentioned state requires the use of appropriate procedures and systems securing the health and life of people on board the aircraft, protecting air traffic safety, eliminating the adverse effects of hazardous environmental factors, and increasing the reliability of aircraft [4].

Aviation safety consists of two concepts: "aviation safety" - in the narrow sense, and "aviation security". The terms "safety" and "security" are not synonymous and have different meanings. The former relates to the regulations aimed at the production and use of aircraft.

The latter, in turn, covers the entire organizational and legal as well as operational and technical framework for preventing illegal acts against civil aviation. The two terms are complementary to each other as there is no effective safety without security, and vice versa. In order to guarantee an adequate level of safety when traveling by aircraft, it is necessary to agree on uniform legal provisions that will become the basis for the effective operation of states in this area [5].

When discussing the aspect of the impact of drones on aviation safety, it is necessary to precisely define what an unmanned aerial vehicle is within the meaning of the law. Pursuant to Art. 3 point 1 of Regulation 2019/945, a drone is an unmanned aerial vehicle, which means any aircraft operated or intended to be operated without a pilot on board, which can operate independently or be remotely piloted [6]. Defined devices have become an accessible source of information in the form of images or photos from the air, and equipped with material means, they can be a load carrier, often carrying dangerous measures in application - for example, explosives. We already know cases of the use of drones by Islamic State troops, which modify UAVs to adapt them to carrying weapons.

The use of UAVs, however, is wider than those mentioned above, it can literally reach the stratosphere within its range. The development of satellite technology indicates the wide futuristic use of UAVs, which will be explained in more detail in this article. In addition, the topic of popularizing these devices in the field of defense was discussed, with emphasis on the importance of small arms gradually revolutionizing the tactics of the battlefield.

1. Research problem and methods

The aim of the article is to identify the opportunities and threats resulting from the use of UAVs for aviation safety. The main research problem was determined: How do unmanned aerial vehicles influence on aviation safety?

In order to solve the mentioned problem of paper, qualitative and quantitative research methods were used:

- system analysis, enabled the solution of the complex problem of the aviation safety,
- the risk analysis consisted in knowing the nature of the risk in the safety of aviation,
- analogy, it was used to search for similarities between issues in the aviation safety,
- statistical method, allowed for the acquisition, presentation and analysis of data describing incidents in the civil aviation,
- the analytical method, allowed for the consideration of the organization of aviation safety and security,
- a comparative method, on the basis of which

basic mechanisms of aviation safety,
- diagnostic survey carried out by aviation institutions.

Unmanned aerial vehicles have a significant impact on aviation safety. The advantages of UAV include monitoring air operations, the technical condition of infrastructure elements and airport security, supervising compliance with applicable procedures, and preventing acts of unlawful interference. UAVs are becoming more and more tools of unlawful interference, they can also be used for criminal purposes, which has specific consequences for the risk of threats in aviation.

Recently, there has been an increased interest in drones that can be used to monitor smart cities from the air in order to ensure the safety of citizens and compliance with the rules of safe movement. Drones will help local governments to monitor and analyze air pollution, control the traffic situation or locate fire sources during fires.

Unmanned aerial vehicles enable air quality assessment and facilitate rescue operations. Drones can be useful in searching for missing persons, in rescue operations, supervision of infrastructure, and even to promote the city. The use of unmanned aerial vehicles by public institutions presents many opportunities, but also creates challenges. And this is not only related to the need to ensure the physical safety of people and property during flights, but also to protect privacy.

2. Empirical research results

In terms of empirical research, data from studies conducted by the Civil Aviation Authority (CAT), ICAO and IATA were used. Table 1 presents the basic data, important in terms of safety analysis, on the size of the Polish aviation market.

The data goes back to 2019 for a simple reason - from 2020 the COVID-19 pandemic creates extreme results that cannot be clearly correlated with the development of the UAV industry. This is evidenced by statistical data from the International Air Transport Association (IATA). In addition to empirical research, the work was edited on the basis of own experience gained while working in Polish military air bases (1st Airlift Base and 33rd Airlift Base), as well as knowledge in the field of aviation and astronautics obtained during studies at the Polish Airforce Academy. The analyzes of the satellite use of UAVs are based on the analogy of the research of the master's thesis in the field of aviation system, based on the EGNOS satellites usage, which is called EGNOS Data Access Service - EDAS.

