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Use of Unmanned Aerial Vehicles in Support of Artillery Operations

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Abstract

Unmanned aerial vehicles (UAVs) recently gain more importance due to their use in military operations and the fight against terrorism. Military forces must follow and encourage the development of modern technologies to improve their tactical and strategic capabilities. It has been shown that in the 21st century, the countries that more extensively use UAVs typically dominate in military operations. The UAVs development announces a significant change in the concept of warfare. An analysis of the UAVs' employment in the Croatian Armed Forces (CAF) shows poor usage of the UAVs. This paper analyses the application of UAVs in the role of the forward observer for artillery operations, based on the experience of the armed forces worldwide. It is proposed to introduce UAVs into the artillery fire support system to increase the capabilities of artillery weapons, including the suggestion to equip the CAF with contemporary UAVs to match capabilities that the armed forces of some other countries have already achieved.

Keywords

unmanned aerial vehicle, Croatian Armed Forces, artillery, forward artillery observer, classes, artillery armament, structure

Introduction

UAVs are aircraft controlled remotely, autonomously, or through a combination of both. They are typically used for operational and strategic reconnaissance and battlefield monitoring. They can also intervene on the battlefield directly by using on-board weapons or indirectly by identifying targets for precision-guided ammunition. Compared to traditional manned aircrafts, their use reduces overall costs, increases task efficiency, and avoids human losses.

The development of UAV technology is one of the fastest-changing trends in history, comparable perhaps only to the earlier, unprecedented spread of personal computers in the early 1990s or mobile phones a few years later. Therefore, it is difficult to keep up with the latest news and changing numbers. For example, data from the analysis (Sayler, 2015) stating that "ten countries currently possess armed UAVs, with at least 20 more openly reported to have active development programs" is already outdated – although this report was produced just eight years ago. And really, the more recent report (from 2019) states that 18 countries have armed UAVs (Gettinger, 2019) and this data is also outdated by now.

The same report also states that the number of countries with military UAV capabilities rose from 60 to 95 in less than 10 years (from 2010 to 2019) and that there are 21,000 confirmed unmanned aircraft currently in service around the world, although the actual number is likely more than 30,000. Further development is expected, as at least 24 countries are currently developing new military unmanned aircraft. The People's Republic of China appears to have the most active UAV development programs of any country, with at least 11 parallel projects underway as of this writing (Adnan Khasan, 2019).

Types of UAVs are reconnaissance, attack, radio-relay, electronic warfare, and multirole. Depending on the equipment, UAVs can be used for reconnaissance and surveillance, observation of land and sea borders, electronic jamming of radio and radar facilities, target detection and identification, nuclear, biological and chemical reconnaissance, camouflage and concealment.

During armed conflicts in recent years, the use of UAVs as instruments of tactical psychology has become apparent. The application of tactical

psychology on the battlefield is about making the other side fight less, or even give up. The use of armed UAVs (which infallibly find opposing troops, no matter how well they are hidden) is aimed at breaking the enemy's will to fight (Prakash, 2021). One of the most prominent psychological effects described by the attacked party is a pervasive sense of anticipatory dread of impending UAV attacks (Amnesty International, 2013). UAVs can hover over target areas for hours as part of continuous surveillance missions, leading to stress, emotional breakdowns, outbursts of anger, increased fear, and the desire to hide or run away when an individual sees or hears UAVs (Hijazi *et al.*, 2019).

This paper provides a brief analysis and addresses two research questions: 1) could UAVs be valuable low-cost systems that create multiple new opportunities for modern armies, including the role of UAVs in extending the capabilities of artillery; and 2) whether the Croatian Armed Forces exploit the full potential of UAVs, or they lag behind to integrate them with all services (especially with the artillery). The selected UAVs will be compared according to the following criteria: flight characteristics (maximum flight time, speed and altitude), control signal range, and price.

General Classification of UAVs

Regarding the classification of military UAVs, the most commonly used is the NATO standard (NATO, 2019), where UAVs are assigned a classification ranging from I to III based predominantly according to their maximum take-off weight: Class I (less than 150 kilograms), Class II (150 to 600 kilograms), and Class III (more than 600 kilograms).

