

UNMANNED AIRCRAFT SYSTEMS IN SUPPORT OF THE LAND FORCES. SELECTED ISSUES

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Abstract:

The following paper presents selected aspects of the employment of unmanned aircraft systems (UAS) during land force operations, it focuses on its capabilities and constrains. In contemporary operations land forces, mainly UAS of I and II class category, are used in ISR missions, most frequently for the tactical support (armed roles) of land forces. These activities are treated as an additional element of the improvement of situational awareness, they also strengthen fire support. The presented article is based on allied and coalition doctrinal papers associated with unmanned aircraft systems.

Keywords:

unmanned aircraft systems, air support to land forces, planning, CAS, ISR

INTRODUCTION

The plan for the technical modernization of the Polish Armed Forces 2013–2022 assumes equipping them with unmanned aircraft systems [11]. The adopted operational requirements assume the use of various classes and categories of this type of means mainly by the land forces, although some of them will also be used in the air forces and, in the longer perspective, in the navy as well. In regard to the ground troops, they will mainly consist of unmanned aircraft systems of class I, up to 150 kg, (category: micro, mini, small) in accordance with the operational requirement under codename WIZJER and class II, 150–600 kg, (category: tactical purpose), in accordance with the operational requirement under codename GRYF and ORLIK. In addition, the ground troops, including special forces, will be equipped with unmanned aircraft systems with the vertical take-off and landing function. It can be estimated that in the perspective of the next decade, the tactical unit of the land forces (division) will have up to several

hundred of unmanned aircraft systems in the mini and micro category and a dozen or so of larger unmanned systems of the first and second class.

The already undertaken actions constitute the reason to discuss the scope of the use of unmanned aircraft systems in support of the land forces. Therefore, it will be necessary to develop doctrinal assumptions related to the use of this type of warfare. Currently, there are no statutory provisions for their use – hence, the analysis of NATO's documents and possible implementation of assumptions adopted in NATO are reasonable actions which must be undertaken. Another issue, necessary for the proper functioning of unmanned aircraft systems for the needs of the land forces, will be articulating the capabilities and limitations of unmanned aircraft vehicles and indication of the key areas of considerations relating to the planning of missions that support the activities of ground troops. The following content is an attempt to address the above-mentioned problems.

1. CAPABILITIES AND LIMITATIONS OF UNMANNED AIRCRAFT SYSTEMS

The analysis of the capabilities of unmanned aircraft systems, which includes the assessment of range, flight duration, as well as flight level of task performance, allows to conclude that the possession of this kind of weapon significantly increases the combat capabilities of each type of armed forces, especially in building the projection of military power. Moreover, unmanned aircraft systems can perform tasks which are difficult or impossible for manned aircrafts, e.g. in the environment where weapons of mass destruction are used or during combating the air defence of the enemy.

The majority of today's unmanned aerial platforms are able to stay in the given zone for long periods of time and perform specific tasks for a period of time which is usually limited only by the need to refuel or carry out technical services. The achievement of the longevity of task performance mainly results from the use of the latest technologies, which can be applied due to the elimination of the pilot and his frailties from the cockpit of the aircraft. Additional space allows to carry equipment of greater weight and dimensions. Future unmanned aircrafts will be also equipped with the technology that reduces radar cross-section (stealth), which will allow to perform actions within the enemy formation with many air defence units in the area. Additional equipment for self-defence measures will increase their lifespan on the battlefield, and the systems of autonomous in-flight refuelling (also from unmanned tankers) will further increase the duration of air operations. It is worth noting that there is work in progress on the unmanned aircraft systems which will be able to operate continuously for several years without refuelling (solar systems). This allows to put forward the thesis that in the future, the cooperation of unmanned aircrafts with manned aviation, as well as the space systems should be expected, this in turn will lead to continuous supply of information on a given area of interest and it will contribute to the achievement of the synergy effect [10].

The capabilities of the unmanned aircraft systems allow for their versatile use, thanks to the possibility of the installation of various types of equipment (sensors, cargo). Virtually every unmanned aircraft, regardless of its primary purpose, is able to perform

tasks associated with observation and reconnaissance, as well as collecting information about weather conditions or tracking the objects of potential impact. It should be also emphasized that unmanned aircrafts can be used to evaluate the results of operations and also as communication relays. The role in providing the marking of objects on the battlefield and supplying information within dynamic targeting should not be underestimated, especially with regard to objects with short projection on the battlefield. Therefore, providing the equipment of unmanned aircraft systems with appropriate sensors allows to locate, identify and mark the object, it also makes the assessment of the results of further impact possible [4].