The indirect goal of the work, obtained on the basis of the analysis, is to present the needs in the field of aviation safety in the future, as well as to outline the spheres that require monitoring and, along with the development of the UAV industry, to implement a specific system of remedial measures.

The risk of drone incidents is increasing. A drone collision with an airplane or the use of an armed drone by terrorists is a real threat to airport security. Activities involving the illegal use of drones may include: transferring an explosive charge and dropping it on the airport infrastructure, leading to an air disaster, spraying chemicals over the airport, spying (conducting the reconnaissance of the location and functioning of the airport infrastructure), operating flights against bans issued by relevant authorities, another person taking control of the drone, the operator loses the ability to control the drone, drone failure, taking pictures or videos for home [10].

In December 2018, Gatwick airport near London had to close the runway due to numerous reports of drone activity. The incident affected 140,000 passengers and led to the involvement of the police and the national guard.

Table 1. Aircraft included in the Aircraft Register or the Polish Air Force Register - recognition of the increase in the number of UAVs over 4 years [7]

Type of aircraft	**Number (register as at December 31, 2015)**	**Number (register as of December 31, 2016)**	**Number (register as of December 31, 2017)**	**Number (register as of December 31, 2018)**	**Number (register as of December 31, 2019)**
Planes	1238	1252	1279	1334	1394
Helicopters	195	204	213	223	243
Gliders	846	871	916	946	982
Paragliders	28	29	30	30	30
UAV	10	23	24	28	339
TOTAL	2317	2379	2462	2561	2988

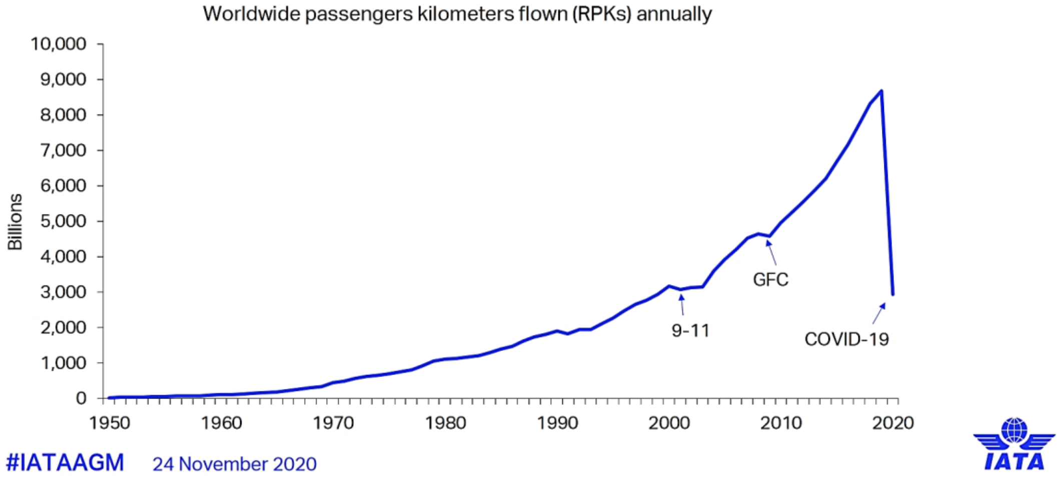
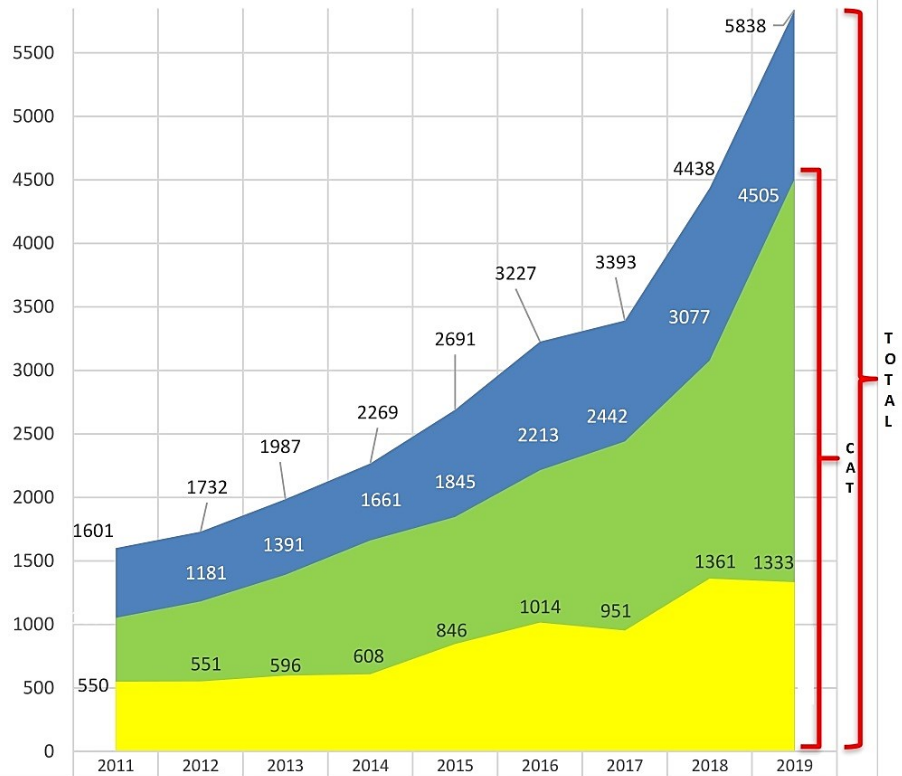