Class III aircraft are sometimes referred to as "medium-altitude long-endurance" (MALE) or "high-altitude long-endurance" (HALE) UAVs. A typical Class III system has an endurance of up to 24 hours or more and a payload capacity of several hundred kilograms. Some Class III UAVs can be operated at a range of several thousand kilometres. Also, many Class III UAVs are capable of carrying a mix of weapons, while others in this class are designed solely for intelligence gathering. The NATO definition of Class III includes three sub-categories – MALE, HALE, and Strike/Combat (Gettinger, 2019).

Such a classification is also in line with the Brooke-Holland preposition (Brooke-Holland, 2012), where the smallest Class I is subdivided into four weight-based subclasses: UAVs weighing less than 200 g are classified as Class (Ia), heavier UAVs are Micro (Ib) and Mini (Ic), while the heaviest are the so-called small UAVs (Class (Id), 20 – 150 kg).

There are other classifications, such as the one in (Arjomandi, 2006) or (Weibel and Hansman, 2004) and others. There is also a good overview shown in (Hassanalian and Abdelkefi, 2017) together with a division into classes carried out according to dominant characteristics, such as propulsion systems and actuators, power supply and endurance, different types of guidance, navigation, and control, etc. As for propulsion, the majority of today's UAVs are equipped with propeller propulsion, while only a few sophisticated ones use a jet propulsion. Also, systems powered by electric motors in combination with fuel cells and solar panels are currently under development.

Classification of military UAVs based on capabilities (and not necessarily the weight) can be found in (Kunertova, 2019), where UAVs are divided into Small UAVs (SUAV), Tactical UAVs (TUAV), Medium Altitude Long Endurance (MALE), and High Altitude Long Endurance (HALE). What this study clearly shows is that the European industry is significantly lagging in terms of UAV development and production. Competitiveness is only good in the category of small aircraft, but weaker in the TUAV category, poor in the MALE category, and virtually non-existent in the HALE category where there is a strong monopoly of American platforms. This 2019 study also mentions "future procurement of Triton by Germany and the United Kingdom", referring to the potential purchase of several U.S. Navy MQ-4C Triton Global Hawk UAVs after abandoning the customized EuroHawk version. The classification proposed in (Kunertova, 2019), despite the different names, does not deviate from the NATO classification. Therefore, HALE and MALE categories correspond to NATO Class III, the TUAV category belongs to Class II, and SUAV belongs to NATO Class I. As for the use of armed UAVs, the United Kingdom is the only European country that operates the armed version of Reaper, while other European countries remain reluctant to arm their UAVs and use them exclusively for ISR (intelligence,

surveillance and reconnaissance) purposes. However, experiences from the Russo-Ukrainian War suggest that such thinking may be outdated.

Table 1 shows the characteristics of different categories of UAVs and some examples of frequently used UAVs.

Table 1. Classification

CLASS	CATEGORY	LEVEL OF USE	OPERATIONAL ALTITUDE	OPERATIONAL RADIUS	EXAMPLES OF UAVS
ClassI (below 150 kg)	MICRO (below 2 kg)	Individual (one operator)	Up to 60 m	5 km	Black Widow
	MINI (2-20 kg)	Tactical Unit (manual operation)	Up to 1000 m	25 km	ScanEagle Raven Skylark
	SMALL (over 20 kg)	Tactical Unit (launch system)	Up to 1500 m	50 km	Hermes 90 Luna
Class II (150-600 kg)	TACTICAL	Tactical formation	Up to 3000 m	200 km	Aerostar Hermes 450
ClassIII (over 600 kg)	Air strike	Strategic / National	Up to 20000 m	Unlimited	/
	HALE	Strategic / National	Up to 20000 m	Unlimited	Global Hawk
	MALE	Operational	Up to 14000 m	Unlimited	Predator B Predator A Harfang Hermes 900

