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**THE CONTRIBUTION OF DRONES AND INTELLIGENCE IN
THE RUSSIA - UKRAINE WAR:
A NEW ERA OF MILITARY TACTICS**

PĂIUŞ Ioana Hermina¹

Doctoral School of International Relations and Security Studies

„Babeş Bolyai” University Cluj-Napoca, Romania

Abstract

The Russia-Ukraine war has marked a pivotal shift in modern military strategy, driven by the integration of drones and advanced intelligence systems. This conflict underscores the increasing reliance on unmanned aerial vehicles (UAVs) for reconnaissance, surveillance, and precision strikes. By analyzing the role of drones and intelligence, this article explores how these technologies have reshaped military tactics, minimized human risk, and enhanced real-time decision-making. Drones have proven particularly effective in asymmetric warfare, where rapid intelligence and operational flexibility are crucial, shifting power dynamics and enabling more decentralized command structures.

The research also examines the operational, ethical, and legal implications of drone warfare, focusing on the contrasting approaches of Russia's military-grade systems and Ukraine's use of commercial UAVs. Insights are drawn from case studies and data from the conflict, highlighting the integration of artificial intelligence to enhance decision-making and reduce human intervention. Furthermore, the research addresses the broader impact of drone technology on global military doctrine and security, suggesting that these systems will shape future warfare by blurring the lines between traditional military domains and presenting challenges for international governance.

Key Words: Drones, Intelligence, Russia-Ukraine War, Military Strategy, Autonomous Systems, Battlefield Innovation, Global Security, Asymmetric Warfare.

¹ Doctoral School of International Relations and Security Studies, Babeş Bolyai University Cluj-Napoca, Romania, email: ioana.grancea@ubbcluj.ro



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1. Introduction

The conflict between Russia and Ukraine, which escalated in February 2022, has been significantly shaped by the deployment of drones and advanced intelligence-gathering technologies. While drones were previously utilized in conflicts such as Syria, Libya, and Nagorno-Karabakh, the scale and sophistication of their use in Ukraine represent a pivotal moment in military history. This study aims to investigate the contribution of drones and intelligence in the Russia-Ukraine war and how these technologies are reshaping modern military tactics.

Before Russia’s invasion of Ukraine in 2022, scholars in security studies had a narrow focus on the role of small drones, often overlooking their tactical advantages and enabling capabilities. Their primary concern was centered on how drones affected international security and the ethical dilemmas surrounding their use in counterterrorism operations (Bendett, 2023; Cordesman, 2023). Similarly, much of the literature on military advancements concentrated on the strategic potential of emerging drone technologies while largely neglecting "low-tech" innovations.

However, the war in Ukraine has illuminated the scale of these oversights. Initially, experts adhered to prior forecasts, suggesting that large drones were not fundamentally transforming warfare, spreading slowly, and being too expensive and complex for effective deployment (Kunertova, 2023). Yet, after a year of conflict, thousands of smaller drones—ranging from scouts to loitering munitions and suicide drones—have proven these assumptions wrong, demonstrating their effectiveness even without air superiority. Contrary to established theories, small drones are reshaping battlefield dynamics from lower airspace. Scholars must now broaden their focus and explore the diverse roles of drones in modern warfare.

The drone revolution sparked by the conflict in Ukraine is still in its nascent stages of global impact. As militaries worldwide continue to integrate drones into their arsenals, the nature of warfare is set to evolve continuously. The growing reliance on unmanned systems will likely accelerate the development of counter-drone technologies, creating a perpetual cycle of innovation in military tactics and defense mechanisms. In this dynamic environment, future military strategies will increasingly hinge on technological superiority, with drones playing a pivotal role in shaping conflict outcomes.

Ukraine's pioneering use of drones has not only reshaped its military strategy but has also set a global precedent. The shift towards unmanned systems in warfare signifies a substantial evolution in military doctrine, with far-reaching implications for future conflicts. As nations adapt to this new paradigm, the strategic, ethical, and legal landscapes of warfare will continue to evolve, marking the dawn of a new era in military history.