Fig. 1. The size of the ranges of passenger aircraft routes in relation to the COVID-19 pandemic [8]



	2011	2012	2013	2014	2015	2016	2017	2018	2019
All incidents	1601	1732	1987	2269	2691	3227	3393	4438	5838
Amount CAT's incidents	1051	1181	1391	1661	1845	2213	2442	3077	4505
Amount off CAT's incidents	550	551	596	608	846	1014	951	1361	1333

CAT category includes:	
Passenger category	**Cargo category**
Airline	Airline
Air Ambulance	Air Ambulance
Air Taxi	Air Taxi
Rescue helicopters HEMS	Helicopter's operations – OFFSHORE (over the sea oil rigs flights, landing on elevated surfaces)
Helicopter's operations – OFFSHORE (over the sea oil rigs flights, landing on elevated surfaces)	
Sightseeing	Other cargo's CAT operations - OTHER
Other passenger's CAT operations - OTHER	

Fig. 2. Total number of aviation events vs number of Civil Aviation Authority events / CAT specification (**Poland 2011-2019**) [9]

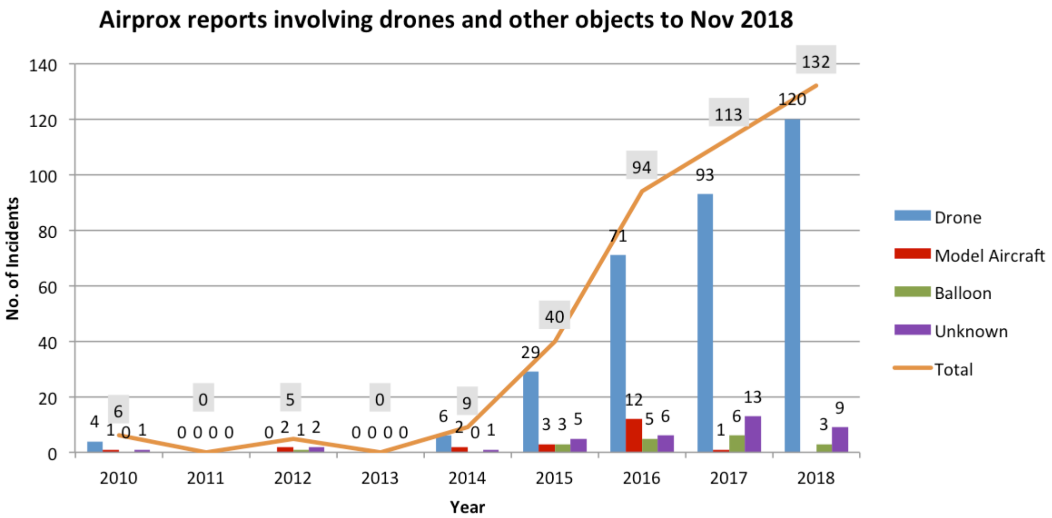


Fig. 3. Airprox report showing the number of accidents involving drones in the UK [11]