Regarding the comparison of UAVs and manned aircraft, the advantages of the former are multiple: without a human element on board, UAVs have greater endurance and are ideal for surveillance missions. They can collect an unparalleled amount of data and are even better than satellites in this regard. A UAV can serve as a communication relay. In combat missions, they show great accuracy and thus reduce the risk of collateral damage, even compared to guided missiles. It must not be forgotten that the cost of procurement and its use is two or three orders of magnitude lower than the cost of manned aircraft. Even the largest UAVs cost significantly less than fighter aircraft: a Predator system costs $20 million, and a Reaper system costs $53 million. For comparison, an F-22 fighter jet costs about $150 million. It should also be taken into account that with UAVs, there is no longer a risk of losing a pilot (Mosco, 2017), and today a point has been reached where the F-35 Joint Strike Fighter is predicted to be the last manned fighter aircraft. There is more and more evidence in favour of this belief: ever since 2009, the Air Force has been training more UAV operators than fighter pilots, and the proportion of manned aircraft is decreasing year by year. This trend is unlikely to stop in the future (Enemark, 2013). According to a report by the US Department of Defense, four services (including the National Guard) currently operate more than 11,000 unmanned aerial vehicles. These UAVs range in size from the small RQ-11B Raven to the largest RQ/MQ-4 Global Hawk/Triton, which weighs more than 32,000 pounds (U.S. Department of Defense).

Role of UAVs in artillery

Initially, unmanned aerial vehicles were intended for general data collection and reconnaissance, while over time they have found their role in artillery either as part of the Fire Control System (FCS) or as an artillery system on their own. The UAVs were introduced into the FCS of the artillery in the role of the Forward Artillery Observers (FAO). When used as a complete artillery system, the UAV uses weapons carried on-board to destroy the target. A contemporary example is the war between Armenia and Azerbaijan. The combination of Azerbaijani artillery and their UAVs (used as either FAO or as an artillery weapon) proved highly effective in the war (Kohl, 2022).

More recently, following the Russian invasion, Ukrainian artillery inflicts significant damage on the aggressor thanks to the use of low-cost UAVs (Hambling, 2022). UAVs capture and transmit high-resolution images and videos in real time over a radio link to command posts, allowing for precise guidance of artillery fire on enemy formations and objects.

Therefore, in the context of conventional artillery operations, UAVs could be used for artillery reconnaissance, accelerating the decision-making process, achieving greater accuracy in artillery fire, protecting and monitoring the fire position area from enemy attacks, creating 3D digital maps of the area (including the position of enemy formations), and reconnaissance of enemy activities. The UAV can perform the tasks of the FSO far deeper within the enemy-held territory and typically with increased accuracy compared to the human counterpart who is located on the ground.

The introduction of UAVs into the artillery units does not disrupt the function of the forward artillery observer (FAO) (Katsev, 2021). The FAO retains the tasks of determining the target and providing information about it, calling for fire on the target, assessing the fire correction according to the observed miss of the previous projectile or the movement of a target, and sending the information related to the battlefield to which the artillery fire is deployed. It is necessary to provide as much information about the enemy as possible, determine high-value targets, and monitor the enemy's movement. Following the previously mentioned capabilities, the UAV, therefore, does not become a "competition" for the FAO, but a valuable help for faster and better task performance.

It should be noted that UAVs have an advantage due to their increased capabilities with respect to range, high technical resistance, and reliability in operation. Therefore, the first significant difference between UAVs and FAOs is that UAVs have the capability of long-term continuous operation, while human beings get tired over time and the quality of their work decreases. Furthermore, the forward artillery observer is not always able to determine the difference between the target and the point of impact (due to incorrect assessment, poor visibility, blind spot, etc.) – and thus the FAO can never achieve the same level of accuracy in its assessments as the UAV can.

On the one hand, UAVs can overfly the target and gather much more information about the enemy while avoiding the problem of target concealment. When directing the artillery fire, they provide accurate target coordinates and corrections with an accuracy of one metre or less. On the other hand, some targets (e.g. bunkers) are more easily spotted by a human observer from the ground than from assets in the air as they are typically concealed from air raids by conventional airplanes.

As for the weaknesses of UAVs, it must be emphasized that in use (which involves deep penetration into enemy territory), they become targets for potential destruction. Their navigation system could also be disrupted, or they could be shot down by conventional air defence systems. Depending on the level of complexity, they would be expensive and difficult to replace if they get shot down.