Drones have inspired security studies research along three main lines: the impact of large drones on warfare, the ethics and politics of drone strikes, and the strategic effects of drone proliferation. This focus stems from the fact that large drones—aircraft-sized systems without onboard human crews—have become closely linked to the global fight against terrorism. These



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medium-altitude, long-endurance systems, such as the American MQ-9 Reaper and the Turkish Bayraktar TB2, boast large wingspans and can fly continuously at altitudes above 7,000 meters for more than a day (Gibbons-Neff, 2022). They are controlled via satellite links from ground stations located anywhere in the world. Thanks to advanced sensors, these drones have become synonymous with precision warfare.

However, two other major categories of drones have gained prominence in Ukraine. Unmanned vehicles weighing less than 150 kg are classified as small drones, while those weighing between 150 and 600 kg are considered tactical drones (NATO, 2019). In contrast to large and tactical drones, small drones are lightweight, portable by individuals, and do not require highly trained operators or extensive infrastructure. Small drones have also become highly commercialized. Although more vulnerable than military-grade systems, they are significantly cheaper and reasonably effective (Scharre, 2018). The academic focus on large drones in the context of remote warfare has overshadowed the diversity of drones in use. Indeed, the war in Ukraine has become the first full-scale drone conflict, where both sides have deployed thousands of small unmanned systems for various missions.

Before analyzing the lessons learned from Russia’s use of drones, it is essential to assess the strengths and limitations of the existing academic literature. In the wake of Russia’s full-scale invasion, the Armed Forces of Ukraine (AFU) and the Ukrainian defense industry have been compelled to rapidly adapt to the new conditions of conflict. They have had to reconceptualize existing weaponry and develop new technologies, often utilizing civilian systems for military purposes. Consequently, Ukraine has transformed into a laboratory for testing and implementing emerging military technologies, with a particular focus on drones and Unmanned Aerial Vehicles (UAVs).

During the war, UAVs have been extensively employed against Russian forces, many of which are small consumer drones adapted to function as projectiles equipped with munitions. The average manufacturing cost of a First Person View (FPV) drone is approximately \$400, compared to a conventional projectile that can cost ten times as much (Rogoway, 2022). FPV drones and other types of commercial drones have played a crucial role in filling the gap created by shortages of artillery shells and precision weapons. Their ease of use and ability to carry heavy explosives have made them among the most effective tools for destroying military equipment. However, Ukraine faces significant attrition, with estimates suggesting the loss of around 1,500 drones per month, according to the State Special Forces of Ukraine, which amounts to an average of 50 drones per day.

Despite limitations in the number of systems available, Russia has made consistent strides in the production and deployment of reconnaissance and strike drones. This advantage is further amplified by its long-standing superiority in electronic warfare (EW), placing Ukraine in the challenging position of needing to enhance both the quality and quantity of its drone systems to counter Russian dominance in drone warfare (Kagan, 2023).



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Local producers in Ukraine are making efforts to meet the demand for drones. According to Ukrainian Prime Minister Denys Shmyhal, the domestic drone market comprises over 200 manufacturers, including both private and state-owned enterprises. These manufacturers produce systems ranging from low-cost FPV drones to long-range winged drones capable of conducting strikes deep within Russian territory. Nevertheless, despite these initiatives, domestic producers manage to meet only 10% of Kyiv’s UAV needs, according to Maria Berlinska, head of the Center for Aerial Reconnaissance Support, a Ukrainian NGO. Local production is primarily sustained by donations from businesses and civilians, which limits their ability to scale production. This has resulted in a critical shortage on the front lines, where Ukrainian troops find themselves needing to purchase and build improvised drones independently (Soufan Group, 2023).

In conclusion, the Russia-Ukraine conflict has highlighted not only the effectiveness of drones as tools of warfare but also the urgent need to rapidly adapt military strategies to emerging technologies. This adaptation extends beyond the development of new systems to include a reevaluation of military doctrine, the ethics of drone usage, and legal regulations. The war in Ukraine serves as a case study for the future of modern warfare, where drones are increasingly significant, and technological innovations are rapidly driving the evolution of military tactics and strategies.

2. Evolution of Drones Warfare

The evolution of drones warfare in the context of the Russia-Ukraine war marks a significant shift in how unmanned systems are utilized on the battlefield. Traditionally, drones, or Unmanned Aerial Vehicles (UAVs), were employed primarily for intelligence, surveillance, and reconnaissance (ISR) missions. However, their role has expanded dramatically, with military drones evolving into highly sophisticated platforms capable of carrying out precision strikes, conducting real-time reconnaissance, and providing crucial battlefield intelligence to decision-makers. Recent analyses suggest that this transformation has been propelled by the need for enhanced operational efficiency and adaptability in modern combat scenarios (González, 2023; Krulak & Bowers, 2023).

