COMPARATIVE ANALYSIS OF COMBAT EFFICIENCY OF MORTAR UNITS AND COMBAT DRONES UNITS

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Summary: The creation of modern and more efficient armed forces has conditioned the connection of various systems and means in order to increase the efficiency of fire support units. The paper presents a comparative overview of the effectiveness of the combat systems of the company fire group armed with mortars 82 mm and the combat efficiency of the combat drone unit, which has four combat drones that use mortar mines of 82 mm. The results of the research show a significant advantage in the use of combat drones in the role of fire support units of the first combat echelon compared to the use of conventional means of fire support in modern combat operations. Units equipped with combat drones that are armed with 82 mm mines are more than 400% more efficient than a chetnik fire group armed with 82 mm mortars.

Keywords: Drone, UAV, mortar, fire support, efficiency, fire capabilities, armament

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1. INTRODUCTION

With the tendency to create modern, better equipped and more efficient armed forces, the need for integrating and connecting different systems in order to increase the efficiency of units is growing in all armies of the world. As the precision and lethality of weapons systems grows, so does the need for data for their efficient and rational use. In this context, there are technological and operational challenges to cope with the progress of platforms for collecting and processing data, sensors, communication systems and their diversity, as well as advances in the development and use of combat-armed drones.

The aim of the paper is to present the possibility of using drones as a fire support unit in an attack operation with a focus on the comparative display of the effectiveness of combat systems, a company fire group equipped with mortars 82

mm and units equipped with drones that are armed with 82 mm mortar mines. There are objective needs for the implementation of drones whose application would provide adequate support to fire support units in carrying out modern combat operations.

It is possible to find a large number of drones on the market today, with different characteristics and different purposes. A large number of armies of the world have different types of drones in their armaments. [4,5,7,8] The military's requirements for the characteristics of the drone for use in various types of operations are very uneven. Drones have demonstrated their importance and value in modern combat operations.

Fire support is a type of combat support that is prepared and performed in order to support the units of the first combat echelon in the realization of the tasks achieved and in achieving the set goals. [2] The main carriers of support in the combat operations of the infantry and mechanized battalion are mortar units, which perform the assigned tasks of fire support as an element of the combat layout of the unit it supports, forming fire groups. [1] Fire support is achieved by indirect shooting from sheltered fire positions, which achieves greater protection, better use of tactical and technical characteristics of the tool and better maneuvering of trajectories, but also higher missile consumption and longer time of realization of set fire tasks.

The application of drones armed with mortar mines increases accuracy and precision and reduces the time of the shooting process when performing a fire task, and tasks can be performed at longer distances. This leads to a decrease in reaction time, increases fire efficiency, greater resistance and a greater degree of steering.

1. DESCRIPTION OF THE PROBLEM

Fire capabilities are the projected, ideal, technical capabilities of a system that conducts fire engagement in tablicconditions. It is expressed in different measurements (number of neutralized and/or destroyed targets), in accordance with the basic purpose of the combat system. Since the basis of the firepower of any weapon and/or system is expressed as a fire effect, in theory it is often referred to as fire efficiency. Experience has shown that the effectiveness of any combat system is directly proportional to the efficiency of performing the basic function (fire capability), the effectiveness of management and protection in armed conflict.

The effectiveness of the combat system (Ebs), based on the instruction, is equal to the product of fire capabilities and geometric mean of the efficiency of control and the efficiency of mortar protection, and is determined according to the mathematical expression:

$$E_{bs} = V_{mef} \times \sqrt{E_u \times E_z} \quad (1)$$

where is:

Vmef – fire capability effective (expressed in the number of destroyed targets with 1 b/k) and is taken from the instructions for determining the combat capabilities of the SAS;

- Eu – management efficiency, the values of which are shown in Table 1;

- Ez – the effectiveness of the protection, whose values are shown in Table 2.

