TRANSPORT PROBLEMS 2011
PROBLEMY TRANSPORTU Volume 6 Issue 4

Unmanned Aircraft Vehicle, Unmanned Aircraft Systems

Tomasz GUGAŁA
NATO CIS Systems Agency (NCSA)
Avenue de Luxembourg 46, B-7010 SHAPE, Belgium
Corresponding author. E-mail: pink_dragon1@o2.pl

THE USE OF UNMANNED AIRCRAFT SYSTEMS (UAS) IN COMBAT OPERATIONS

Summary. In this publication has been presented selected aspects of the wide spectrum of Unmanned Aircraft Systems (UAS)/UAV[1] adaptation within the military structures. With regard to many years of experience of the author within the national and NATO Integrated Air Defence Command and Control System, the objective paper is also related to the Airspace Management (ASM) in the light of present and future use of UAS in this environment. Wider and wider application of UAS in many areas of human life as well as in military and civilian services is forcing to take the definite steps in connection with elaboration of "New Concept of Polish Airspace Management in Context of UAS Development", what is currently under consideration of the author. The respective publication is simultaneously the specific trial for inspiration of the civilian society to take an initiative heading for implementation of UAS out of military service.

UŻYCIE BEZZAŁOGOWYCH STATKÓW POWIETRZNYCH (BSP) W DZIAŁANIACH BOJOWYCH

Streszczenie. W przedmiotowym opracowaniu przedstawiono wybrane aspekty szerokiego spektrum zastosowania Bezzałogowych Statków Powietrznych (BSP) w strukturach militarnych. Ze względu na wieloletnie doświadczenie autora w służbie w Systemie Dowodzenia Obroną Powietrzną RP i NATO, artykuł ten dotyczy także zagadnień związanych z zarządzaniem przestrzenią powietrzną, uwzględniając aktualne i przewidywane wykorzystanie BSP w tym środowisku. Coraz szersze zastosowanie BSP w wielu dziedzinach życia, zarówno w wojsku jak i w środowisku cywilnym wymusza podjęcie określonych działań związanych z opracowaniem „Nowej Koncepcji Wykorzystania Przestrzeni Powietrznej RP w Kontekście Użycia BSP", czym autor aktualnie się zajmuje. Jednocześnie opracowanie to jest swoistą próbą inspiracji środowiska cywilnego do podjęcia inicjatyw zmierzających do zastosowania BSP w poza militarnych dziedzinach życia społecznego.

[1] The term Unmanned Aerial Vehicle (UAV) is promoted at the moment in NATO environment by some NATO bodies – for example the FINAS (Flight in Non-segregated Air Space) working group – and is similar to the term Unmanned Aircraft System (UAS).

1. INTRODUCTION

Formation of the first Unmanned Aerial Vehicles (UAV) in the world has been noted down between the years twenties and thirties of the past centuries [12].

There was mostly common radio stirring constructions used as targets for Anti Air Defence systems. However the real development of these type of constructions are falling on the turn of the 20th and 21st centuries, when together with growing up of technological possibilities in domain of gaining and transferring picture from the board of UAVs, they have been applied for the military reconnaissance. Further technological progress (electronics, computers, miniaturization) and change of human mentality (robots for fighting against people), have been brought to a combat adaptation of UAVs called also Uninhabited Combat Aerial Vehicles (UCAV), in particular taking in to consideration use of precision weapons in real- time for destroying of Time Sensitive Targets (TST). Unexpected efficiency of combat employment of the UAS (unparalleled Israeli success during the 1982 ''Peace for Galilee'' campaign against Syrian missile batteries in the Bekaa Valley) [13], has been caused by the general adaptation of this kind of weapon in every considerable military conflict all over the world (Iraq, Afghanistan, Israel, etc.).