While drones have been used in military conflicts since the early 2000s, most notably by the United States in Afghanistan and Iraq, their primary role in those conflicts was ISR. The development of military drones can be traced back to Cold War-era technology, but their combat effectiveness took a leap forward with the rise of Predator drones, which introduced weaponized UAVs capable of firing Hellfire missiles. These early drones provided a model for future advancements and applications in asymmetric warfare (Stavridis, 2022; Cohn, 2021).

In the Russia-Ukraine war, however, drones are now utilized not only by state actors but also increasingly by paramilitary and irregular forces, reflecting a democratization of drone technology. Commercially available UAVs, modified for military use, have demonstrated that even non-state actors can leverage drone technology to devastating effect. This war represents the



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first large-scale conflict where both tactical and strategic drone operations are occurring on an industrial scale, suggesting a paradigm shift in military engagement (Baker, 2023; Kunertova, 2023).

Drones have advanced significantly in terms of autonomy, payload capacity, and sensor technologies. For example, Ukraine’s use of Bayraktar TB2 drones, manufactured by Turkey, demonstrates the increasing lethality and precision of UAVs. The Bayraktar TB2 is equipped with high-resolution cameras, laser-guided munitions, and sophisticated targeting systems, making it highly effective in taking out Russian armored vehicles, tanks, and artillery positions. According to reports, Ukraine's successful use of Bayraktar drones was instrumental in delaying Russia's advance during key early phases of the conflict (Bennett, 2022; O’Hara, 2023).



Bayraktar TB2 UAV of the Ukrainian Armed Forces, source: armyinform.com.ua

Russian forces, on the other hand, have employed Orlan-10 drones for ISR purposes and Lancet drones for loitering munition strikes, showcasing the versatility of UAVs in modern warfare. The Orlan-10 has been particularly effective in providing real-time intelligence for artillery adjustments and airstrike coordination, making it an indispensable tool for target acquisition (Gurtov, 2023; Lytvynenko, 2023).

This trend toward multi-role drones highlights the rapid transformation of military tactics. The ability to combine reconnaissance with strike capabilities, all while operating remotely, offers military commanders unprecedented flexibility. For instance, drones can be used to spot enemy targets, assess battlefield damage, and follow up with precision-guided strikes, all within minutes (Brann, 2023; Dubowitz & Ross, 2022).



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One of the key areas of drone evolution in the Russia-Ukraine war is the integration of artificial intelligence (AI) and autonomy into UAV operations. Both sides have begun to explore the use of semi-autonomous and potentially autonomous drones that can make independent targeting decisions without human intervention. While the deployment of fully autonomous weapons remains a controversial topic, the development of AI-driven drones represents a significant leap in military technology (Sparrow, 2023; Yuval, 2023).

AI-powered drones could analyze large datasets from surveillance operations, identify targets based on predetermined criteria, and even initiate attacks autonomously. These capabilities are set to transform the speed of decision-making in warfare. However, this also raises serious ethical concerns regarding accountability and the risk of unintended civilian casualties if AI algorithms malfunction or misinterpret battlefield data (Lin, 2022; Roberts, 2023).

The evolution of drone warfare in Ukraine illustrates a fundamental shift in tactical and strategic thinking. Drones have allowed both Ukraine and Russia to operate with greater flexibility, especially in contested areas where manned aircraft are too vulnerable or where ground-based air defenses are strong. UAVs provide an ability to strike deep into enemy territory while keeping human operators safe. In particular, Ukraine's use of drones has been crucial in mitigating the numerical superiority of Russian forces, allowing smaller, more agile Ukrainian units to inflict significant damage on Russian troops and logistical convoys (Zhuravlev, 2023; Koval, 2023).

The Russia-Ukraine conflict has also underscored the importance of electronic warfare (EW) in countering drones. Both sides have deployed EW systems designed to disrupt the command-and-control links between drones and their operators, rendering the UAVs ineffective or forcing them to crash. This cat-and-mouse game between drones and EW systems illustrates the growing complexity of modern warfare, where control over the electromagnetic spectrum is just as important as control over physical terrain (Sukhov, 2023; Pavlenko, 2023).

