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Use of Unmanned Aircraft in the Logistics Support of Military Formations

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Abstract: The present development describes an experiment using an unmanned aerial vehicle (UAV) conducted at the Vasil Levski National Military University - the town of Veliko Tarnovo, and the purpose of the experiment is to determine the possibilities of using a drone in the logistical support of military formations of tactical level. The experiment was carried out in field conditions, and for this purpose a logistics company from the composition of a mechanized battalion was deployed in field conditions in rugged terrain. The drone used is a DJI MAVIC PRO 2.

Keywords: Unmanned aircraft, Logistics support, Drone

Introduction

The modern security environment and dynamic changes on a global scale require the use of alternative and modern methods of conducting and securing combat operations in a different environment. The large-scale use of unmanned aerial vehicles in the war in Ukraine shows that this type of means has effectiveness in conducting combat operations, which necessitates the expansion of their application in various military spheres. Modern military UAVs perform a wide range of functions, for the implementation of which they perform multiple tasks above the territory of combat operations and in the depth of the enemy's position. At the same time, as a result of the development of high technologies and innovations in military affairs, the functions and tasks of UAVs often change in real time. (Zagorski, 2021)

Army UAV capabilities have evolved from a theater reconnaissance asset to core tactical roles such as surveillance, reconnaissance, attack, targeting, communications transmission, convoy surveillance, and more. The Army uses UAS as an extension of the tactical commander to locate, fix, track, facilitate and terminate targets. Army UAS missions are integrated into the commander's mission planning, as a combat multiplier in a modern operational environment (Kappenman, 2008). The categories for military drones are quite different from those for civilian drones. They are categorized based on their weight, range, speed as well as their specific capabilities. The classification is used by NATO groups and is according to the US Department of Defense:

- CLASS I (< 150 kg): SMALL – this class includes micro, mini or small drones with primary reconnaissance, surveillance and targeting purposes. They are often fixed wing with an average weight of about 20-100 kg, a maximum speed of 100 km/h and a flight height of up to 4 km. Main application is for espionage.
- CLASS II (150–600 kg): TACTICAL – includes drones with the size and capabilities of small aircraft. They feature a combination of flexibility, durability and robustness and are used for surveillance and monitoring in damage analysis and assessment, border surveillance, reconnaissance and emergency response.
- CLASS III (> 600 kg): STRATEGIC – This category includes aircraft-sized drones. They have a wide range of applications, being used to determine the position of the enemy or the movement of certain targets.

Based on the specific role they must play in a particular military operation, military drones are divided into target and decoy, reconnaissance, attack, and research and development. They are applied and will continue to be applied in various military operations due to their great convenience in reducing losses and providing the ability to perform narrow profile and risky missions. Drones are also used in border security and coast guard. The future is in the increasingly complete autonomy and most innovation of military unmanned aerial systems - military drones. (Jelev, 2018)

Logistics Support System

A single system has been built to provide effective logistical support for the Armed Forces (AF) at the strategic, operational and tactical levels. The system for logistical support of the Armed Forces is a set of management bodies, forces and means for carrying out the activities of providing the troops, connected in a single network of interconnections and also represents a complex organizationally complete economic system, which consists of units interconnected in a single process of management of material and accompanying flows transforming logistics resources with activities and processes in logistics chains, in accordance with the mission, objectives, tasks and performance criteria, supporting the normal functioning of the life cycle of the Ministry of Defense and the Bulgarian Army. The logistics support system includes the following elements:

- command staff.
- forces and means of logistical support.
- infrastructure and transport communications.
- consistency, forms and principles of interaction in organizing and implementing logistics provision.
- communication and information system.
- protection of the forces and means of logistical assurance (Figure 1) (Botev, 2002).

Figure 1. Logistic support system

Functional Areas of Logistics

The overall logistics provision is formed by the uniform and coordinated implementation of various logistics functions, grouped in the following functional areas:

- supply of material resources.
- logistics information management.
- operation, maintenance and repair.
- movement and transportation.
- securing the military infrastructure.
- provision of services.
- medical insurance.
- negotiation.
- host nation support (Figure 2). (НП-4, 2019)

Through the present development, the areas of possible application of the unmanned aerial vehicles in the system of logistical support of the military formations at the tactical level will be determined.