The possibility of arming the unmanned aircraft is another fact proving their versatility. It seems that in the future, it will not be hard to imagine mixed groups of unmanned and manned aerial vehicles or autonomous operations of the latter. Equipping them with kinetic and non-kinetic means of interaction undoubtedly is also an advantage of the unmanned aircraft, especially since more and more weapons are dedicated directly to unmanned aircraft systems [5].

One of the key elements in the use of unmanned aircrafts in the current and future battlefield is and will be their integration with other systems, especially within the network-centric command system [5]. Cooperation with network-centric systems of the battlefield will allow for a more efficient use of unmanned aircraft systems. The condition is to achieve hardware compatibility between the individual elements of the system, as well as the interoperability of the entire system. The use of the network-centric technology will allow to supply necessary information directly to the units which need it (analysts, planners, combat units, etc.) and eliminate the limitations associated with the bandwidth of the elements transferring data. The use of the above-mentioned solutions will also lead to the increase in the degree of autonomy of unmanned aircraft systems, which in turn will facilitate the performance of tasks characterized by long endurance and routine. It must be remembered that such tasks are better performed by machines. There are widespread opinions that an increase in the autonomy of the system will not promote the integration process [10]. This view is not entirely true, because the use of unmanned aircrafts performing the tasks in an autonomous manner will allow the operators to obtain information which will significantly facilitate the process of planning and decision-making. Moreover, it should be also noted that unmanned aircraft systems within the network-centric system will be incorporated into the system at any given moment or excluded from it, when such a need occurs. On the other hand, the failure of the entire system will not affect the process of information supply, because an appropriately programmed unmanned aircraft will supply necessary data in an autonomous manner. An important element affecting the integration of the system is the linking of elements of the unmanned aircraft with a traditional command station and information exchange between various elements with the use of all possible methods.

It is probable that the unmanned aircraft systems designed for the performance of combat tasks will be used together with other aerial platforms in mixed combat teams. The first such solutions were used in Iraq in 2007. There was a concept of the use of

unmanned aircrafts in missions aimed at preventing the use of improvised explosive devices by rebels and terrorists. In Iraq, special task force ODIN (Observe, Detect, Identify and Neutralize) was created to use the capabilities of manned platforms (light reconnaissance airplanes C-12 and combat helicopters AH-64) and unmanned platforms (Sky Warrior Alpha) [8].

The possibility of using unmanned aircraft systems in support of the ground troops, instead of manned airplanes, is very important. Due to arduousness of long-term observation missions conducted over sparsely populated areas, the use of unmanned reconnaissance aircrafts (smaller and quieter than manned reconnaissance airplanes) can ensure the secrecy of such operations. On the other hand, the shooting down of a manned aircraft is associated with the need to carry out expensive and complex combat rescue operations (Combat Search And Rescue – CSAR). In order to help one pilot, the lives of many well-trained professionals must be risked. Very often, these are the soldiers of special forces [9].

Unmanned aircraft systems are also subject to limitations, which may determine their use in support of the land forces, and thus make them a less desirable platform compared to manned aircraft. The most important of them include: terrain, weather conditions and threats associated with a potential enemy.

The terrain, as one of the factors affecting the use of unmanned aircraft systems, refers not only to its natural characteristic features, but also to the objects that were created by human hands: urban agglomerations, airports, bridges, railway lines, transmission and communication lines, towers, etc. These objects, similarly as in the case of manned aviation, constitute a real danger for unmanned aerial platforms performing the flight. It is obvious that open spaces ensure the optimal use of sensors for the location and identification of a possible enemy. On the other hand, mountains or cities limit the capabilities of sensors, as well as the communication with the unmanned platform itself.

An important limitation could be weather conditions, which must be considered in relation to the aircraft, as well as the sensors installed on the board of a given unmanned aircraft. Rainfall, wind and air temperature have a significant impact on unmanned aircraft's ability to perform tasks and may even make these tasks completely undoable. From among the above-mentioned elements, icing seems to be the most dangerous one, it may lead to the loss of an aircraft. Unfortunately, most of the currently used unmanned aircraft systems are not equipped with appropriate installations which eliminate this threat, as a result, an aircraft loses its aerodynamic properties and in extreme cases, it may even crash. The only reaction is the intervention of the operator who should lead the aircraft out of the icing zone or change the height of its operation [6].