The empirical research contained in the presented statistics shows both a dynamic increase in the number of UAVs and air incidents. The proportionality of the data is not accidental. Recently, the number of incidents that disrupt aviation safety, as a result of drones, has increased significantly. In addition, data on registered drones also indicate that many of these ships operate without legalization with the Civil Aviation Authority. The correct risk analysis in terms of the legal use of registered drones will be appropriate after the disclosure of the statistics for 2021, because it was this year that a revolution in UAV law took place under the Commission Delegated Regulation (EU) 2019/945 and the Commission Implementing Regulation (EU) 2019 / 947. Figure 2 presents amount of aviation incidents with emphasizing specification of air transport.

Another, and at the same time a key problem in relation to the indicated subject, requiring statistical analysis, is the number of air accidents with the use of UAVs. The United Kingdom already alarmed in 2017 that even a commercial drone in the hands of an amateur could damage the glazing of the cabin, especially helicopters. The British Department for Transport was one of the first to tighten the rules of drone flights. The office checked what was happening to a passenger plane that was hit by an unmanned device - after receiving the results of research by the British Pilots Association and the Military Aviation Agency, which revealed that drones weighing 400 grams and more could seriously damage the aircraft, alarms were raised about changes to the regulations.

The presented Airprox report clearly shows the sharp increase in air accidents involving drones over the last 8 years. The results are alarming and although the case in this case concerns Great

Britain, where the problem immediately escalated, it is expected that the above pattern will apply to all EU countries. According to the British Airprox Council, by November 2018, 117 crash situations between drones and planes had been reported, which is slightly more than 25% more than in the whole of 2017. The British Airprox Council, jointly sponsored and equally financed by the Civil Aviation Authority of Great Britain and the United Kingdom Military Aviation Authority then began publishing monthly reports to monitor the situation more closely.

The above statistics prove that in Poland, the control of air accidents together with the study of the possibility of creating a threat from UAV operators and the implementation of countermeasures should be implemented into the national aviation security systems. An undesirable action would be to peak incidents by repeating the risk scenario of misuse of drones in the airspace. In this case, the experiences of neighboring countries should be an incentive to improve the aviation safety system. Safe branches, satellite techniques that do not affect aviation safety due to their intended use, operating consortia and high operational ceilings should also be developed.

3. CHALLENGES FOR THE UNMANNED AIRCRAFT INDUSTRY WITH SAFETY OF AVIATION - SOLAR DRONES

When analysing the subject of research, one should focus on the safe use of the technical and tactical possibilities of modern unmanned aerial vehicle technology. Recently, solar drones have attracted special attention and interest of space technology experts, as they can use their capabilities efficiently in the aspect of, inter alia, orbital satellites.

According to The European Space Agency's definition, High Altitude Pseudo-Satellites (HAPS) are airborne platforms like conventional flying vehicles, but working like satellites. The only difference is that instead of being in space, they maintain their position in the atmosphere - for weeks or even months, providing continuous services to the grounds below [4].

The best height for work is approximately 20 km above the clouds and jet streams, and 10 km above commercial aircraft. This is where the wind speeds are low enough for the device to hold its position for extended periods of time. These types of aircraft are called pseudo-satellites, i.e. devices that, like ordinary stations used, e.g. in navigation, they will provide various types of information, mediate in communication or monitor the indicated area. The difference, however, is that drones are reusable, operate at much lower altitudes than satellites, and do not pollute the environment, which is a big problem when ordinary satellites are sent into orbit. From such a height, pseudo-satellites can survey the area up to the horizon lying 500 km further, which allows for accurate monitoring services and observation, high-speed communication; and support for existing satellite navigation services.

The above-mentioned satellites in an environmentally friendly version, as well as ordinary stations used, among others in navigation, they will provide various types of information, mediate communication or monitor the indicated area. The difference, however, is that drones are reusable, operate at much lower altitudes than satellites, and do not pollute the environment, which is a big problem when ordinary satellites are sent into orbit. Summing up, the balance of benefits is absolutely positive.

The problem of emissions of harmful gases into the atmosphere is definitely a common topic, we are trying to care for ecology with more and more care, limiting certain habits - an excellent example is also the aviation industry and the space industry.