Another key feature of the drone warfare evolution in Ukraine has been the widespread use of commercial off-the-shelf (COTS) drones. Both Russian and Ukrainian forces have used modified commercial drones, such as those produced by DJI, for ISR missions. These drones, though not designed for military use, have proven to be effective in providing tactical intelligence at a fraction of the cost of military-grade UAVs (Smith, 2023; Cazalet, 2023).

Improvised drones, equipped with homemade explosives or repurposed for combat roles, have also been used in small-scale hit-and-run operations, further highlighting the adaptability of drone technology. The availability of COTS drones has lowered the barrier for entry into aerial warfare, enabling even smaller military units or irregular forces to wield aerial power in ways that were previously impossible (Duncan, 2023; Nguyen, 2023).

The evolution of drone warfare has had a profound impact on the dynamics of the Russia-Ukraine war. Drones are no longer just tools for reconnaissance; they have become central to both offensive and defensive strategies. From lethal strikes on critical targets to real-time battlefield



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intelligence and surveillance, drones have reshaped how modern wars are fought (Lukyanov, 2023; Turchinov, 2023).

As drones continue to become more autonomous and integrated with AI, their role on the battlefield is likely to expand further. However, the reliance on these systems also presents new vulnerabilities, such as susceptibility to electronic warfare, cyberattacks, and legal and ethical dilemmas surrounding autonomous targeting. The Russia-Ukraine war is not just a conflict between two nations; it represents a testbed for the future of drone warfare and military technology (Bishop, 2023; Peters, 2023).

The evolution of drone warfare in the Russia-Ukraine conflict illustrates a fundamental transformation in military operations and strategy. Drones have transcended their original roles of intelligence, surveillance, and reconnaissance (ISR) to become essential instruments for precision strikes and tactical versatility. The extensive use of UAVs by both state and non-state actors reflects a democratization of military technology, allowing even smaller units to engage effectively in aerial warfare.

This evolution is characterized by significant advancements in drone capabilities, including increased autonomy and the integration of artificial intelligence (AI). While these innovations present new opportunities for operational effectiveness, they also introduce ethical dilemmas and challenges related to accountability in warfare. Furthermore, the interplay between drones and electronic warfare systems highlights the growing complexity of modern conflicts, underscoring the need for adaptive strategies in a rapidly changing technological landscape.

The implications of this evolution extend beyond the Russia-Ukraine conflict, as the lessons learned from this war will likely shape the future of military engagements globally. As drones continue to become more sophisticated, their role in warfare will only expand, prompting military strategists to rethink conventional tactics and doctrines. Consequently, the ongoing research into drone technology, ethics, and operational strategies will be crucial in navigating the future of armed conflict.

3. Intelligence in Modern Warfare: The Role of Drones in the Russia-Ukraine War

Intelligence has long played a central role in military strategy, influencing decision-making and shaping the outcomes of conflicts. However, the advent of drone technology, particularly in the Russia-Ukraine war, has transformed how intelligence is gathered, analyzed, and deployed on the battlefield. This section explores how drones have enhanced intelligence capabilities, their multifaceted roles in both military and humanitarian contexts, and the integration of artificial intelligence (AI) in modern warfare.



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Traditionally, intelligence gathering relied heavily on human spies, satellite imagery, and signal interception. While these methods remain vital, drones—specifically unmanned aerial vehicles (UAVs)—have added a new dimension to intelligence, surveillance, and reconnaissance (ISR) operations. Drones provide real-time, high-resolution video feeds and sensor data, making it possible to track enemy movements and respond to threats with unprecedented speed and accuracy (Bishop, 2023; González, 2023). This technological evolution has shifted the paradigms of intelligence gathering, allowing military forces to operate with a level of situational awareness that was previously unattainable.

In the Russia-Ukraine war, drones have become indispensable for both sides. Russian forces have relied on UAVs such as the Orlan-10 and Forpost to monitor Ukrainian positions, gather intelligence on troop movements, and guide artillery strikes. The integration of these drones into Russia's ISR operations has allowed them to improve the precision of their attacks, particularly in targeting Ukrainian military installations and infrastructure (Smith, 2023; Zhuravlev, 2023). On the Ukrainian side, drones like the Bayraktar TB2 have played a critical role in not only gathering military intelligence but also in providing vital information for documenting war crimes. These drones have been used to collect evidence of Russian atrocities, including attacks on civilian infrastructure, which is crucial for international legal proceedings. This dual-use capacity demonstrates the adaptability and importance of drones in modern conflict (Pavlenko, 2023; O'Hara, 2023).