Another atmospheric phenomenon affecting the functioning of unmanned aircraft systems is the wind which has a significant impact during take-offs and landings. A particularly dangerous type of wind is a crosswind, which often makes it impossible to perform a take-off or landing and which affects the accident rate during these activities. On the other hand, small rainfall does not significantly affect the operation of

unmanned aerial systems. However, it should be remembered that in certain conditions, it may affect the quality of transmitted imaging, it can also disrupt the control of the aerial vehicle.

Other atmospheric phenomena, such as fog or a low cloud base, mainly affect the limitation of capabilities of the sensors installed on unmanned aircraft systems. For example, the infrared camera may carry out monitoring only in the case of the occurrence of a small fog. Obtaining better image quality enforces flight at a low altitude and a low speed, which in turn poses a threat in the context of the air defence systems of the enemy, and even the personal weapons of soldiers. The above-mentioned considerations are presented in Table 1.

Table 1. Unmanned Aircraft Systems Weather Limitations

Weather	Unmanned Aircraft System	UAS sensors
Icing	– Can create dangerous flying conditions if limited or no de-icing capability installed	Ice may obscure sensors
Crosswinds > 8 m/s	– Often exceeds operational capabilities	N/A
High winds > 25 m/s	– Can create dangerous flying conditions	N/A
Light rain	– UAS generally can operate	N/A
Heavy rain: 5 cm or more per hour	– UAS often cannot operate	Poor, unusable imagery
Fog, low clouds, dust, sandstorm	– Increase risk at take offs/ landings; reduces payload effectiveness	Can penetrate light but not heavy fog/ clouds

Source:[3]

Weather conditions, temperature, time of the year and day also affect the selection of a specific type of sensors necessary for gathering information and imaging. Depending on the above-mentioned conditions, they present various capabilities (Table 2).

An important limitation, which to a greater extent is associated with unmanned aircraft systems than manned aviation, is high susceptibility to damage associated with extreme weather conditions, as well as fire impact from potential enemy. This mainly results from the design of unmanned aircrafts, which do not develop high speeds and are not fully adapted to performing missions at night, and often there is also a lack of on-board self-defence measures which would be adequate to the threats. Also, the on-board equipment of unmanned aerial vehicles often requires the performance of flights at low heights, which significantly increases the chances of the loss of the aircraft or its damage. Therefore, it seems reasonable to equip unmanned aircraft systems with various systems increasing their service life on the modern battlefield. The main ones include: means of electronic warfare, stealth technology, means of passive defence (flares and chaffy) or appropriate armament for self-defence (air-to-air mis-

siles). An important element of improving the service life will be the use of the latest technologies, which will make the unmanned aircraft systems “more intelligent” in the context of threats.

The unreliability of unmanned aircrafts often results from technical defects. For example, there is only one engine in the majority of currently used unmanned aircraft systems, which in many cases poses a threat of losing the entire aircraft. On the other hand, an increase in technical efficiency cannot be carried out with an excessive increase in production costs and aircraft weight. The accident rate among unmanned aircraft is often caused by the lack of adequate training of the operators, which can be eliminated by an appropriate training system.

Table 2. Unmanned Aircraft Systems Sensor Matrix

Advantages	Disadvantages
Electro-optical	
Affords a familiar view of a scene	Employment of camouflage and concealment techniques can deceive the sensor
Offers system resolution unachievable in other optical systems or in thermal images and radars	Restricted by weather conditions; visible light cannot penetrate clouds or fog
Preferred for detailed analysis and measurement	Restricted by terrain and vegetation
Can provide 3D imaging for better analysis	Limited to lighted areas during night time
Infrared	
A passive sensor; not easy to jam	Not as effective during thermal crossover (1 to 1.5 hours after sunrise or sunset)
Offers camouflage penetration	Bad weather degrades quality
Provides good resolution	Risk from A/A systems
Night imaging capability	
Synthetic Aperture Radar	
Near continuous situational awareness even in adverse weather	Requires trained personnel to interpret
Detailed imaging of large area	No video capability. Not supported by One System Remote Video Terminal (OSRVT) /Rover
Photographic-like images	Extensive processing and distribution bandwidth
	Image latency based on bandwidth
	Can be jammed
Ground Moving Target Indicator	