However, when considering all the advantages and disadvantages, adding the UAV to the existing FAO significantly increases the capabilities of conventional artillery.

For the use in artillery, the most interesting (within Class I) are small, unmanned aircraft used by the army in most cases to find targets. Their weight ranges from 20 to 150 kg. Usually, a crew of two or more is required, and they use simple launch systems.

Greater possibilities could be obtained by using Class II UAVs: they have a range of up to 200 km, fly at altitudes of up to 5,500 m, and can stay in the air for several hours. They can usually carry a load of up to 100 kg. They generally operate outside the operator's line of sight.

The greatest possibilities are given by Class III UAVs, which have the greatest range and can be controlled using satellites and data links such as mobile networks. The drawback is their low speed, which makes them easy targets for air defence if it has not been previously destroyed or is inadequate (e.g. cannot act on targets at higher altitudes). Also, due to their size, they require a runway for take-off and landing and significant logistical support and infrastructure (United Nations, 2015).

Usage of UAVs in the war between Armenia and Azerbaijan

On 27 September 2020, the war between Armenia and Azerbaijan began over the disputed region of Nagorno-Karabakh. According to (Modebadze, 2021) this was the first war in modern warfare history to be won entirely through the use of UAVs. This example illustrates the value of UAVs in support of artillery operations. Armenia had infantry weapons, artillery, tanks, and air defence systems in its arsenal, while Azerbaijan had additional armed and unarmed UAVs (the Turkish Bayraktar TB2 and the Israeli Kamikaza).

At the beginning of the war, the Armenian forces made a mistake by revealing their artillery positions and air defence systems to Azerbaijani UAVs over Nagorno-Karabakh. After their positions were revealed, they were subjected to attacks. Their supply lines, logistics, and air defence system were destroyed, and they could not withstand the incoming attacks due to the technological deficiency of their air defence. Armenia had UAVs as well, but they were of much lower quality than those in Azerbaijan. The innovative tactical use of advanced UAV technology allowed for dominance over Armenian forces, which relied heavily on conventional Russian weaponry and traditional tactics. Due to heavy losses, Armenian forces were finally forced to sign a ceasefire under unfavourable conditions. This conflict has proven the effectiveness of the use of new technologies in war (Amirkhanyan, 2022).

From the outcome of this war, it can be concluded that the use of UAVs in combination with other weapons leads to dominance over the enemy and ultimately victory. Of course, Azerbaijan's victory could be attributed not only to the technical capabilities of its UAVs, but also to its tactical and professional advantages, or the lack of readiness and capabilities of Armenian forces. But even if Azerbaijan did not achieve victory only thanks to UAVs, most authors agree that they played a key role (Chaari and Al-Maadeed, 2021). This claim can be confirmed by the analyst F. S. Gady (the research fellow on the future of conflict at the International Institute for Strategic Studies), who says that it is not entirely true that tanks and armoured vehicles will become obsolete... but Nagorno-Karabakh has shown the increasing importance of using armed UAVs along with other weapons and highly trained ground forces, and the exponentially more devastating consequences of failure in modern warfare (Dixon, 2020).

An extensive analysis (Mitzer and Janovsky, 2020) reports destroyed war equipment and also estimated losses for each side. The report estimates that Armenian and Nagorno-Karabakh forces, and ethnic Armenians living in the disputed region, lost 185 tanks, 45 armoured combat vehicles, 44 infantry combat vehicles, 147 towed artillery pieces, 19 self-propelled artillery pieces, 72 multiple rocket launchers, and 12 radars. Azerbaijan's losses were only one-sixth of this. Azerbaijan's losses were significantly lower due to the use of UAVs, not only due to their characteristics and capabilities, but also due to the strong psychological impact.

Michael Kofman of the Center for Naval Analyses (CNA), analysing the war between Armenia and Azerbaijan, reached the following conclusion: "Drones offer small countries very cheap access to tactical aviation and precision-guided weapons, allowing them to destroy the enemy's much more expensive equipment, such as tanks and air defense systems." (Dixon, 2020)

All these findings, resulting from the direct combat experience, clearly indicate the importance of UAVs in modern warfare.

