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Safety in unmanned transport in armed conflicts

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Abstract: *Purpose*: The main purpose of this paper is to investigate the safety of unmanned transport in armed conflicts, with a particular focus on the Russo-Ukrainian war. *Methodology*: The authors employ a multidimensional comparative analysis of selected Unmanned Aerial Vehicles (UAVs) used for reconnaissance, combat, and transport tasks. Various sources such as scientific literature, military reviews, historical facts, technical specifications, and illustrations support the arguments and compare different types of UAVs. *Results*: The authors confirm their research thesis that in current geopolitical conditions, UAVs will become one of the equipment elements of the armed forces of individual European countries. They highlight their diverse functionality, positive impact on safety, and technological progress. *Theoretical Contribution*: This paper contributes to the field of military technology by providing a comprehensive analysis of the role and impact of UAVs in modern warfare. It offers valuable insights into the evolving nature of conflict and the increasing reliance on unmanned technologies. *Practical Implications*: The findings of this research have significant practical implications. They suggest that the use of UAVs in future military technologies will become increasingly common, and their combat capabilities and electro-optical equipment will continue

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to improve. This underscores the need for ongoing research and development in this area to ensure these technologies' safe and effective use in the context of armed conflict.

Keywords: air transport, Russian-Ukrainian war, drones, security, military security, sustainability

1. Introduction

The advent of Unmanned Aerial Vehicles (UAVs) has revolutionised many fields, including military operations, disaster management, and environmental monitoring. Despite the growing utilisation of UAVs, their role and impact in armed conflicts remain under-researched. This gap in the literature forms the basis of our study.

This research aims to investigate the safety of unmanned transport in armed conflicts, with a particular focus on the Russo-Ukrainian War. We aim to provide a comprehensive analysis of the role and impact of UAVs in modern warfare and how they contribute to the evolving nature of conflict.

Our research questions revolve around the functionality of UAVs, their positive impact on safety, and the technological progress in this field. We hypothesise that in current geopolitical conditions, UAVs will become one of the equipment elements of the armed forces of individual European countries.

We employ a multidimensional comparative analysis of selected UAVs used for reconnaissance, combat, and transport tasks to test our hypotheses. We use various sources such as scientific literature, military reviews, historical facts, technical specifications, and illustrations to support our arguments and compare different types of UAVs.

2. Literature review

According to a recent study by Królikowski (2022), the use of unmanned aerial vehicles (UAVs) in contemporary armed conflicts has significantly increased. This is supported by Ahmed et al. (2022), who noted the tremendous improvements in the structure, working methodology, flying features, and navigation control of UAVs. However, Siddiqi et al. (2022) highlighted the security-related concerns of UAVs, including potential attacks and limitations.

According to W. Kitler, the term security is internal trust, peace of mind, certainty, properly or falsely justified in the circumstances giving rise to concerns (Kitler, 2011, p. 22). According to Stańczyk, this is the primary need of people and social groups, a strategic goal (Stańczyk, 1996, p. 18). One type of security is the military. The analysis of the term "military security" allows us to conclude that its essential elements include: armed forces, concluded alliances, and agreements between international organisations, as well as documents in the form of strategic concepts such as the National Security Strategy of the Republic of Poland (Kozicki, 2023, pp. 38-39; Mitkow, Tomaszewski & Kozicki, 2021. See Malinowska, 2020, Błaszczak, 2023). Firstly, considerations about unmanned aircraft present their definitions. Unmanned ship unmanned aerial vehicle - a camera flying without a pilot onboard, remotely controlled or performing flighty autonomously, driven electric or combustion engine exploitative strength aerodynamic (Zielinski, 2014, p. 33). Versatility drones allow us to use them in various daily industries, e.g., industry transport, construction, agriculture, medical, and film, until unmanned ships air in military technologies.

3. Research methodology

Literature review: A systematic search of relevant databases, such as MEDLINE, PubMed, Google Scholar, and others, was performed to identify and review previous studies on UAVs, their definitions, characteristics, applications, and challenges. The keywords used for the search included “unmanned aerial vehicles”, “drones”, “armed conflicts”, “security”, “military”, and their combinations. The inclusion criteria for the literature review were: (a) published in English; (b) focused on UAVs and their safety in armed conflicts; (c) peer-reviewed and original articles; (d) published between 2010 and 2023. The exclusion criteria were: (a) not related to the research topic; (b) reviews, editorials, commentaries, or

letters; (c) published before 2010 or after 2023. The literature review provided the theoretical background and the conceptual framework for the comparative analysis of UAVs.