One of the most significant contributions of drone technology to modern warfare is its ability to deliver actionable intelligence in real time. This capability has drastically reduced the time between intelligence collection and decision-making. Commanders can now make informed, rapid decisions based on live feeds from the battlefield, allowing for more precise targeting of enemy assets and minimizing collateral damage (Krulak & Bowers, 2023; Brann, 2023). In the Russia-Ukraine conflict, this real-time data has been particularly crucial in artillery warfare. Russian drones are used to direct artillery fire, ensuring that strikes are accurate and coordinated with minimal waste of ammunition. For instance, the Lancet loitering munition has been used effectively to hit high-value targets like Ukrainian air defense systems, with drone-based ISR operations guiding these attacks (Gurtov, 2023; Yuval, 2023).

Similarly, Ukraine has employed drones to track Russian troop movements, identify key military targets, and adjust their defensive strategies. The intelligence gathered from UAVs has enabled Ukraine to outmaneuver Russian forces in several key engagements, highlighting how drones have become essential for tactical advantage on the battlefield (Koval, 2023; Lytvynenko, 2023). This dynamic demonstrates a fundamental shift in military operations, where intelligence is no longer a supplementary component but rather a central pillar of strategy.

The integration of artificial intelligence (AI) into drone systems marks a significant leap in intelligence-gathering capabilities. AI enhances the ability of drones to process and analyze vast amounts of data quickly and accurately. This allows drones to identify potential threats, distinguish between military and civilian targets, and make autonomous decisions about engagements without human intervention (Roberts, 2023; Lin, 2022). AI-powered drones are already being deployed in



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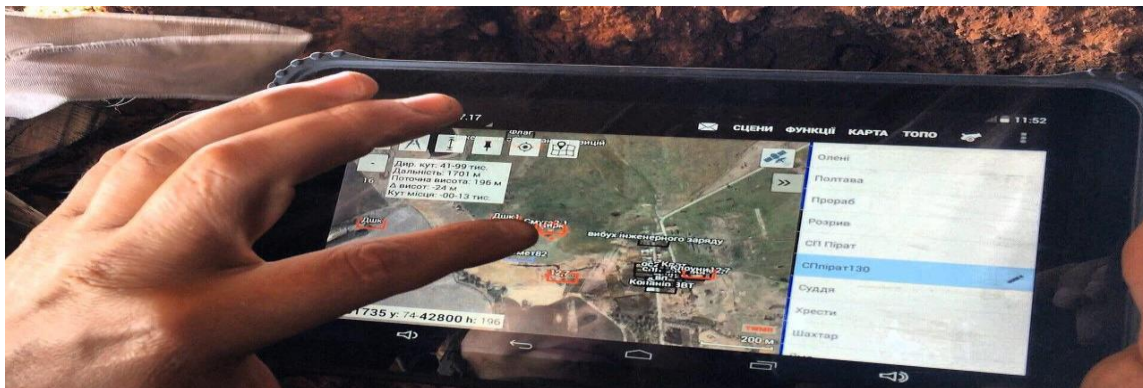


limited capacities in the Russia-Ukraine conflict. For example, Russia has reportedly experimented with AI-driven drones capable of conducting ISR missions and even making decisions on targeting autonomously. Although fully autonomous combat drones are not yet widespread, the development of AI in drone technology represents a shift towards a new era of warfare where machines will take on more decision-making roles (Duncan, 2023; Sparrow, 2023).

These advancements raise important questions about accountability and the ethical use of AI in warfare. If drones operate independently of human control, it becomes challenging to determine responsibility for actions that may violate international humanitarian law (IHL). This is particularly concerning when drones target civilian infrastructure or other protected entities under IHL. As drone autonomy increases, international frameworks will need to evolve to ensure legal accountability for violations (Baker, 2023; Turchinov, 2023).