Use of UAVs in the war in Ukraine

The conflict in Ukraine further highlights the value of the use of UAVs in artillery. In February 2022, Russia enters Ukraine and begins an attack. The deployment of UAVs in conjunction with artillery represents one of the many twists and turns that the battle has experienced. Unlike Russia, which has degraded its ability to use UAVs, Ukraine utilizes its UAVs to launch effective attacks without wasting material resources and personnel. The UAVs have enabled Ukraine to disrupt Russian supply lines and disable air defence systems. It is a combat that would be regarded as the first real UAV war, providing a glimpse into future battlegrounds (Dijkstra *et al.*, 2022).

Ukraine has been studying UAVs since the Crimean War in 2014. In that operation, the Russian military integrated UAVs into ground tactics to destroy Ukrainian forces with artillery strikes. During the period of eight years, Ukraine formed a small fleet of 300 UAVs based on reconnaissance

UAVs such as the A1-SM Fury and Leleka-100, and later the Bayraktar was added. In addition, Ukraine had large reconnaissance UAVs such as the Tu-141 from the Soviet era, and small American UAVs like the Switchblade.

UAVs have allowed the use of artillery to be more accurate, precise, and cost-effective, accelerating the pace of the war and shifting the initiative to the Ukrainian side. Previously, carrying out an artillery attack could take up to 30 minutes, but now it takes no longer than three minutes. Furthermore, Ukrainian commanders can simultaneously observe multiple approaches and positions, and assess the situation in a much shorter time. UAVs can be in a state of readiness for a designated area, ready to neutralize defence and, when needed, destroy it. They play a significant role in the war in Ukraine, collecting intelligence, correcting artillery fire, and dropping bombs (Gray, 2022). The commander of Ukraine's UAV unit for Khartia, Yaroslav Markevych, says that artillery and UAVs together represent the "most important pair" in offensive operations.

In the following, the detailed use of UAVs in Ukraine is given. A fully equipped UAV (with a camera, transmitter, receiver, etc.) is operated by an operator from a base towards a predetermined point where it flies over Russian positions, records them, and returns to the base. The recorded data is read on computers in the base. Then the process of identifying the locations of Russian vehicles and bases begins. Artificial intelligence, which can also recognize square artificial objects, is primarily used to find Russian positions and equipment, even if they are well camouflaged. Even small deviations from the environment indicate a possible target (e.g. dry leaves in a certain area compared to the surrounding fresh leaves). After discovering the target, the command decides which targets the artillery units will shoot at. Before firing, operators fly again to make sure the target is still in the same place. This double confirmation serves to avoid wasting Ukraine's limited artillery ammunition. During the firing, the command directly monitors the firing of targets and communicates with the artillery unit as needed for fire coordination (Beaubien, 2022).

Special value is seen in the use of laser-guided artillery shells, which allows the Ukrainian artillery to achieve exceptional precision and creates conditions for inflicting significant damage on the enemy. Therefore, Ukraine, by using a combination of unmanned aerial vehicles and smart ammunition, gains a great advantage over Russian forces that do not have or are not trained to use such a combination.

Unmanned aerial vehicles in the Croatian Armed Forces

UAVs were used by the Croatian Armed Forces (CAF) almost during the all stages of the Homeland War. Through the examination of UAV footage, it was determined that the Croatian Army did not excessively utilize its artillery in the areas of Knin and the Dalmatian Zagora during Operation *Storm*. During the same Operation, a UAV platoon from the Sinj area scouted Serbian positions near Knin and monitored the movement of their forces, and lines of communication. Additionally, UAVs were used to adjust and direct artillery fire at the *Red Earth* training ground, where Serbian artillery was concentrated in an attempt to prevent CAF units from advancing closer to Knin.

For all these purposes Class I UAVs were used. They were launched manually and controlled by an individual flight controller. UAVs had a range of less than 50 km and flight duration of up to 2 hours. Their main advantages were mobility and adaptability.