Selection of UAVs: A list of UAVs that are used or have the potential to be used in armed conflicts was compiled based on the literature review. The UAVs were classified into two categories: (a) reconnaissance UAVs, which are designed to collect and transmit information about the enemy, the terrain, the weather, or other factors, and (b) combat UAVs, which are equipped with weapons and can perform attack or defence missions. The selection criteria for the UAVs were (a) relevance to the research topic, (b) availability of data and information, and (c) diversity of types, sizes, capabilities, and origins. The final list of UAVs included in the comparative analysis consisted of six UAVs: Ryan 147 Lightning Bug, BAE Systems Phoenix, Canadair CL-289, SAGEM Crecerelle, Bayraktar TB2, and MQ-9 Reaper.

Data collection and analysis: For each UAV, data and information on the following parameters were collected from various sources, such as official websites, technical reports, scientific articles, news articles, and others: (a) name and origin; (b) dimensions and weight; (c) engine and propeller; (d) speed and altitude; (e) range and endurance; (f) payload and weapons; (g) sensors and cameras; (h) launch and recovery; (i) operational history and performance; (j) advantages and disadvantages; (k) safety issues and challenges. The data and information were verified and cross-checked for accuracy and reliability. The data and information were then analysed using descriptive and comparative methods to highlight the UAVs' similarities and differences and evaluate their safety in armed conflicts. The analysis was based on the following criteria: (a) effectiveness and efficiency; (b) reliability and durability; (c) flexibility and adaptability; (d) vulnerability and resilience; (e) ethical and legal implications. Tables, figures, and diagrams supported the analysis to illustrate and summarise the results.

4. Findings and analysis

The history of flight began around 500 BC when Archytas of Tarentum designed wooden pigeons. He created a load-bearing structure by incorporating moving wings. Thanks to the streamlined shape of the application, it could cover a distance of about 200 meters in flight and is considered the first model of an aircraft (Valavantis, 2007, p. 35). The launch of the pigeon in flight was achieved by lighting a fire under a ball filled with water, to which the bird was attached. Compressed air was directed into the interior of the wooden pigeon, and once it was fully inflated, it would take flight and travel a certain distance.

Figure 1: Wooden pigeon Archytas of Tarentum

Source: https://www.facebook.com/mythicalgreece.gr/photos/a.480488532521708/601361047101122/?type=3

Discoveries in gyroscopes and remote-control devices behind help halyard radio were base for developing manned ships air. In 1898, Nicola Tesla was featured first on the world unmanned vehicle-controlled road radio (http://www.samolotypolskie.pl/samoloty/3233/126/Wright-Flyer2, 2024). Tesla developed constructions high coil voltage, which emits strong electromagnetic waves and started

works above devices capable of capturing these waves. His patent for a device for transmitting and receiving electromagnetic waves was ready in 1900. The device Tesla named left Tele automaton, which was by boat. Pioneering controls contributed myself directly to the development of technological unmanned ships air.

The armed conflict in Vietnam is considered the first war event in which unmanned aircraft used up to 3,435 missions where they played functions of reconnaissance (Tilford, 2024, p .74). Key implementation sentences by unmanned ships air in Asia left hailed precursor in further use ships flying in activities war (Grzegorzewski, 2023, p. 27). One of the first flying ships which had opinion carry actions reconnaissance was the Ryan 147 Lightning Bug; the first version of the model's length was 6.7 m, range wings 8.2 m, weight starting weight was about 350 kg, and the maximum speed was 980 km/h depending on version which with time was modified. In the first configuration, ships flying after completing a mission were destroyed by the lack of possibilities of landing In place for this purpose. The Mid-air Retrieval System (MARS System) denied this problem. With a combination of helicopters that intercepted a given ship, Parachutes delivered a fully functional flying object to the base, where it could be used again for reconnaissance activities. Mission reconnaissance after carrying out mass configuration in the ship flying permanently on average 8 hours. An unmanned aircraft equipped with sensors could conduct reconnaissance at various altitudes.

Figure 2: Unmannedshipairborne Ryan 147 Lightning Bug

Source: www.deviantart.com

In military technologies, unmanned aerial vehicles are used to transport equipment for reconnaissance tasks. By using the UAV transport function, we do not expose the pilot to the risk of loss of life, and we can quickly retrofit a given UAV by using it as a transport platform with various types of equipment for various missions, e.g.:

- image recognition (IMINT);
- electromagnetic reconnaissance (SIGINT);
- verification progress in armed activities;
- collecting evidence acts genocide;
- dynamic targeting;
- detection and observation of air weapons;
- disruption radar stations.

Phoenix is a British unmanned aerial vehicle in a double-beam arrangement for task reconnaissance. The structure is made of fibreglass and kevlar. Thanks, that is why its weight is only 175 kg. It is powered by a two-stroke engine Meggitt WAE 342 with 25 HP, which drives a biplane wooden propeller. Range wings have a 5.6-meter speed maximum of 155 km/h. Included in the equipment of the reconnaissance unit was an infrared camera and a camera working in light during the daytime. Introducing the Phoenix into flight was taking place by catapult driven hydraulically or pneumatically. BSP was deprived of the chassis, so the landing took place behind the parachute, which was mounted in the rear part of the gondola (Abraszek, 2023).