Chemtrails are no longer alien to us - the Oxford English Dictionary defines chemtrail as a visible trace in the sky left by aircraft, which some believe consists of chemicals or biological agents released during carrying out covert operations. Condensation streaks, despite many years of attempts to disprove conspiracy theories, which were often not supported by actual evidence, can still be a controversial topic. Of course, as you can easily guess, the situation repeats itself in the case of spacecraft operational technologies. The process of launching space rockets or ordinary flights by airplanes have a negative impact on the environment, which is why alternative solutions are increasingly being sought. One of them was proposed by Airbus - the Zephyr solar drone, which draws energy directly from the sun, thanks to which it does not pollute the environment.

Zephyr passed the 21 km altitude test in the summer of 2021 by spending in the air for a total of 36 days, including only two landings during that time. In 2019, the Zephyr S was flying continuously for almost 26 days (exactly 25 days, 23 hours and 57 minutes), and Airbus says it is working on solutions that will allow for a 180-day flight. Increasing the possibility of stratospheric drones is important, but it should be constantly emphasized that it is renewable - the possibility of reusability - is their main advantage. They are better than satellites operating in orbit - when the fuel runs out, the devices are not suitable for further use.

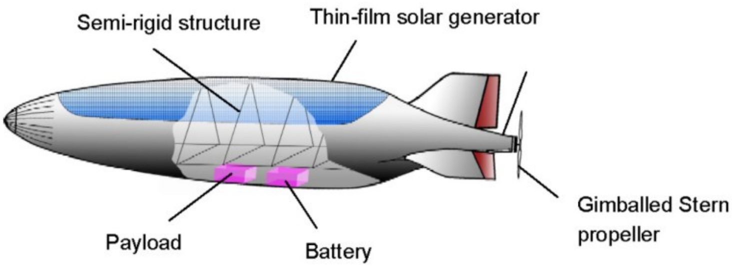


Fig. 4. Potential High Altitude Pseudo Satellite Design [12]

Fig. 5. Zephyr – project of Airbus [13]

Fig. 6. Zephyr S of Airbus [14]

Technical properties of the Zephyr structure: wingspan - 25 m; weight - less than 75 kg; load - different levels of load capacity with incremental levels of efficiency. The Zephyr is an autonomous, OPAZ compatible, Airbus indoor Earth observation system designed for the stratosphere. It cooperates with the advanced processing capabilities of Airbus Intelligence, is able to integrate information resources provided by the client. It can handle a wide range of satellite data, including but not limited to: electro-optical, infrared, hyperspectral, passive radio frequency (RF) radar, synthetic aperture (SAR) radar, early warning, lidar and automatic identification system (AIS).

The discussed Airbus project oscillates around numerous benefits, without the potential threat of unmanned solar devices influencing the flow of traffic in the airspace in an undesirable way. The uncompromisingly project exceeds the currently used solutions in terms of benefits resulting from the method of acquiring satellite information. Conducting a detailed analysis, highlighting the long-term advantages, a comprehensive balance sheet with a comparative analysis should be presented. In order to make the product innovative, the most important benefits resulting from the presented Airbus solution are presented.

A. First of all, the Airbus drone does not pollute the environment. It uses two 0.45 kW electric motors each. So we are dealing with an electric drive and the thrust is generated by two propellers.
B. Electricity is generated thanks to solar panels placed over the entire surface of the airfoil. At night, when access to the light of our star is difficult, the engines draw electricity from batteries with a total power of 3 kW Amprius lithium-ion. The Sion company is responsible for their production.
C. Airbus solar drones also differ in weight - the basic version weighs 53 kg, while the weight of the Zephyra-S is 75 kg. The second variant will be able to operate in the air for a longer period of time (ultimately up to 180 days - still long way to achieving).
D. According to experts, the use of stratospheric drones as satellites can solve many problems that we are struggling with today (including space debris or environmental pollution caused by the launch of probes orbiting the Earth with rockets). However, it is not known when they will be used on a larger scale - currently Airbus has built four Zephyrs, three of them are regularly tested.
E. Airbus's solar drone may, in the future, be an unbeatable replacement for satellites.