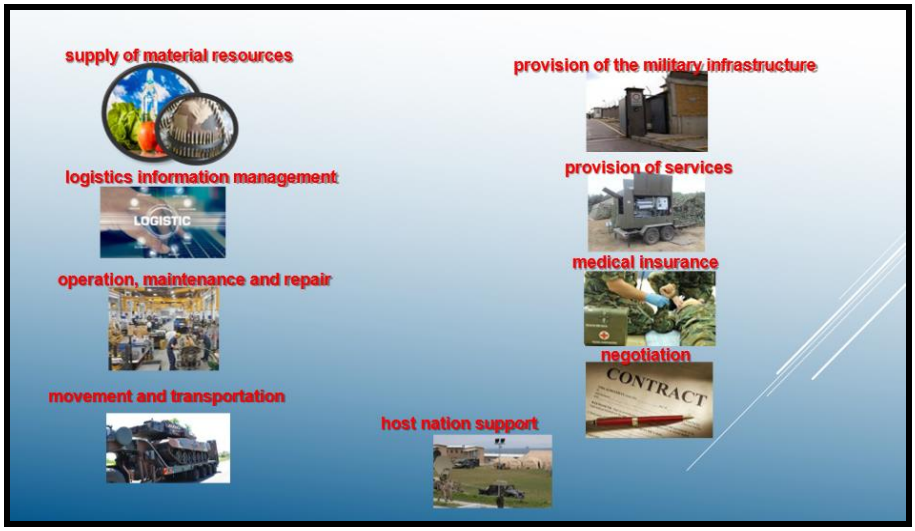

Figure 2. Logistic functional areas

Method

The present experiment was carried out using a DJI Mavic Pro 2 unmanned aerial vehicle, and tasks related to the logistical support of a mechanized battalion in field conditions were planned and executed. After completing the tasks, an analysis was made for the performance such as time, data transmission, difficulty of performance. During the execution of the tasks, the information from the UAV is transmitted to live data in a deployed logistic support control center (LSCC). The UAV is managed by a specialist operator from the control center, and the received data is recorded and processed by officials in the composition of the LSCC. The drone used has the following technical characteristics (Table 1).

Table 1. DJI Mavic Pro 2 specs

Take off Weight	**Mavic 2 Pro: 907 g**
Dimensions	Folded: 214×91×84 mm (length×width×height) Unfolded: 322×242×84 mm (length×width×height)
Diagonal Distance	354 mm
Max Ascent Speed	5 m/s (S-mode) 4 m/s (P-mode)
Max Descent Speed	3 m/s (S-mode) 3 m/s (P-mode)
Max Speed (near sea level, no wind)	72 kph (S-mode)
Maximum Takeoff Altitude	6000 m
Max Flight Time (no wind)	31 minutes (at a consistent 25 kph)
Max Hovering Time (no wind)	29 minutes
Max Flight Distance (no wind)	18 km (at a consistent 50 kph)
Max Wind Speed Resistance	29–38 kph
Max Pitch Angle	35° (S-mode, with remote controller) 25° (P-mode)
Max Angular Velocity	200°/s
Operating Temperature Range	-10°C to 40°C
Operating Frequency	2.400 - 2.483 GHz 5.725 - 5.850 GHz
GNSS	GPS+GLONASS
Hovering Accuracy Range	Vertical: ± 0.1 m (when vision positioning is active) ± 0.5 m (with GPS positioning) Horizontal: ± 0.3 m (when vision positioning is active) ± 1.5 m (with GPS positioning)
Internal Storage	8 GB

Results and Discussion

Tactical tasks were planned and carried out in the following functional areas of logistics - supply of material resources, medical provision, repair and evacuation of equipment.

Supply of Material Resources

Execution of task 1 – The drone is brought into working mode for reconnaissance and determination of the most suitable route for delivery of material resources (Photo 1). During the execution of the task, the air temperature was 29 ^{0}C, moderate wind with light rain showers. After analyzing the transmission of the data in the LSCC, officials can choose a route for the movement of vehicles loaded with material resources to provide the formations from the front end. Here, the main advantage of using UAVs is the significant shortening of the time for conducting the reconnaissance of the planned routes for the delivery of material resources and ensuring timely supply.

Photo 1. Routs for supply with material resurces

Execution of task 2 – is directing and escorting the transports of material resources along the reconnaissance route (Photo 2). Here, the experience and training of the drone operator to observe uncharacteristic properties of the area, to avoid improvised explosive devices and possible sabotage plays a major role. The early warning of a possible danger will prevent the decommissioning of the means of transport and will be a guarantor for the implementation of the logistical operations of the provision of material means.

Photo 2. Optimal rout for supply

Execution of task 3 – is directing the means of transport to obtain material resources at meeting points of the next line of logistics provision (Photo 3). The main advantage of the UAV in the performance of this task is to accompany and guide the means of transport in an unfamiliar environment and to support the recognition of formations at the opposite points, by using predetermined signals and signs.

Photo 3. Reception and transfer of material resources

Execution of task 4 – When the operational situation changes, the drone can be used to redirect the delivery of material resources to another end user in case of disruption of the communication-information system (Photo 4).

Photo 4. Change route

Medical Insurance

Execution of task 5 – Search for wounded and sick on the battlefield and their timely evacuation. The main advantage of this task when using UAVs is the ability to observe the battle field from a high altitude and cover a

fairly large observation perimeter. This will ensure the timely search and finding of the wounded and the provision of timely medical assistance, which in turn will reduce the combat losses of the military formation (Photo 5).

Photo 5. Surching for injury military personel

Execution of task 6 – is directing the sanitary facilities of the medical station to the places of injury and transporting the injured to the nearest medical stations and medical facilities (Photo 6).

Photo 6. Medical post

Repair and Evacuation of Damaged Equipment

Execution of task 7 – is the use of UAVs for technical intelligence. Advantage – a large radius of the observed perimeter and provides an additional technical observation post and obtains timely information on the required degree of repair, through visual observation directly from the crew of the affected machine. In this way, the time required to return the machine to service through the repair and evacuation stages is shortened.

Photo 7. Second degree repair

Execution of task 8 – is technical provision and reconnaissance during the march. The UAV moves above the military column and observes for technical malfunctions and accidents during the movement of the main forces to the commanded area.

Photo 8.Technical support

Conclusion

The current experiment shows that unmanned aerial vehicles have a place in the logistical support of military formations at the tactical level. The results show that the use of drones in logistical support supports decision-making by commanders at the tactical level and shortens the time for carrying out logistical operations for the

provision of mechanized military formations. The implementation of this type of apparatus in the logistics formations at the tactical level will improve many times the activities of the all-round logistics provision of the maneuver formations.

Scientific Ethics Declaration

The authors declares that the scientific ethical and legal responsibility of this article published in EPSTEM Journal belongs to the authors.

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