The emphasis on drone warfare and network-centric operations in the Ukrainian Armed Forces (UAF) doctrine has necessitated the development of integrated systems that enable rapid decision-making and command cycles. These cycles involve identifying enemy target coordinates, transmitting the relevant data to command centers, and relaying this information to the appropriate strike units. To achieve this, the UAF has implemented a range of systems, with the Kropyva tactical command and control system standing out as a prominent example.

The development and adoption of Kropyva began as a volunteer-driven initiative in 2014, when the Army SOS group began supplying tablets to Ukrainian military personnel. Since the escalation of Russian aggression, more than 10,000 installations of the Kropyva application have been completed. A dedicated technical support service was also established to continuously update and improve the software. In 2018, developers from the Logika design bureau donated the Kropyva system, including its source code and licensing, to the Ukrainian Armed Forces. This system streamlines the automation of command and control functions at multiple operational levels, including battalion, company, platoon, and even individual vehicles. Kropyva effectively integrates reconnaissance, command, and firepower into a unified information network, enhancing the coordination and efficiency of military operations (Mykhailo S, 2024).



Kropyva tactical command and control system, source Defence Express



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In relation to military intelligence, drones have played a crucial role in humanitarian efforts in the Russia-Ukraine war. Ukrainian forces and international organizations have used drones to survey damage to civilian infrastructure, assess humanitarian needs, and document war crimes. The ability of drones to access hard-to-reach or dangerous areas has proven invaluable in gathering evidence of human rights violations and ensuring that the international community remains informed about the realities on the ground (Nguyen, 2023; Cazalet, 2023). This dual-use capacity of drones further highlights their versatility and significance in modern warfare. While primarily used for military intelligence, drones have demonstrated their value in non-combat roles, making them indispensable tools not just for military operations but also for ensuring accountability in conflict situations.

The integration of drone technology into intelligence-gathering operations has revolutionized modern warfare, as evidenced by its extensive use in the Russia-Ukraine conflict. Drones have enhanced real-time decision-making, improved the precision of military strikes, and provided crucial data for documenting human rights abuses. The incorporation of AI into these systems is pushing the boundaries of what drones can achieve, signaling a shift towards even greater autonomy in military operations. However, these advancements also introduce new ethical and legal challenges that the international community must address. As drones continue to evolve, it is imperative that international legal frameworks adapt to ensure accountability and protect civilian populations in future conflicts.

4. The Impact on Civilian Infrastructure in the Russia-Ukraine Conflict

The ongoing conflict between Russia and Ukraine has underscored the pivotal role of drone warfare in modern military strategy, particularly regarding its effects on civilian infrastructure. This section explores the nature and extent of drone strikes on civilian targets, the implications for the Ukrainian population, and the legal and ethical concerns arising from these tactics.

In the Russia-Ukraine conflict, the deliberate targeting of civilian infrastructure has emerged as a central strategy, with drones increasingly utilized to strike key facilities such as power plants, water treatment facilities, and communication networks. The use of drones for these purposes is particularly alarming due to their precision capabilities, allowing for strikes that can inflict significant damage while minimizing collateral damage to military assets (Hromov, 2023; Smith, 2023). For instance, Russian forces have employed drones like the Shahed-136, supplied by Iran, to target Ukraine's energy infrastructure, leading to widespread outages and significant disruptions in essential services. These attacks have had dire consequences for civilians, especially during harsh winter months when access to heating and electricity becomes critical (González, 2023; Bowers, 2023). The war has led to repeated assaults on the Ukrainian energy grid, resulting in millions of people being deprived of basic utilities, exacerbating the humanitarian crisis caused by the conflict.



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Moreover, the destruction of water treatment facilities has led to shortages of clean drinking water, further endangering public health. The World Health Organization has raised alarms about the potential for disease outbreaks as a result of these attacks, illustrating the far-reaching impacts of targeting civilian infrastructure beyond immediate destruction (WHO, 2023). This trend of targeting essential infrastructure highlights not only the tactical aspects of modern warfare but also the implications for humanity in the face of armed conflicts.

The strategic rationale behind targeting civilian infrastructure stems from an intention to undermine Ukrainian morale and destabilize the country's ability to support its military operations. By inflicting damage on critical services, Russia aims to erode public confidence in the Ukrainian government and sow discord among the civilian population. This tactic is a classic example of the principle of "total war," where the enemy's ability to sustain its war effort is attacked comprehensively, encompassing both military and civilian resources (Duncan, 2023; Pavlenko, 2023).