Advantages	Disadvantages
Provides increased UA survivability through increased stand-off ranges	Additional processing may be required
Focuses attention on relevant movement/activity	Stationary targets not visualized
	Can be jammed

Source: [1]

One of the most important limitations, which must be considered during planning of a mission for unmanned aircraft systems, is the potential threat from the combat systems of the enemy. Basically, it is believed that unmanned aircrafts should operate in regions, where there is no threat from air defence systems and artillery. Therefore, the flight routes, height, entry and egress points in regard to the operation area should be carefully planned with respect to a possible threat from the surface-to-air systems of the enemy. Currently, only a small number of unmanned aircraft systems have danger warning systems. In the future, depending on the class of unmanned aircraft system, also the threats from air, e.g. from air-to-air missiles [12], will have to be taken into account in the planning.

To sum up, the limitations associated with the use of unmanned aircraft systems are similar to those, which are also attributed to the manned aviation. Nevertheless, their capabilities, mainly long-term durability of operation combined with the increased safety for staff, predispose them to the use in many missions supporting the land forces.

2. SELECTED ASPECTS OF PLANNING MISSIONS OF THE UNMANNED AIRCRAFT SYSTEMS IN SUPPORT OF THE LAND FORCES

Planning of the mission for unmanned aircraft systems must be considered in the context of their subordination within the command structures. It must be assumed that most of unmanned aircraft systems of class I and II will directly perform tasks for the benefit of ground troops, at the level of brigade and division (mainly reconnaissance, observation and partly attack missions). In the future, we must strive to incorporate those systems directly into the structures of individual brigades and divisions. In the situation of creating the base for unmanned aircraft systems, individual sets from its structures will perform tasks for the benefit of individual brigades and divisions, in accordance with assigned (demanded) effort. In regard to unmanned aircraft systems of class II, it seems that they will perform tasks at the operational level (theatre of operations).

Issues related to planning the use of unmanned aircraft systems are practically the same as the ones related to manned air platforms. A liaison officer from the unit of unmanned aircraft systems should provide an appropriate and comprehensive flow of information between the supported subunit and the unit of an unmanned aircraft, and ensure that the supported unit knows the capabilities and limitations of unmanned aircraft systems. The combat capabilities of unmanned aircraft systems predispose them to perform many missions, including: reconnaissance and observation, improving situational awareness, ensuring safety of moving convoys, retranslation of communica-

tion, identification of attack objects or battle damage assessment. On the other hand, an armed unmanned aircraft will be able to perform the following tasks: air interdiction, close air support, combat search and rescue, the suppression of enemy air defences or the support of naval operations.

It must be assumed that in the case of the central subordination of the resources of the unmanned aircraft systems, the process of mission planning will be carried out by the officers from the supported subunit in close cooperation with the liaison officer from the unit of unmanned aircraft systems. This process will not deviate from the standard planning procedures adopted at a given level of organizational structure. It will be mainly carried out by the officers from section S-2 and S-3, and the supported commander should specify the criteria for the maximization of success in regard to the use of unmanned aircraft systems, in cooperation with the liaison officers from the unit of unmanned aircrafts.

Unmanned aircraft systems can support the operations of land forces in any given place of battlefield, providing necessary data both during the day and at night, at the same time reducing the risk associated with the use of manned platforms. They can perform tasks (depending on the class of the system) from previously prepared places of take-offs, as well as from unprepared landing sites or airports. However, the location of the ground control station in the structure of supported unit increases coordination capabilities, in relation to the direct access of the elements of unmanned aircraft systems to data concerning the aerial situation, potential threats or weather conditions. Besides, the unit (for the benefit of which the tasks will be performed) can have tools, which may substantially facilitate and accelerate the process of mission planning [6].