Table 1. Values of management efficiency coefficients [13]

Equipment of fire control systems (SUVs) and command and information systems (KIS)	**Coefficient of management efficiency**
Means and soldier (servants) **equipped** with the latest generation of SUVs and KIS	**0,8**
Means and soldier (servants) **partially equipped** with the latest generation SUV and KIS	**0,5**
Asset and soldier (servants) **are not equipped with** the latest generation SUV and KIS	**0,2**

Table 2 The value of the coefficient of protection efficiency

Degree of resistance and protection	**Coefficient of protection efficiency**
High level of protection against fire, reconnaissance and electronic actions	**0,8**
Partial protection against fire, reconnaissance and electronic actions	**0,5**
Poor protection against fire, reconnaissance and electronic actions	**0,2**

The efficiency of the lines of a particular combat system (Evbs) in fire support is equal to the product of the mathematically expected number of

hits and the efficiency of the combat system and is determined by mathematical expression [3]:

$$E_{vbs} = MO_p \times E_{bs} \quad (2)$$

- MOp – mathematical expectation of the number of hits;
- Ebs – the effectiveness of the combat system.

The mathematical expectation of the number of guesses at the same probability of guessing is calculated according to the expression [9]:

$$MO = n \times p \quad (3)$$

- n – the number of projectiles fired;

- p – probability of guessing.

When calculating the effectiveness of combat systems (mortars 82 mm and combat drones armed with mines 82 mm), it is envisaged to target the defense department at a distance of 3000 m, where a combat kit of 50 current-fugas mines for mortar 82 mm and 12 currently-fugas mines with which one combat drone is armed was taken. Based on the theory of shooting and calculation of errors during the preparation of the initial elements, it is predicted that 13 projectiles are needed to destroy the target when shooting with a mortar 82 mm and 9 projectiles when mines are dropped from a combat drone.

2. MODEL OF CALCULATION OF COMBAT CAPABILITIES OF MORTAR LINES 82 mm

The 82 mm mortar divisions, during the conduct of combat operations, generally form a company fire group as an element of the combat schedule of the infantry company. As a company fire group, intended for the fire support of the main forces of the infantry company, the 82 mm mortar division: they perform the same fire task, achieve the same goal and operate on a single command. In a word, they prepare and perform shootings like an 82 mm mortar platoon. The 82 mm mortar platoon (company fire group) consists of: platoon commander, deputy platoon commander (fire position chief - SVP), two 82 mm mortar departments, the required number of scouts, radiophonyists and the required number of drivers and means of transport. The 82 mm mortar platoon is commanded by a platoon commander, who is also the shooter. [2]

Using mathematical expressions and applying table values from the instruction, the efficiency of mortar waters 82 mm was calculated (Table 3). The efficiency of 82 mm mortar lines was calculated for a shooting distance of 3,000 m at a probability determined on the basis of tabular values and errors of complete and shortened preparation of the initial elements.

Table 3. Water efficiency of mortars 82 mm

<table>
<tr><td></td><td></td><td></td><td>EFFICIENCY</td></tr>
<tr><td rowspan="2">Missile</td><td colspan="2">n</td><td>50</td></tr>
<tr><td colspan="2">p</td><td>0,1015</td></tr>
<tr><td colspan="2">MO=n × p</td><td>number of hits</td><td>5,075</td></tr>
<tr><td colspan="2">Vmef</td><td>Destroyed targets with 1 com/kit</td><td>1,66</td></tr>
<tr><td rowspan="5">Efficiency</td><td>Eu</td><td rowspan="2">Coefficient</td><td>0,2</td></tr>
<tr><td>Ez</td><td>0,2</td></tr>
<tr><td>Emb=Vmef×√(Eu×Ez)</td><td rowspan="3">destroyed targets</td><td>0,332</td></tr>
<tr><td>Emb=MOp×Emb</td><td>1,68</td></tr>
<tr><td>Evmb=MOp×Emb</td><td>6,74</td></tr>
</table>

3. MODEL OF CALCULATION OF COMBAT CAPABILITIES OF THE COMBAT DRONE UNIT

The term drone has a broad meaning, it is a means with a motor that is remotely controlled by an operator or are assets that possess a certain level of autonomy (control is carried out using communication software, and often used artificial intelligence and various types of sensors), which can be used once or on several occasions and can be carriedand lethal or non-lethal cargo and transmit data in real time. It represents a synthesis of the means and devices necessary for the management of it. [10,11,12]

The paper analyzed a combat drone armed with 12 mines for an 82 mm mortar and equipped with a camera for shooting in all weather conditions and conditions of limited visibility. The combat drone unit analyzed in the paper consists of commanders and four operators, with the required number of drivers of motor vehicles.