After the tragic 11th of September terrorist attack on the New York -World Trade Center, UAS have been applied not only in military conflicts but also in peacetime for airspace patrolling. As from year 2006 UAS operating high over the USA territory, are monitoring their airspace with simultaneous verification of the border crossing authority.

As, now that employment of UAS out of military conflicts is causing a matter of fact, why not to take the trial for wide UAS adaptation in civilian society?

Most probably in the near future we will be the eye-witnesses of battlefield robotics, management of common combat operations as well as UAS and manned aircraft and universal implementation of UAS in every domain of human life.

The Republic of Poland has been a full value NATO member for more than eleven years as well as in military and political structures. This membership gives the opportunity for Polish Armed Forces and civilian society to take an advantage of the wide spectrum of technological acquisitions and NATO experiences in domain of UAS application. For that reason I am willing to present the selected aspects of UAS usage in NATO combat operations, having the use of a number of NATO experts' publications and using personal knowledge and experience.

2. MAIN TOPIC

Taking into consideration Intelligence, Reconnaissance, Surveillance and Target Acquisition hardware and software, NATO Nations have got now about 6700 HALE (High Altitude, Long Endurance), MALE (Medium Altitude, Long Endurance) and TACTICAL (Low Altitude, Short Endurance) UAS (Fig.1 [9]). The current classification of UAS has been widened to SMALL, MINI, MICRO and NANO. However the most of them are the TACTICAL unmanned aircraft developed and operated via National organizations. The projected numbers of UAS and associated ground systems are expected to grow up during the entire period up to 2020 as most NATO Nations are acquiring new systems. Up to now only the few Nations have employed weapons on-board of UAS. The main manufacturers of UAS are USA, Israel, United Kingdom, France and Germany. Combat uses of UAS that have already occurred mainly in Iraq, Afghanistan and Balkans, are Close Air Support (CAS) and Air-to-Air Combat (AAC). The combat NATO missions of Suppression of Enemy Air Defence (SEAD) and overwatch are good direction in the near future use of UAS. As UAS are generally smaller than manned aircraft and therefore less observable, there is a good idea to use them for the SEAD mission. Additionally, personnel are not in danger when UAS are used in this potentially high risk mission. In the long term combat UAS capabilities are going to exist in NATO, most likely in one of two possible approaches. First, UAS capabilities could be combined with manned aircraft in strike packages. Second, UAS combat capabilities could be combined with non-combat UAS capabilities, either on the same platform, or with separate aircraft. Advantages and disadvantages exist

to each approach. An example of the second approach is the mission of overwatch or armed reconnaissance. UAS, much conducting the overwatch mission, are employing a variation on the concept of dynamic targeting, also called TST. In overwatch the UAS is waiting for a particular situation to occur. When that situation occurs, when a "trigger" happens, the armed UAS operator will confirm the "trigger" and attack if appropriate. In the overwatch mission, UAS have the advantage of persistence, being able to operate for long periods of time, and being able to deliver precise effects on demand. The demand might imply some joint aspects in a situation when the target is discovered by special operations personnel, is allocated via the Combined Air Operations Centre (CAOC) and is going to be engaged by a Land or Navy UAS, which is loitering in the operational airspace. In such a situation the integration of systems involved is a mandatory condition for operational success and networking tactics, techniques and procedures (TTPs) are required [14].