Figure 3: BAE Systems Phoenix

Source: https://pl.wikipedia.org/wiki/BAE_Systems_Phoenix

BSP for tactical reconnaissance tasks. It was created thanks to teams in Canada, Germany and France. A rocket and jet engine powers it. Introduction: the flight takes place from a launch platform mounted on a truck. During the first phase of flight, the CL-289 is powered by a rocket engine with a thrust of 3,300 kg, and then, after reaching cruising speed, the jet engine is started. The maximum speed is 720 km/h, and the unladen weight of the UAV is 140 kg. Landing occurs by turning off the jet engine and deploying the parachute forces vertically. When CL-289 is in a vertical position, it opens a larger parachute and two pillows that cover the fuselage to protect the UAV from damage.

Figure 4: Canadair CL-289

Source: https://www.tripadvisor.com/LocationPhotoDirectLink-g187323-d1798574-i347167721-Military_History_Museum-Berlin.html

Elaborated by French company SAGEM unmanned aircraft to tasks reconnaissance and combat area monitoring. Driven is the rotary engine with a power of 26 HP and a characteristic propeller pushing. The maximum speed is 240 km/h, and the operational ceiling is 3100 meters per flight. Maybe take time up to 5 hours. It is equipped with panoramic camera video, high camera resolution and infrared sensors. Sending real-time images to the operator is possible up to 50 kilometres.

Figure 5: SAGEM Crecerelle

Source: https://en.wikipedia.org/wiki/SAGEM_Crecerelle

The Russian Federation attacked Ukraine on February 24, 2022, and is called a continuation of the Russian-Ukrainian war that has been going on since 2014. In the 2019 Ukrainian army, she stayed retrofitted in Turkish unmanned cameras, flying to lead reconnaissance and combat tasks. Bayraktar TB2, from the beginning gathering Russian troops at the border with Ukraine, was driving action reconnaissance, which allowed Ukraine to document a devaluation of enemy troops. After starting armed invasion, unmanned aerial vehicles, apart from driving territorial reconnaissance, started successively defending your country by effectively using their transport platforms to suspend various types of anti-tank and anti-personnel missiles. The transport platforms on the Bayraktar TB2 UAV effectively carried the operator-pilot, who safely performed the task outside the enemy's field of fire without endangering the life of the UAV.

Turkish drone equipped with a four-stroke engine piston Rotax 912 is generating 100 HP, and his maximum speed is 230 km/h. The ceiling operating is 5500 m, and its starting weight is 600 kg. Equipment combat is changed from the requirements of the mission being carried out:

- UMTAS - long-range anti-tank missile range, target attack up to 8 km;
- MAM - guided missile;
- Roketsan Cirit - 70mm calibre rocket, able to break armour. Accuracy until 3metersbydistancesup to 8 km;
- BOZOK - guided missiles;
- TOGAN – ammunition mortar;
- SAGE – rockets modular.

Figure 6: Bayraktar TB2

Source: https://uk.wikipedia.org/wiki/Bayraktar_TB2

MQ-9 Reaper is an unmanned combat camera flying (UCAV). It is an American General Atomics Aeronautical Systems manufacturer in a search configuration Hunter-Killer strike force. The MQ-9 version is stronger than its predecessor, the RQ-1 Predator. Changes relative to the previous version of relied on retrofitting the technological Relief-On-Station (ROS) system, in which he gave warranty on incessant on-disruptive signals to the command centre. Thanks to the application engine turboprop Honeywell TPE331-10GD with 950 HP, the distance which defeated MQ-9 is 15 times bigger comparison to the RQ-1 version, increased mass load utility she bet BSL Reaper in the new light usability (Martin, 2015, p. 86-90).

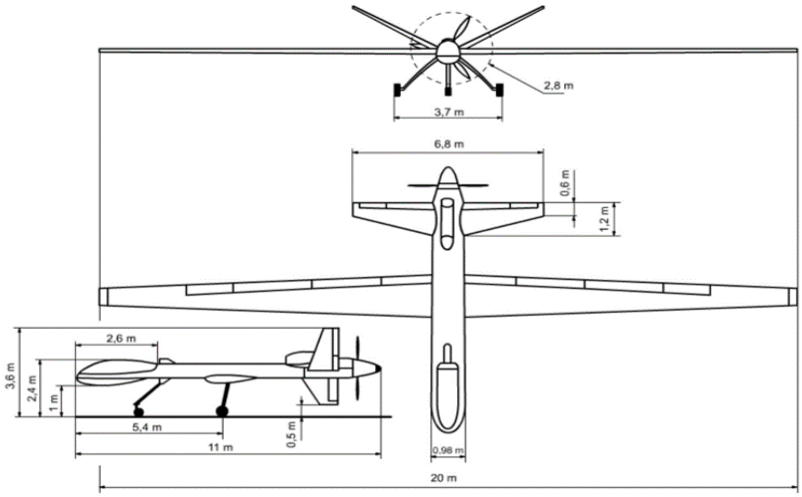
The MQ-9 Reaper is a medium-wing plane, that is, by plane globe load-bearing inmates on height axis longitudinal hull. In the shape tail section, the empennage butterfly is turned toward supper, acting as an old rudder or height. Engine turboprop left is located in the back parts hull, which drives a three-lobed propeller.