In the context of planning the mission for an unmanned aircraft system, it is necessary to consider the situation in which all of its elements will be entirely allocated in the structure of the unit (for the benefit of which the tasks will be performed) and in which they will be divided into a part responsible for mission planning and commanding and elements responsible for the start and recovery of an unmanned aircraft. This mainly depends on the class of the unmanned aircraft system. In the first case, it will be easier to plan the mission and command of the unmanned aircraft as well as ensure logistical support. On the other hand, it is probable that it will emit more electromagnetic energy, which can facilitate detection. In the other case, the elements responsible for unmanned aircraft mission planning and commanding will be deployed in the command post (e.g. in the tactical operational centre) of the supported unit, and the part responsible for the start and recovery of the unmanned aircraft will mainly function in the rear zone of the supported unit. It will receive tasks from planning and command elements from the operational centre of the supported unit, while being responsible for the preparation of a specific mission of the unmanned aircraft and its recovery after the completion of the task. After the start and reaching the prescribed height, the control over the unmanned aircraft is passed to the ground control station, located by the supported unit. In the case of recovering the unmanned aircraft, the process is reversed – at the prescribed height in the given zone, the control is handed over to ele-

ments responsible for start and recovery [6]. The selection of the start and recovery zone of the unmanned aircraft systems is one of the key factors, which must be considered during planning. The elements which must be considered encompass the distance and scope of eye visibility in regard to the potential area of task performance, appropriate space necessary for the performance of start and landing, as well as engineering support, including the consideration of terrain obstacles which prevent take-off and landing. Densely populated areas with overhead traction infrastructure that prevent the performance of tasks must be avoided. In the situation of performing a task in an urban area, there is an additional factor which increases the risk, and hence it must be separately considered. Areas with high saturation of devices emitting electromagnetic energy may interfere with taking over the control of the unmanned aircraft, and therefore they must be avoided. Moreover, the take off and recovery zone cannot be located far away from the elements responsible for the planning and command of the mission so as to ensure the effective takeover of the control of an unmanned aerial vehicle. Another important factor is the insurance of the safety and protection of the zone, providing survival and hindering its detection by the enemy. In the case of sharing the zone (airport) with manned airplanes, it is necessary to develop a plan that allows for the non-conflicting use of airport area for take-offs and landings (recovery) of unmanned aircrafts [6].

In the process of planning a mission of unmanned aircraft systems for the supported unit, the HQ elements from the supported unit are involved. It should be assumed that the commander of the supported land unit will be interested in the capabilities and limitations of unmanned aerial system. Therefore, from his point of view, the answers to the following questions will be crucial [6]:

- What is the daily effort of support by unmanned aircraft systems?
- What is necessary for the daily functioning of unmanned aircraft systems for the benefit of the supported unit?
- How to ensure safety for the operation of unmanned aircraft systems?
- How will weather conditions affect the potential activities of unmanned aircraft systems within one day, 48 and 72 hours?
- What steps must be taken and at what time in order to effectively change the mission for unmanned aerial systems?

These are just examples of questions for which the commander of the supported unit should find an answer, in order to effectively use unmanned aircraft systems in support of his own operations. More detailed questions will be asked by the S-2 section officers. For example, questions relating to the following matters must be answered: time and type of data collected thanks to the support of unmanned aircraft systems; areas of reconnaissance; objects of reconnaissance; potential threats to the mission; terrain limitations affecting the performance of unmanned aircraft tasks; the impact of weather conditions on the mission of unmanned aircraft systems. On the other hand, the officers from the operational section should ensure the exchange of operational procedures between the supported unit and the subunit of unmanned aircraft sys-

tems, including the determination of the role and place of the subunit of the unmanned aircraft in the operation, they should also set the criteria associated with the mission command related to the use of unmanned aircrafts. The operational section will be also responsible for the airspace control for the needs of unmanned aircraft systems. Generally speaking, the order to perform the task given to the unit of unmanned aircraft systems should include the following elements: region of operation, task, time slot for completion of the task, the method of task performance, reconnaissance objects, priority reconnaissance needs, output lines, air corridors the area of operation, coordination means of fire support and airspace control, communication and logistical support.

To sum up, the mission planning procedures for unmanned aircraft systems supporting the operations of land forces do not differ from the ones used by ground troops. In the context of the future implementation of unmanned aircraft systems into the structure of land forces, there will be a need to develop detailed standard operational procedures assigned to a given set of unmanned aircrafts.