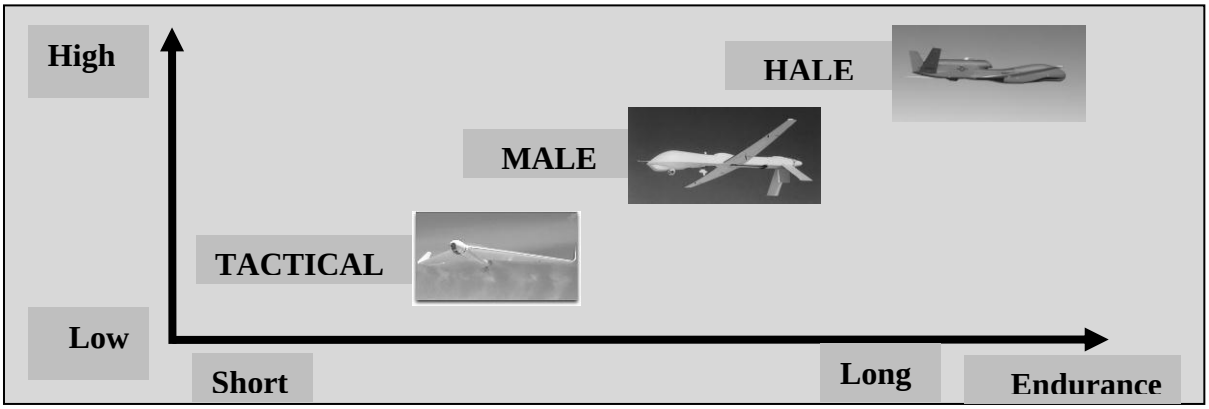

Fig. 1. NATO classification of UAS
Rys. 1. Klasyfikacja Bezzałogowych Statków Powietrznych wg. NATO

To summarize combat employment of UAS within the NATO structure is necessary to state, that this kind of armament is founding more and more adaptation in military service, and its role is growing up in combat operations. However the above mentioned combat employment of UAS is generating many problems especially for all Command and Control (C2) systems (sensors). How to detect and identify enemy UAS considering the fact that UAS are small, fly at low altitudes and at slow speeds, what makes their detection extremely difficult? In defending against UAS operations, how will ground forces know that the UAS above them is friendly and not an adversary's reconnaissance platform or worse, an adversary's armed UAS? How will Ground Based Air Defence (GBAD) know what they should fire at and what to let go? The separation friend from foe has to be absolutely assured.

Nowadays many corporations are manufacturing the UAS, as well as HALE, MALE, TACTICAL and others. The one of most popular HALE UAS manufactured by Northrop

Grumman corporation is RQ-4A/B Global Hawk" (Fig. 2), used by USA. As far as I know Global Hawk will be used by Germany as a "Euro Hawk'' as well.

The Air Force RQ-4 Global Hawk is a high-altitude, long-endurance UAV designated to provide wide area coverage of up to 40,000 nm² per day. Sensor data are related to its mission control element, which distributes imagery to up to seven theatre exploitation systems.

The Raytheon Launch and Recovery Ground Station is housed in an 8x8x10ft shelter. Ground Control Station (GCS) (8x8x24ft shelter) housing communications, C2, mission planning and image processing computers with four workstations for the mission control staff and officers. Each GCS can control up to three air vehicles. This UAV needs 1525 m long runway for Take-off and Landing. The characteristic data are as follows: Wing span-35.4 m; Weight-12111 kg; Length-13.5 m; Loiter speed-340 knots; Max Altitude-65 000 ft; Max Endurance-35 h; Max Payload-907 kg/1360 kg (version A/B) [14].

The very useful MALE manufactured by General Atomics Aeronautical Systems Inc., exploited by USA, Italy, Turkey and United Kingdom is "RQ/MQ-1 Predator" (Fig. 3).