The psychological impact on the civilian population is profound. Constant threats to essential services foster an atmosphere of fear and uncertainty, which can affect public support for the government and its military initiatives. In this context, drone warfare becomes not just a military tool but a psychological weapon intended to demoralize the opposition (Krulak & Bowers, 2023; Zhuravlev, 2023). The tactic of attacking civilian infrastructure is, therefore, a means of undermining the population's resilience and creating a climate of panic and distrust.

Widespread attacks on civilian infrastructure in Ukraine have drawn significant condemnation from the international community. Critics argue that these actions constitute violations of International Humanitarian Law (IHL), particularly regarding the principles of distinction and proportionality. IHL mandates that combatants must differentiate between military targets and civilian objects, and any attacks must not cause excessive civilian harm relative to the anticipated military advantage (Baker, 2023; Turchinov, 2023). Reports from human rights organizations have documented numerous instances where drone strikes have targeted civilian infrastructure, raising concerns about whether these attacks were indiscriminate or intentionally directed at non-military targets. For instance, the repeated targeting of energy facilities—especially during winter months—demonstrates a blatant disregard for civilian welfare and a potential violation of IHL. As such, these actions could be classified as war crimes under the Rome Statute of the International Criminal Court (ICC) (O'Hara, 2023; Lytvynenko, 2023).

Furthermore, the international legal framework surrounding warfare increasingly emphasizes the protection of civilian objects. The prohibition against attacking civilian infrastructure is a cornerstone of IHL, aimed at safeguarding non-combatants from the ravages of war. As the conflict continues, calls for accountability grow louder, with advocacy for investigations into potential war crimes committed by Russian forces through the use of drones (Hromov, 2023; Yuval, 2023).

The humanitarian impact of drone strikes on civilian infrastructure is stark. The resulting deprivation of essential services has led to widespread suffering among the Ukrainian population. The United Nations and various humanitarian organizations have raised alarms about the situation,



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noting that millions of civilians face acute shortages of heat, electricity, and clean water as winter sets in. This crisis has not only immediate health implications but also long-term effects on the country's recovery and rebuilding efforts post-conflict (WHO, 2023; Brann, 2023). This humanitarian dimension is crucial for understanding the full spectrum of consequences of drone usage in warfare.

Drones also facilitate the documentation of these attacks, with various non-governmental organizations (NGOs) and citizen journalism initiatives using drone technology to capture evidence of strikes on civilian infrastructure. This evidence is vital for international legal accountability and for raising awareness about the humanitarian consequences of the conflict (Nguyen, 2023; Cazalet, 2023). This demonstrates not only the technological role of drones but also their importance as advocacy tools for human rights.

The impact of drone warfare on civilian infrastructure in the Russia-Ukraine conflict is profound and multifaceted. The targeting of essential services undermines the resilience of the Ukrainian population, exacerbates humanitarian crises, and raises significant legal and ethical questions regarding the conduct of warfare. As the conflict evolves, it is crucial for the international community to address these issues, ensuring accountability for violations of IHL and prioritizing the protection of civilians in military operations. The lessons learned from this conflict will shape future discourse on the use of drones and the need for stringent regulations to govern their deployment in warfare (Sparrow, 2023; Turchinov, 2023).

5. Technological Advancements in Drone Warfare: Future Drones

The ongoing conflict in Ukraine has significantly accelerated advancements in drone technologies, reshaping the landscape of modern warfare. Both Ukrainian and Russian forces are heavily investing in the development and deployment of advanced Unmanned Aerial Vehicles (UAVs), leading to rapid technological innovations that could redefine military engagements in the future (González, 2023; Krulak & Bowers, 2023).

In the Russia-Ukraine war, both sides have utilized drones for various roles, including reconnaissance, surveillance, targeting, and direct attacks. The Ukrainian military has notably leveraged drones supplied by Western allies, such as the Turkish Bayraktar TB2, which have proven effective in targeting Russian armor and artillery positions (Smith, 2023; Hromov, 2023). The integration of advanced sensors, cameras, and guided munitions in these drones has enabled precision strikes that were previously not possible with traditional aircraft (Pavlenko, 2023; Baker, 2023).