Today, there are several models of unmanned aerial vehicles in operational use in the CAF:

- BL M-99 Bojnik (domestic UAV, actively in use since the Homeland War)
- Skylark Mk I (a UAV of Israeli production)
- Orbiter 3 (also an Israeli UAV).

The mentioned UAVs are currently mostly used for reconnaissance and data collection. However, they are not used in artillery support.

Bojnik M-99

The M-99 Bojnik system is a UAV of Croatian production. The idea to create such an unmanned aircraft emerged at the beginning of the Homeland War, as a result of the need to reconnoitre enemy-occupied territory. The characteristics of the aircraft are as follows:

- weight 36 kg and a wingspan of 4 m
- equipped with TV and photo cameras 6x6 cm
- durability in the air for about 6 hours and a range of up to 120 km.

It is launched from a launch pad mounted on a customized army vehicle and controlled by a radio signal from a ground station. Today, it is assigned to the Centre for Unmanned Aircraft Systems, part of the Intelligence Regiment of the CAF.

Figure 1. The M-99 Bojnik UAV

Skylark I

The mini unmanned aerial vehicle Skylark I has a relatively low weight of 5.5 kg and is launched by hand. Its range is 40 km and it can stay in the air for approximately 2 hours. When operating, it sends a real-time video to a portable ground station. Its main purpose is tactical observation and reconnaissance. It is used in the Centre for Unmanned Aircraft Systems of the CAF Intelligence Regiment, and in the military intelligence companies of the CAF Guards Brigades.

Figure 2. Skylark 1

Orbiter 3B

Orbiter 3B is a UAV used for reconnaissance and surveillance, and is currently the largest unmanned aircraft in the Croatian Armed Forces.

Figure 3. Orbiter 3B

Orbiter 3B has a mass of about 30 kg and is launched from the launch pad. It can spend 6 hours in the air and has a maximum operational range of up to 150 km. It is not visible on radars because it can switch to "stealth" mode due to its delta wings, carbon composite construction, very quiet electric motor, and almost non-existent thermal reflection. Stealth mode also involves interrupting the real-time video signal flow toward the ground station to reduce the electromagnetic reflection, but the recording function continues without interruption. As for the civil service, this system is intended for surveillance and control of fisheries, fire protection, and help during search and rescue missions.

The described aircraft can also be used for military purposes, but in the CAF their capabilities are not fully made use of. Orbiter 3 is predominantly used in intelligence missions, for terrain reconnaissance and data collection. On the other hand, these UAVs have limited capabilities which shows that the CAF is lagging behind compared to the armed forces of neighbouring countries. They have more powerful UAVs, and use them for artillery support and even for offensive operations. The mentioned lag shown by the CAF is all the more dangerous because some neighbouring countries already have Class III UAVs.

Preposition for the selection of new UAVs

This chapter presents an analysis of the available UAVs and their characteristics, which, according to the criteria of price and potential types of use, could compete for introduction into the CAF and then be used for reconnaissance operations, locating targets, and directing fire at the enemy.

Only Class I unmanned aerial vehicles, subclass I(d) "small aircraft", were taken into account. Class II UAVs were excluded from the analysis because of their unnecessarily long range of over 200 km, and Class III UAVs were discarded because of their high cost, large mass, and high radar reflection that make them easy targets. Note: Class II and III aircraft were only discarded if used as an aid to artillery, but they could be extremely useful for other purposes (e.g. anti-armour operations).

As for the UAVs already used in the CAF, Skylark I was not considered due to its short range, and Bojnik M-99 due to its obsolescence compared to new systems (e.g. Orbiter 3B) that offer more advanced functions. After the analysis, three UAVs were selected: Luna, Hermes 90, and Orbiter 3B.