Using mathematical expressions and applying the table values from the instructions, the efficiency of the combat drone department was calculated (Table 4). The effectiveness of combat drones armed with mines 82 mm was calculated for a shooting distance of 3,000 m at a probability determined on the basis of table values and a height of 200 m for dropping missiles at the target**.**

Table 4. Efficiency of combat drones department

			EFFICIENCY
Missile	***n***		***12***
	p		***0,7***
MO=n × p		***number of hits***	***8,4***
Vmef		***Destroyed targets with 1 combat/kit***	***1,33***
efikasnost	***Eu***	***Coefficient***	***0,8***
	Ez		***0,5***
	Ebd=Vmef×√(Eu×Ez)	***Coefficient***	***0,841***
	Ebd=MOp×Ebd	***destroyed targets***	***7,06***
	Eobd= MOpo×Ebd		***28,26***

4 COMPARATIVE ANALYSIS OF 82 mm MORTAR WATER EFFICIENCY AND COMBAT DRONES DEPARTMENT

Table 5 provides a comparative overview of the research results relating to the 82 mm mortar platoon (four mortars) and the combat drone division (four combat drones). Based on the presented results, it is concluded that the combat drone division, where each drone armed with 12 mines is 82 mm significantly more effective compared to the mortar line 82 mm. With the consumption of 48 mines of 82 mm caliber, the combat drone department can destroy 28.26 targets, while the MB 82 mm platoon with a combat kit of 200 mines can destroy 5.36 targets.

Table 5. A comparative analysis of efficacy

Comparative analysis	***platoon MB 82 mm***	***Company BD***
The battle kit.	*200*	*48*
Vmef (destroyed targets with 1 com/kit)	*1,325*	*1,33*
Ebs (*coefficient****)***	*0,264*	*0,841*
Ebj (destroyed targets)	*6,74*	*28,26*

Based on the results presented in the table, it is concluded that the effectiveness of the combat system of a combat armed drone with 12 mines of mortar caliber 82 mm is 318% more effective than mortars 82 mm, at a shooting distance of 3000 m, and the number of destroyed targets with the only combat kit is higher by 419%. The number of destroyed targets with the same number of missiles (50 missiles) increased by 1752%.

The research has come up with reliable indicators that determine the impact of combat armed drones on the effectiveness and improvement of the characteristics of fire support units. The implementation of these systems and means has an impact, both on the way of preparing and executing shooting, as well as on the way of preparing and organizing fire support to battalion units in attack and defense. [12]

5. CONCLUSION

Theknowledge of the work is reflected in the presentation of the model for the calculation of the efficiency of 82 mm mortar lines and the department of combat armed drones equipped with mines 82 mm. Based on mathematical calculations according to the formulas given in the Instruction for determining the combat capabilities of units of the Serbian Armed Forces and determining the effective fire capabilities of combat systems (Vmef), it was concluded that the efficiency of fire support units armed with combat drones carrying mortars 82 mm missiles equipped with fire control system.

The combat system model (combat-armed drone is based on scientific knowledge and experiential indicators, and its and its implementationinto fire support ***units*** achieves faster response in combat operations, higher

shooting accuracy, more efficient group shooting, greater resistance and integration with the command and information system of units.

The application of the proposed model would significantly increase the efficiency and effectiveness of fire support units:

1. increased resistance and strength protection;
2. increase the accuracy and precision of shooting;
3. increase the ability to reconnaissance and track enemy units;
4. increase the ability to observe target areas and determine the exact coordinates of missile crashes;
5. increased the combat capability of fire support units of infantry and mechanized units,
6. reduced missile consumption;
7. reduce the maneuverability of the enemy;
8. Reduce the time required to prepare and execute the shooting.

The above model represents a theoretical consideration of the author, with the aim of examining this model and implementing it in fire support ***units***, in order to increase the efficiency and effectiveness of fire support units. The following research should be focused on: selection of the most effective combat drone armed with mortar mines, analysis of the time required for the realization of the combat task and integration of the said combat system into the fire control system and command information system.

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