Construction hull combat aircraft folds myself with carbon-quartz fibers and coatings Kevlar. The frame she stayed built officers carbon and duralumin, an alloy of metals such as aluminium, copper, manganese, magnesium, silicon and iron.

Figure 7: MQ-9 Reaper firing a Hellfire Longbow missile

Source: https://en.wikipedia.org/wiki/General_Atomics_MQ-9_Reaper

Figure 8: Graphical view of the MQ-9 Reaper



Source: https://model.dron.pl/mq-9-reaper

Possibilities combatequipmentMQ-9 Reaper are 1360 kg, Thanks maybe he is equipped with 4 AGM-114 Hellfire missiles and two bombs laser guided GBU-12 or GBU-38.

Figure 9: AN/DAS-1 MTS-B electro-optical system

Source: https://dziennikzbrojny.pl/artykuly/art,6,28,7717,lotnictwo,bezzalogowce,bezzalogowy-statek-powietrzny-mq-9-reaper-czesc-i

The RQ-4 Global Hawk is an unmanned camera flying down tasks reconnaissance productions American technology and defence consortium Northrop Grumman. February 28, 1998, took place on my first trial flight, and 1999 RQ-4 powered up the US armed forces. From the beginning of production, the reconnaissance platform flying is continuously modified and enriched with the latest technologies, increasing terrestrial capacity detection goals. Production RQ-4 Global Hawk was in a system of many

first blocks that embraced Ju stand-only diagnosis visual IMINT (Image Intelligence). Each subsequent block included modifications to the flying platform to be equipped with sensors to detect ballistic missiles and the range of the BSP itself to be increased.

The shape of the tail section, similar to that of the MQ-9 Reaper, faces upwards, and the front part of the fuselage is rounded. The reconnaissance aircraft's structure consists of carbon fibre and an alloy of aluminium, copper, manganese, magnesium, silicon and iron. The rear dorsal section houses the engine, which allows the aircraft to reach a maximum speed of 650 km/h. This is a Rolls-Royce AE3007H turbofan jet engine.

Figure 10: Service ground-based RQ-4 Global Hawk

Source: https://en.wikipedia.org/wiki/Northrop_Grumman_RQ-4_Global_Hawk

Transport operations. The use of BSP in logistical matters aimed at delivering ammunition, medical supplies or food to an ongoing armed conflict site is becoming a key concept and the solution to many logistical problems. With a payload of 500 kg, Sending BSP offers the possibility of delivering supplies to the scene of an ongoing conflict and then enabling the evacuation of civilian and military casualties. An additional advantage of using the BSP in transport operations is the exclusion of the presence of crew in helicopters delivering supplies; thus, the pilot is not exposed to danger and decisions are not dictated by stress and are not dictated by stress and the feeling of risk to life or health.

An example of a transport BSP is the AirMule, an Israeli-made BSP. Thanks to fan rotors located inside the craft instead of a classic rotor system, its size is four times smaller than that of classic helicopters. AirMule can land in crowded public areas or cramped streets, from where it successfully evacuates casualties.

Figure 11: AirMule during takeoff

Source: https://www.nowastrategia.org.pl/airmule/

Drones were perceived as electronic equipment used for playing, photographing and filming. As air couriers delivering shipments at Amazon or serving residential areas of the USA with new supplies of medicines from nearby pharmacies appeared, How important and making it easier functions they can perform in life social.

5. Summary and conclusions

The main focus of this paper is investigating unmanned transport safety in armed conflicts.

A multidimensional comparative analysis of selected Unmanned Aerial Vehicles (UAVs) used for reconnaissance, combat, and transport tasks is employed by the authors.

Various sources such as scientific literature, military reviews, historical facts, technical specifications, and illustrations support the arguments and compare different types of UAVs.

The research thesis confirmed by the authors is that in current geopolitical conditions, UAVs will become one of the equipment elements of the armed forces of individual European countries.

The paper concludes by suggesting that the use of UAVs in future military technologies will become increasingly common, and their combat capabilities and electro-optical equipment will continue to improve.

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Conflicts of Interest

The authors declared no conflict of interest.

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