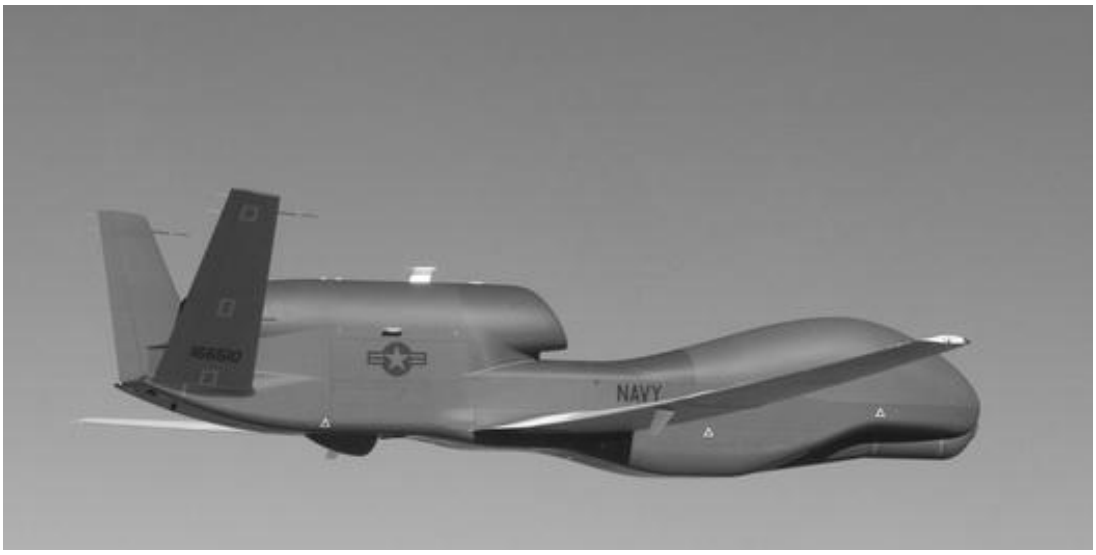

Fig. 2. HALE UAS – "Global Hawk"
Rys. 2. BSP klasy HALE – "Global Hawk"

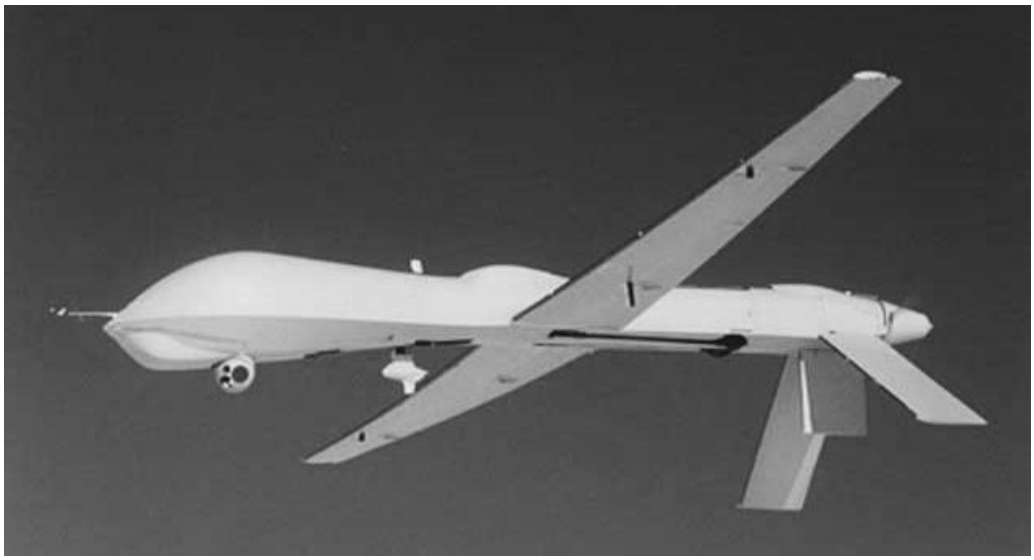

Fig. 3. MALE UAS – "RQ/MQ-1 Predator"
Rys 3. BSP klasy MALE – "RQ/MQ-1 Predator"

Launch & Recovery System (LRS) – Conventional wheeled, Take-off – 1530 m, Landing – 920 m, 5 people L&R team required, one GCS can control up to four UAVs but one operator can control only one UAV. Analysis Equipment consist of three Boeing Data Exploitation and Mission Planning Consoles and two SAR (Synthetic Aperture Radar) workstations. Every Predator system consists of four UAVs, a ground control station, and a satellite communications terminal. Required distance of the runway is 1530 m, Wing span-14.8 m, Weight-1043 kg, Lenght-8.2 m, Cruise speed-120 knots, Max ceiling- 25 000 ft, Max endurance-40 h, Max payload-204/136 kg (internal/external) [14].