In the area of the above-mentioned field of drone research there is one more satellite of the future that should be mentioned - namely Thales Alenia Space is preparing a Stratobus that is lighter than air. The floating Stratobus is expected to lift up to 250 kg, be powered by fuel cells overnight, and electric motors to be able to hold it in one place. Thales Alenia Space is a French-Italian consortium offering solutions for the space industry. It is a joint venture that was created as a result of the acquisition of shares in Alcatel Space Services and Operations (Alcatel Alenia Space and Telespazio) by the French concern Thales.

Originally, it was planned that the test flight of the Stratobus technology demonstrator would take place by the end of 2019, and tests with the equipment will begin in 2020. The next flight dates were postponed to 2022 and 2023 [15]. The Stratobus will be a HAPS (High Altitude Pseudo-Satellite) class aircraft, i.e. a pseudo-satellite, filling the gap between classic Earth satellites and conventional unmanned aerial vehicles (UAV) and manned reconnaissance aircraft. Research and development work on it was announced on April 26, 2016.

In the first phase of the design it was speculated that this pseudo-satellite is a vision of the distant future, but the process is proceeding in accordance with Thales' assumptions. On January 9 2020, the Thales Alenia Space joint venture (composed of Thales and Leonardo) signed an agreement with the French arms agency DGA (Direction générale de l'armement) to conduct a feasibility study for the development of a reconnaissance and reconnaissance platform based on the autonomous Stratobus airships, as required operational land forces [16].

The Stratobus project has the potential to modernize the European Union's common defense architecture, streamlining the intelligence, surveillance and reconnaissance sectors by laying the foundations for the integration of autonomous aircraft. These improvements can result in greater interoperability between European armed forces, especially in areas such as counter-terrorism, border control and cybersecurity. In addition, the project's potential to modernize European defense could also serve as an innovative paradigm. The attractiveness of the project may encourage Member States to deploy UAVs to provide the necessary support in the sea, air, ground areas, and even cosmic ones. The potential success of the Stratobus could be the starting point for a new generation of stratospheric vehicles that could provide enormous added value for European defense cooperation.

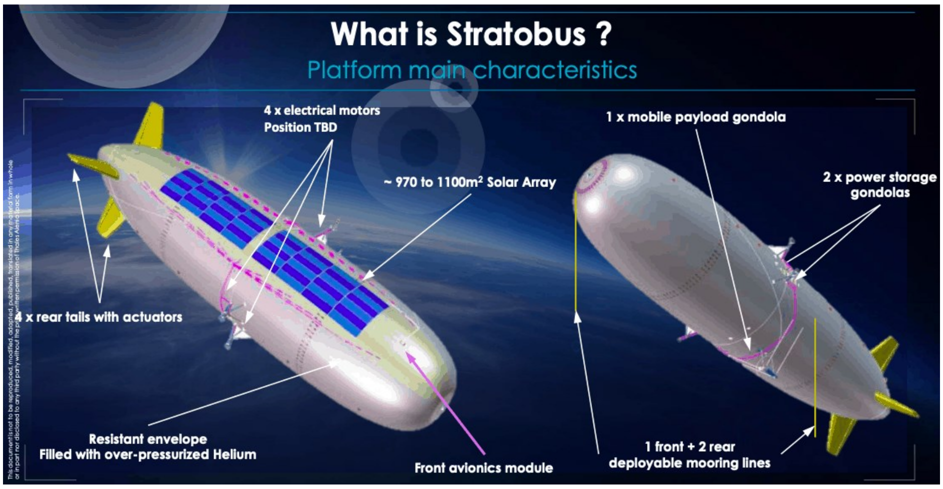


Fig. 7. Stratobus main characteristics [17]

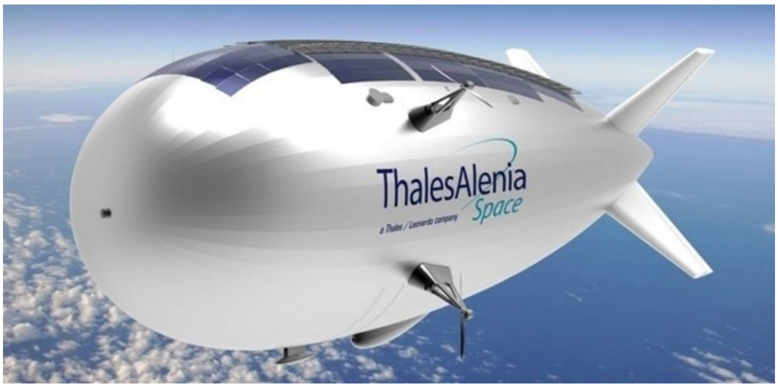


Fig. 8. Thales Alenia's Stratobus project [18]

Fig. 9. Vertical Take Off and Landing Unmanned Aerial Vehicle ATRAX [19]

Fig. 10. Unmanned Aerial Rescue Vehicle (UARV) [20]

The essence of the rational implementation of the discussed projects is undeniably the financial aspect.