3. THE SCOPE OF THE USE OF UNMANNED AIRCRAFT SYSTEMS IN SUPPORT OF THE LAND FORCES

Currently, there are no doctrinal provisions concerning the use of unmanned aerial systems in the Polish Armed Forces. Therefore, it is reasonable to analyze the basic doctrinal assumptions of NATO related to the use of unmanned aircraft systems during land forces operations. They were standardized in the document entitled *ATP-3.3.7.1 UAS Tactical Pocket Guide*, issued in April 2014. The key areas of the use of unmanned aircraft systems in such operations include: tasks associated with broadly understood observation and reconnaissance (Intelligence, Surveillance and Reconnaissance Missions – ISR Missions) and tactical air support (Tactical Air Support – TAS) [3]. It is assumed that within ISR missions, the unmanned aircraft systems should be used in the operations of land forces for widely understood tactical air reconnaissance (Tactical Air Reconnaissance – TAR) and surveillance of a given area. The subject standardization document characterizes several types of reconnaissance that may be carried out in the operations of the ground troops with the use of unmanned aircraft systems. The reconnaissance may take the form of: reconnaissance of roads and communication routes (Route Reconnaissance), reconnaissance of zones (Zone Reconnaissance) or areas (Area Reconnaissance). Regarding the route reconnaissance, it is assumed to use the unmanned aircraft systems in order to acquire detailed information concerning a specific road or communication route, as well as the area around them from which the enemy can affect the movement of own forces. Concerning the zone reconnaissance, the unmanned aircraft can be used for acquiring detailed information about the terrain (roads, terrain obstacles, etc.) and the enemy forces within a defined zone with clearly defined boundaries. On the other hand, the area reconnaissance is perceived similarly to the zone reconnaissance, but the boundaries of reconnaissance performance are treated in a different way. In the zone reconnaissance, the unmanned aircraft systems can be used only inside the adopted boundaries (restrictive), while in the case of the area reconnaissance such a limitation does not exist and the boundaries

are treated as a measure used to determine the desired area of reconnaissance performance (permissive). They can be crossed if the development of the operational and tactical situation requires such an action [3].

The tasks of unmanned aircraft systems during the land forces operations associated with air observation may assume the form of observation of a specific area (Surveillance of a Specified Area) or long-term observation (Long Endurance Surveillance), in accordance with the standardization contained in NATO's standardization document *ATP-3.3.7.1*. In the first case, the unmanned aircraft systems are used for systematic observation of areas or buildings, which are in the scope of interest of the tactical task group of land forces. They supply video imaging to ground elements in a continuous manner, directly to the receiver terminals located there. In the second case, the unmanned aircraft systems provide continuous and long-term observation of approach direction of the enemy forces, the defined areas of reconnaissance interest (Named Area of Interest – NAI) or areas which are interesting due to the combat needs of the attack objects (Target Area of Interest – TAI) [3].

Tactical air support, in accordance with the provisions of *ATP-3.3.7.1*, includes four categories of the use of unmanned aircraft systems for the direct support of ground troops and assistance in conducting operations in the terrestrial environment. It includes: security operations, armed reconnaissance, strike and strike coordination and reconnaissance (SCAR) [3].

The use of unmanned aircraft systems in order to ensure the safety of troops may involve collecting information on the activity of the enemy forces around the protected object or constant observation of access roads to such an object. Unmanned aircraft systems can be used for detecting the enemy forces and maintaining contact with them, combating their reconnaissance forces or hindering the implementation of their tasks without the need to involve the main forces. Also, the use of unmanned aircraft systems is meant for harassing the enemy forces and directing the fire of own fire means that carry out the indirect fire. Such systems can be also used for directing the activities of reaction forces. Depending on the concept of the implementation of the tasks associated with ensuring the safety of troops, the unmanned aircraft can be used as a part of forces conducting screening operations (Screen), protective operations (Guard), cover operations (Cover), ensuring safety in the given area (Area Security) or in certain proximity of the protected objects (Local Security) [3].

The main task of unmanned aircraft systems operating as a part of the forces conducting screen operations is to provide early warnings. The capabilities of unmanned aircrafts, including the availability of a wide range of sensors and cargo as well as the possibility of a long-term operation during the day and at night, predispose them to carry out such a task. They can perform them on their own, in teams or as part of the entire warning system of a given group of land forces. Usually, they will expand the early warning capabilities of ground troops.

The operations of unmanned aircraft systems in guard missions – compared to operations carried out as part of the forces conducting screen operations – are distinguished

by greater capabilities related to a potential response to threats. Unmanned aircraft systems will have the capabilities thanks to which it will be possible to affect the enemy in a manner forcing him to withdraw and even defeat him before the engagement of the main forces. They will carry out the reconnaissance and surveillance missions of areas and approach the zones of the enemy, maintain contact with the enemy and fight with the reconnaissance units of the enemy.