Table 2. Potential UAVs characteristics

NAME	LUNA[1]	HERMES 90[2]	ORBITER 3B[3]
NATO Class	I	I	I
NATO Subclass	I(d)Male UAV	I(d)Male UAV	I(d)Male UAV
Mass (kg)	37	115	30
Max. Flight Time (h)	6 - 8	15	7
Max. Speed (km/h)	70	45	93
Max. Altitude (m)	3 500	4 500	5 500
Cost ($ million)	0.310 (no addit. equipment)	/	0.8 (with addit. equipment)
Range of Data Link (km)	80 - 100	Up to 100	Up to 150
Launch Mode	Pneumatic launcher	Integrated launcher	Pneumatic launcher

Comparing the values shown in Table 2, it may be concluded that the Orbiter 3B achieves an excellent compromise between cost and flight capability. Although it can spend less time in the air compared to the Hermes 90, it makes up for it with a higher maximum flight altitude and range. In addition, it is a smaller aircraft (and therefore a smaller target) which gives it a higher

1 https://web.archive.org/web/20110717032819/http://www.emt-penzberg.de/index.php?id=15

2 https://elbitsystems.com/media/DAVINCI.pdf

3 https://aeronautics-sys.com/home-page/page-systems/page-systems-orbiter-3-stuas/

survival probability, especially when faced with an enemy that has a strong air defence. Considering the size of the terrain where UAVs are likely to be used and the maximum range of Croatian artillery, we estimate that a stronger system is not required – at least from the aspect of artillery support.

Conclusion

Unmanned autonomous vehicles are expected to play an increasingly important role in future armed conflicts. Recent conflicts have demonstrated that the side that employs UAVs more extensively is likely to gain a significant advantage. This paper presents two case studies that support this conclusion (the war between Armenia and Azerbaijan, and the Russo-Ukrainian war).

As for the use of artillery support, the standardized introduction of UAVs would be a great step forward. Despite their current high cost, this investment proves to be justified as they offer improved terrain reconnaissance, faster and safer transmission of information (often in real time), target detection, and more accurate directing of artillery fire. With UAVs, human lives are not put at risk, and their stealth and precision make them invaluable. Additionally, they also have practical civilian applications such as searching for missing persons, early detection of forest fires, and monitoring of land and sea borders. In comparison to traditional aircraft, UAVs offer significantly lower costs and can be operated by just a few or even one operator in a single area.

The analysis of small unmanned aerial vehicles (Class I(d)) suggests that the Orbiter 3B system is highly suitable for tactical reconnaissance and the support of short-to-medium-range artillery, such as that possessed by the CAF. Additionally, its relatively low cost makes Orbiter 3B the best choice.

The Croatian Armed Forces have recently procured exactly this UAV system. In the future, it will be necessary to continue with the further introduction of Orbiter 3B into the military organization, with the ultimate goal of complete integration of UAVs with components of the army and other branches. This could require the purchase of additional units; nevertheless, the knowledge gathered from the analysed modern-day conflicts shows that this is a justified procurement that delivers new capabilities, especially when used as part of artillery.

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Upotreba bespilotnih letjelica u potpori topničkim operacijama

Sažetak

Bespilotne letjelice (UAV) u posljednje vrijeme postaju sve važnije zbog njihove upotrebe u vojnim operacijama i borbi protiv terorizma. Vojne snage moraju pratiti i poticati razvoj modernih tehnologija kako bi unaprijedile svoje taktičke i strateške sposobnosti. Pokazalo se kako u vojnim operacijama 21. stoljeća u pravilu dominiraju one zemlje koje se više služe UAV-ovima. Razvoj bespilotnih letjelica ukazuje na velike promjene u konceptu ratovanja. Analizom njihove upotrebe utvrđeno je da se bespilotne letjelice nedovoljno upotrebljavaju u Oružanim snagama RH. U ovom se radu analizira primjena UAV-ova u svojstvu rubnih promatrača za topnička djelovanja, na temelju iskustava oružanih snaga diljem svijeta. Predlaže se uvođenje bespilotnih letjelica u sustav topničke vatrene potpore radi povećanja sposobnosti topničkog naoružanja, uključujući prijedlog za opremanje OSRH-a suvremenim UAV-ovima u svrhu usklađivanja sa sposobnostima oružanih snaga kojima se neke zemlje već uvelike služe.

Ključne riječi

bespilotna letjelica, Oružane snage Republike Hrvatske, topništvo, prednji promatrač za topnička djelovanja, klase, topničko naoružanje, struktura