At this point, however, it should be emphasized that the issue of accepting HAPS by the market is estimated to come down to greater efficiency and relatively low costs. Experts declared that the above issue will be effectively presented within the demonstration projects.

The Technical Institute of the Land Forces has developed the ATRAX Drone, which is made of very durable materials and the stability during flights makes it suitable for use in actions carried out in mountain areas, especially in caves. The ATRAX unmanned aerial vehicle for vertical take-off and landing is a modern structure made of glass-carbon composites. The set includes:

- ATRAX,
- command station,
- antenna assembly,
- transport box.

ATRAX is designed for:

- control of transport infrastructure,
- patrolling urban areas,
- supporting SAR actions,
- assessment of the effects of natural disasters,
- protection of people and property.

Sylwester Szymański from Poland, designed the Unmanned Aerial Rescue Vehicle (UARV). In addition to the proposed many useful functionalities and general versatility, it was met favourable opinions of GOPR. It would serve primarily to save people injured in the mountains. It has been designed for search and avalanche actions, and above all for the transport of rescue equipment and medications.

The communities of mountain rescuers agree - such a drone would certainly have a positive impact on the effectiveness of their activities and would significantly facilitate their rescue operations in the mountains in difficult weather conditions, in which it is often impossible to use old helicopters.

4. Potential threats arising from the use of drones and the development of a modern fight area

The development of drones is a direct evolution of the current battlefield. Specialized UAV constructors are already able to assemble a drone that is able to accelerate to a speed of 200 km/h in a second. There are also those that we can immediately launch like a grenade, with one quick movement of the hand.

The United States Army, and more specifically the Marine Corps, is already testing a new type of miniature Drone40 unmanned aerial vehicle. The device is activated by firing a standard 40 mm infantry grenade launcher - this way of launching, in contrast to the manual ejection of the device, gives a much higher initial speed and a higher flight altitude. This pocket quadrocopter (has 4 rotors) can circulate in the air for an average of an hour, moving at a speed of up to 60 km/h, at an altitude of 200 m.

The drone can also hover in a motionless observation and reconnaissance of the site. The UAV operator has a tablet-sized portable control console, he sees the image of the drone's camera in real time. Of course, the console easily connects to the internal communication network of a given sub-unit, and we are able to send specific information, for example, directly to the headquarters (HQ - headquarter).

The Australian company DefendTex presented the Drone40 drone as a miniature circulating ammunition. The goal of DefendTex was to provide Australian infantry with the ability to hit targets at distances over 500 meters. The technology is, as it were, the result of an operation in Afghanistan and Iraq, where Australians were fired upon at distances where they could not respond effectively with fire.

These miniature unmanned aerial vehicles for reconnaissance and reconnaissance purposes and combat will evidently change the tactics of the battlefield. Currently, the combat capabilities of the drones in the "swarm" are also being tested.

A group of several or several dozen UAVs participating in one mission against one target is a creative way to revolutionize the battlefield. The mentioned option does not have to be designed to eliminate the enemy - it also successfully performs many other tasks: reconnaissance, intelligence, jamming, interrupting communication or correct communication, blinding properties (laser beam) of the enemy. In 2020, the British used the Drone40 production on a large scale. This is the anti-terrorist operation in the African Sahel. UAV proved to be very effective in difficult operational conditions and extremely handy for soldiers. After a positive recommendation and the purchase of several thousand pieces of new technology weapons, they were put into service not only in special forces but also in land units.

Commercial drones such as DJI, Parrot and AEE with a built-in or optionally mounted camera are intended for recreational purposes. They can be controlled by both the R/C Controller and a smartphone or tablet with Wi-Fi access. Drones have different maximum speeds. It is often less than 14 m/s, but the store also offers models with speeds of up to 72 km / h. The fastest drone achieved a maximum speed of 288.6 km/h (these are, however, machines constructed from components, autonomously). The most popular drones are by far the so-called quadrocopters, which are equipped with four propellers. The operating time of drones is usually 20 minutes or less, slightly less often up to 45 minutes. So what is the difference between a recreational drone and a UAV of a modern battlefield?