Providing cover missions by unmanned aircraft includes the same activities, which are carried out as part of the forces conducting screen operations and guard missions, but the unit of unmanned aircraft systems implements them independently. In most cases, the activities which are conducted as part of the forces conducting the cover operations and guard operations of unmanned aircraft are a fragment of larger forces. In the discussed case, the cover carried out by an unmanned aircraft is performed independently.

Ensuring the safety within a given area (area security), conducted by unmanned aircraft systems, includes: surveillance and reconnaissance tasks, protection of troops and critical infrastructure in the area of responsibility, deterring forces of the enemy or demonstration of force. They will be implemented both in offensive and defensive activities. Similar tasks can be performed by unmanned aerial systems to ensure safety in certain proximity of protected objects (local security) [1].

The use of unmanned aircraft systems in SCAR missions is aimed at the detection and then ad hoc elimination of detected attack objects in the assigned zones or along the communication routes. NATO's doctrinal standardizations provide for the ad hoc combating of the detected groups of troops, logistic supplies or infrastructure objects used by enemy forces.

The use of unmanned combat aircraft systems for the implementation of the tasks of a strike nature is applied in order to eliminate some specific objects of the enemy, including objects located in the close proximity of own forces, within close air support. The attributes of combat unmanned aircraft and mainly the durability of mission performance, as well as a relatively low speed (compared to manned aerial vehicles), predispose them to carry out combat missions, including close air support. In addition, they offer the possibility of extended communication and reach back ability (reaching to supply area/reaching to the rears). On the other hand, the relatively lower speed constitutes a limitation associated with, e.g. a quick change of mission in the air. Therefore, it should be assumed that unmanned aircraft platforms primarily will be additional combat means that supplement the combat capabilities of helicopters and combat aircraft supporting the operations of the land forces.

In a typical CAS mission, the unmanned aircraft will act as a sensor used by the Joint Terminal Attack Controller (JTAC) in order to locate the objects (especially the ones that are masked) and improve the situational awareness of the target and area of operation. When an object is detected and identified, JTAC with the use of an unmanned aircraft can provide necessary information to the manned aircraft, which will implement the mission of close air support. In another scenario, it is possible to use an unmanned aircraft by JTAC as a laser to mark the object for the airplane (or helicopter)

performing an attack with weapons directed by the laser beam. If the unmanned aircraft is armed, then it will be possible to carry out an attack to the indicated target by the unmanned aircraft itself [7].

In regard to the potential applications of unmanned aircraft systems in the CAS mission, it has to be taken into account that, depending on the class and category of unmanned aircraft, its capabilities will vary, thus various applications in a given mission should be expected. There are more and more unmanned combat aircraft systems with guided air-to-surface ammunition (via laser or GPS). On the other hand, mobile video terminals allow ground subunits to obtain image from the unmanned aircraft almost in real time.

The use of the unmanned combat aircraft system for close air support is based on the same procedures as the ones used for airplanes and helicopters implementing this type of missions. In regard to CAS missions, the operators of an unmanned aircraft should strictly fulfil the same instructions as the ones sent to a manned aircraft by JTAC. Also, a detailed plan should be developed in the case of a loss of communication with the unmanned aircraft. It is also assumed that an unmanned aircraft will not implement CAS control, type I¹. On the other hand, passing control to the lower tactical level will allow for the efficient use of the capabilities associated with the use of reconnaissance sensors, communication sensors or the weapons of unmanned aircraft systems. It will be difficult to change the mission of an unmanned aircraft over long distances due to limitations associated with the cruise speed of unmanned aircraft systems. It will be also necessary to deconflict the airspace for the needs of these platforms.

The tactics of the use of unmanned combat aircraft systems assume two different methods of their use to carry out an attack. The first one (Figure 1), referred to as “wheel”, assumes the flight of the unmanned aircraft on the circular orbit and it is used in the situation when there are no restrictions associated with the direction of attack performance and the terrain (including an urban area) does not mask the object of the attack. The radius size of the circular orbit is 5–8 km over the object of the attack. This method allows the operator of the unmanned aircraft to carry out an attack at any given moment or on command. In the situation when the unmanned aircraft waits for the attack command, the operator of the weapon system will update the data and transmit them to the ground control station. In the case when the object is masked by the terrain, the pilot can manoeuvre in order to limit the masking properties of the terrain [7].