The last example of the existed UAS mentioned in this publication, is the Israeli-Aeronautic Defence Systems Ltd. production TACTICAL-" Orbiter" (Fig. 4), used by Polish Army and Special Forces (it was used in Irak as well in Afganistan). Orbiter is design for simple and easy operation by a single operator (assembled in less than 10 min.). It is autonomous throughout its mission including during launch (by catapult, bungee or hand) and recovery (automatic parachute + airbag), and therefore requires minimal training for operation or support. Handheld Personal GCS is a compact unit

with advanced Real Time Control hardware. Equipped with an electro - optical colour payload, fitted with CCD (Charge-coupled Device) sensor with x 10 optical zoom for daylight operations. An optional night sensor uses low-light level camera. All of the acquired data (video & telemetry) is recorded up to 12 flight hours. Orbiter typically flies a mission of up to 90 minutes at 500-2 000 feet above ground level. It is transported by one soldier in backpack with Wing span-2,2 m, Weight-6,5 kg, Length-1 m, Cruise speed-75 knots, Max altitude-15 000 ft, Max endurance-1,5 hrs and Max payload-1,5 kg [14].

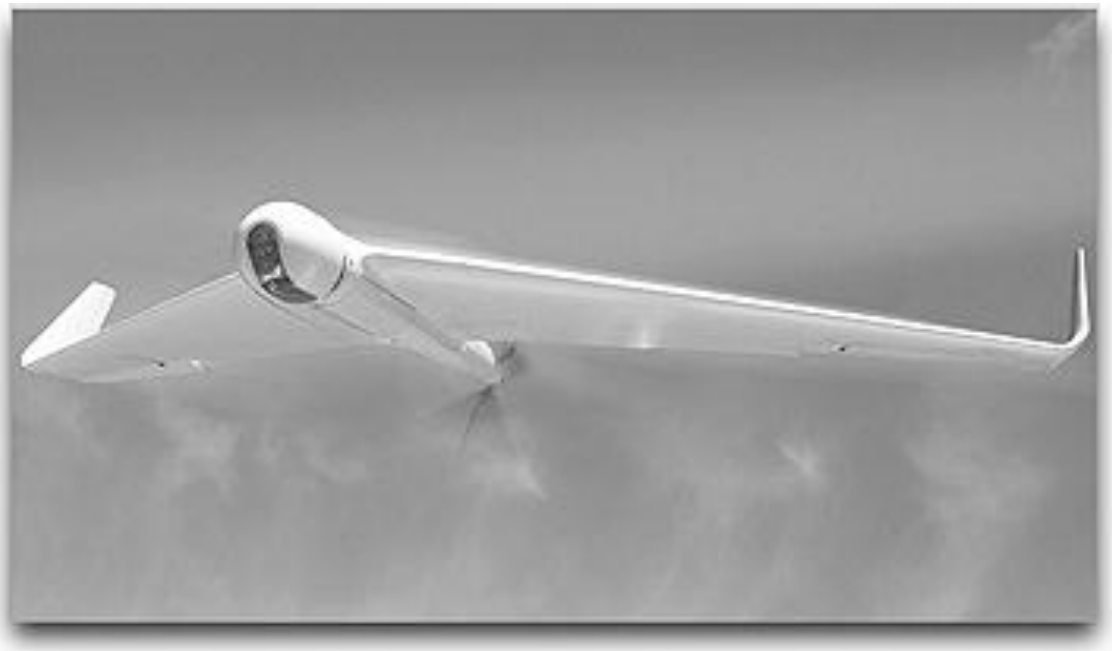

Fig. 4. TACTICAL UAS – "Orbiter"
Fig. 4. BSP klasy TACTICAL – "Orbiter"

One of the basic problem related to UAS, which is under consideration as well as of military and civilian experts all over the world is Air Traffic Management (ATM).