The algorithm for retrofitting the drone is also well known, it is not a problem for the more interested amateur constructor. Advanced weapons can therefore become a dangerous item in the hands of an amateur, often not necessarily registered with the Civil Aviation Authority. What then can happen in the airspace or at the airports themselves? Therefore, the obligation to verify users when purchasing an unmanned device should be gradually implemented in the process of its legal acquisition.

Fig. 11. Dimension of Drone 40 [21]

CONCLUSIONS

Risk assessment at each stage of new technology development, also in the case of unmanned aerial vehicles, is a key issue for the implementation success.

The multidirectional opportunities created by the dynamics of UAV development is undeniably a challenge for companies producing specific unmanned utility devices. At the production stage, however, the effort of research aimed at analyzing the estimated risk of using each manufactured aircraft should be undertaken.

We have been aware for a long time that devices operating in the air can be a dangerous tool and threaten the safety of aviation each time. Thus, we are again heading to the conclusion that risk analysis is undeniably a requirement for the rational and safe implementation of innovative solutions operating in the airspace. We already know cases where the UAV industry has implemented projects without specific risk assessment models.

In the case of pseudo-satellites, there are no concerns about the system of remedial measures due to the specific user sector, defined purposes of use, and strictly defined purpose. There is a concern when it comes to the battlefield, devices for military purposes that are handy and at the same time rapidly developing speed.

The private user sector should be monitored in the future especially at the sales stage. Due to the restrictions on the protection of personal data, in the case of a much more advanced user identification process, the introduction of a QR code for users registered in the CAA system would solve the issue of GDPR during purchasing an unmanned aerial vehicle.

WYZWANIA I ZAGROŻENIA BEZZAŁOGOWYCH STATKÓW POWIETRZNYCH DLA BEZPIECZEŃSTWA TRANSPORTU LOTNICZEGO

W niniejszym artykule skorelowano nowe trendy wykorzystania technologii bezzałogowych statków powietrznych. Główny problem badawczy (pytanie badawcze) brzmi następująco: W jaki sposób bezzałogowe statki powietrzne wpływają na bezpieczeństwo lotnicze?
Przedstawiono możliwości BSP, skupiając głównie uwagę na najnowocześniejszych rozwiązaniach taktycznego pola walki oraz wykorzystaniu dronów w technologii kosmicznej. W każdym przypadku wdrożenia omawianych urządzeń dokonano analizy ryzyka dla lotnictwa. Mając bowiem na uwadze priorytet wykorzystania dronów w sposób odpowiedzialny i zgodny z prawem, z uwzględnieniem bezwzględnego bezpieczeństwa stref przestrzeni powietrznej, należy każdorazowo ocenić hipotetyczne ryzyko rozwoju danej gałęzi BSP.
W artykule zastosowano metody teoretyczne: analogię, analizę systemową, metodę statystyczną, analityczną i porównawczą. Ponadto wykorzystano sondaż diagnostyczny realizowany przez kluczowe instytucje lotnicze.
Dokonano analizy potencjału bezzałogowych statków powietrznych ze wskazaniem bezpiecznych dla lotnictwa kierunków rozwoju, przynoszących wyraźne korzyści z wdrożenia w stosunku do standardowych, powszechnie stosowanych rozwiązań. Wyniki przeprowadzonej analizy, połączone z syntezą wybranych faktów i danych ze statystyk, mają na celu wskazanie konieczności zastosowania środków zaradczych w procesie dynamicznego rozwoju UAV.
Wielokierunkowość możliwości stwarzanych przez dynamikę rozwoju UAV to niezaprzeczalnie wyzwanie dla firm produkujących specjalistyczne urządzenia bezzałogowe. Ocena ryzyka na każdym etapie rozwoju nowej technologii – w tym przypadku bezzałogowe statki powietrzne, jest niezaprzeczalnie kluczową kwestią sukcesu wdrożeniowego.

Słowa kluczowe: BSP, dron, pseudosatelita, bezpieczeństwo transportu lotniczego

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