¹ This type of control is implemented when there is a high risk of attacking the troops and JTAC located in the group of subunits and conducting the operation must monitor the location and profile of the attacking airplane in regard to the target. JTAC grants consent for each individual attack (he sees the target as well as the airplane) – Author’s note.

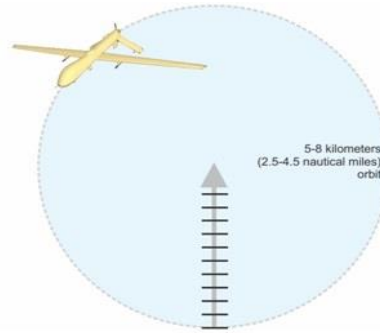


Fig.1 Wheel Orbit

Source: [7]

The second method, referred to as “8-track” (Figure 2), is used in the situation when there are restrictions associated with the final direction of the attack. They can result from the need to deconflict the airspace, changing the position of own troops, potential losses and unintended destruction or a specific nature of the terrain around the object of the attack [7].

The coordination of strike operations with the use of unmanned aircraft systems combined with the performance of air reconnaissance is carried out for the needs of other aerial platforms, including manned aircrafts. These tasks may include: detection of usually mobile objects of the strikes, their identification, the indication of other means of reconnaissance (cross cueing), marking for the needs of strike performance (e.g. illumination with the use of laser beam), assistance in the determination of an attack sequence by another aircraft, autonomous combating the object by unmanned aircraft systems and battle damage assessment [2]. In the case of unmanned combat aircraft systems, they are supposed to be used in the operations of land forces, mainly for eliminating highly mobile, valuable objects of strikes with a short projection time to fire strike, using the tactics of independent searching and elimination (hunter-killer).

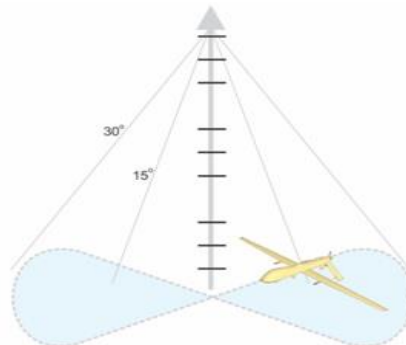


Fig.2 8-Track orbit

Source: [7]

To sum up, the scope of possible tasks carried out by unmanned aircraft systems for the needs of land forces will include a wide range of applications, wherein the missions of widely understood reconnaissance and observation are in the forefront, with more

and more frequent occurrence of the strike missions, including missions of close air support.

CONCLUSIONS

One of the priorities of the technical modernization of the Polish Armed Forces for 2013–2022 is the acquisition of reconnaissance and strike-reconnaissance unmanned aircraft systems. In short-term perspective, their main use will be in the land forces. The land forces predict the use of unmanned aircraft systems mainly for the implementation of intelligence tasks, observation, reconnaissance and, to a lesser extent, for strike tasks. The massive use of systems of mini and micro categories is predicted by the subunits of the land forces, and their loss is considered to be acceptable due to low costs of their acquisition. In the coming years, the efforts should be made to centrally subordinate the unmanned aircraft systems in individual types of armed forces, during the time of peace. During combat operations, such systems should be allocated depending on the development of the operational and tactical situation, as a support for units and subunits of the ground troops.

It is predictable that in the long perspective (10-15 years) a new subunits of land forces responsible for the use of unmanned aircraft systems will be included in the land force units from the battalion to division level. However, it should be noted that there are numerous constrains limiting the wide scope of the employment of unmanned aircraft systems for land forces purposes, such as: weather conditions, terrain, enemy. Thus, in the nearest future, it will be necessary to develop doctrinal assumptions on the scope of the use of unmanned aircraft systems in individual types of armed forces and to implement a comprehensive training system for the operators of unmanned aircraft systems and sensors (cargo). It seems that the training for the needs of armed forces should be carried out according to the NATO standards and the national legal provisions for civil aviation in Poland. The training of operators, other specialists for handling of unmanned aircraft systems and staff securing the operational use of such systems should be implemented in the main training centre with a sufficient base for theoretical and practical training, including the proving ground training.

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BIOGRAPHICAL NOTE

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