The degree of importance of the above mentioned question is conditioned by necessity of providing flight safety procedures for all air vehicles (unmanned and manned) within the airspace as the indispensable condition to achieve the society acceptance of UAS universal adaptation in contemporary world [15]. As mentioned above, many experts within the framework of the different kind of aviation organizations and working groups[2], are conducting intensive studies for providing the legal grounds and procedures, which will allow on skilful and safety flying of UAS within the Air Traffic Service (ATS) space.

In the sphere of considerations it is also the wide spectrum of UAS employment at the present-day world. While it is true that international experts do not foresee even in the future to use UAS for commercial air transport of passengers, but it is possible to apply the UAS also for commercial cargo transport, to reduce the intensity of the ground vehicular traffic.

In the purpose of achievement the required level of flight safety, employment of indispensable operational procedures and improvement of the scale of taking advantage of UAS in every domain of human life, they are consequently equipped with new modern aboard devices, flight remote control systems, independent means of communication, autonomous collision avoidance systems (SENSE & AVOID) [14], modern board computers with the elements of artificial intelligence, etc.

Armed Forces of many NATO countries are currently the main users of UAS in the military environment. Therefore first of all the NATO Theatre is mainly interested in full implementation of

[2] ICAO (International Civil Aviation Organization), EUROCONTROL(European Organization for the Safety of Air Navigation), JAA(Joint Aviation Authorities), EASA(European Aviation Safety Agency), NATO, etc.

operational capabilities of this type of aerial vehicles in available airspace not only during military conflicts, but also for the training or research and development purposes. Considerable achievements in the area of UAS development are also putting down by the civilian aviation organizations, especially in case of establishing the regulations related to UAS utilization of airspace elements as well as adaptation of adequate ATM procedures. Therefore, the guarantee of solving such an important problem is coordinating international civil-military cooperation and further technological development. In result of the previous cooperation, has been established and specified many overall regulations and procedures in case of Air Traffic Management and C2.

Within the European Airspace has been specified many prescriptions for the use of military UAVs as Operational Air Traffic (OAT) outside segregated airspace[3], as follows:

- ATM Categorization of UAV Operations;
- Modes of Operation;
- Flight Rules (right - of – way);
- Separation From Other Airspace Users;
- Sense & Avoid System;
- Separation Minima / Miss Distances;
- Aerodrome Operations;
- Emergency Procedures;
- Airspace Management;
- Interface With ATC (Air Traffic Control);
- Meteorology (Weather Minima);
- Cross-Border Operations;
- OAT CNS (Communication and Navigation System) Functionality Requirements.

Moreover, has been established that in the aim of ATM, UAS operations will be classified on the grounds of regulations related to execution of IFR (Instrumental Flight Rules) or VFR

(Visual Flight Rules) of the manned OAT. In addition, it is reckoned that in the face of Airborne Emergency Situations, UAV should apply the same procedures as manned aircraft.

For all pilots, regardless of where you are flying to, it is important to research the airspace and procedures where you will be flying. Not all airspace is the same as to the services that are provided or their weather minimums. EUROCONTROL, as the equivalent organization to the USA FAA (Federal Aviation Administration), has been working on implementing a strategy that will reduce the number of airspace classification from seven to three by 2010, with a further reduction to two by 2015.

3. CONCLUSION

In fact, the intensive efforts of the international authorities did not sound as yet, the details of this new quality challenge. Accordingly, the essential details of this topic are still an open subject. It is worth to take the trial for elaboration of "New Concept of Polish Airspace Management in Context of UAS Development", based on previous considerable achievements of the international civil and military aviation organizations in this domain.

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Received 20.04.2010; accepted in revised form 25.09.2011