On the other hand, Russia has deployed its UAVs, such as the Orlan-10 and the Lancet. These drones are equipped with intelligence, surveillance, and reconnaissance (ISR) capabilities, providing real-time data that enhance situational awareness and targeting accuracy (Zhuravlev, 2023; O'Hara, 2023). Their use has demonstrated how UAV technology can shift the balance of



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power in asymmetric conflicts, allowing smaller nations to challenge larger military forces more effectively (Turchinov, 2023; Lytvynenko, 2023).



Orlan – 10 Russian Drone, source: mil.in.ua



Lancet - The Russian Kamikaze Drone

A significant trend in drone technology is the integration of artificial intelligence (AI), which is poised to revolutionize military operations. Both Russian and Ukrainian forces are exploring ways to incorporate AI into their UAV systems, enabling drones to process vast amounts of data and make autonomous decisions (Duncan, 2023; Yuval, 2023). This advancement has the potential to enhance the operational efficiency of drones, allowing for quicker and more informed decision-making on the battlefield.

The rapid evolution of drone technology in the Russia-Ukraine war suggests that UAVs will play an increasingly prominent role in future conflicts. This development has several implications for global security:

- **Increased Accessibility of Advanced Technologies:** As drone technology becomes more advanced and widespread, it is likely that non-state actors and smaller nations will gain access to sophisticated UAV systems. This democratization of military technology could lead to more conflicts involving drone warfare, as various actors attempt to leverage these tools for strategic advantage (Sparrow, 2023; Cazalet, 2023).
- **Potential Proliferation:** The use of drones in Ukraine has drawn attention to the potential for the proliferation of drone technologies. Countries observing the conflict may seek to acquire or develop similar capabilities, leading to a new arms race in drone technology. The ease of producing drone systems may encourage more actors to engage in conflicts that leverage these tools, potentially destabilizing regions (Nguyen, 2023; Brann, 2023).
- **International Legal Challenges:** The deployment of autonomous drones raises significant legal and ethical concerns regarding accountability and compliance with International Humanitarian Law (IHL). As AI systems gain autonomy, determining responsibility for actions taken by these drones will become increasingly complex. The international community will need to establish robust legal frameworks to govern the use of UAVs,



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ensuring that their deployment adheres to humanitarian principles (Hromov, 2023; Lytvynenko, 2023).

The advances witnessed during the Russia-Ukraine conflict highlight the transformative potential of UAVs in modern warfare. The integration of AI into drone systems is poised to redefine military operations, posing both opportunities and challenges for global security. As nations continue to invest in these technologies, it is crucial to navigate the ethical and legal implications that accompany their deployment, ensuring that the evolution of drone warfare aligns with humanitarian norms (Turchinov, 2023; Yuval, 2023).

Future Drone – Prototype 2024, source: uvify.com



Conclusion

The conflict between Russia and Ukraine has marked a significant turning point in modern warfare, with drones and intelligence gathering emerging as pivotal components of military strategy. The integration of these technologies has not only reshaped traditional military tactics but has also raised critical ethical, legal, and operational questions about the future of armed conflict. The extensive use of drones in the Ukraine war has illustrated their evolution from reconnaissance tools to vital assets capable of conducting precision strikes and intelligence operations. Drones such as the Turkish Bayraktar TB2 and Russian Orlan-10 have demonstrated the ability to gather real-time intelligence, enabling rapid decision-making and enhancing situational awareness on the battlefield. This shift signifies a departure from conventional warfare, where the tempo and efficiency of military operations can be significantly altered by the effective use of UAVs Artificial Intelligence.

The integration of artificial intelligence into drone systems represents a critical advancement in military technology. AI-powered drones can process vast amounts of data, analyze threats, and even make autonomous targeting decisions, thus enhancing operational capabilities. However, this autonomy introduces complex challenges regarding accountability and compliance with International Humanitarian Law (IHL), particularly in relation to civilian safety and the ethics



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of autonomous warfare. The strategic targeting of civilian infrastructure in the Russia-Ukraine conflict has raised significant humanitarian concerns. Drones have been employed not only for military objectives but also to disrupt essential services, causing widespread suffering among civilians. This dual-use of technology highlights the need for robust legal frameworks to govern the use of UAVs and to ensure compliance with IHL .

Implications for Global payments observed in the Russia-Ukraine war indicate a broader trend towards increased reliance on drone warfare in future conflicts. As the barriers to accessing drone technology lower, non-state actors and smaller nations may increasingly adopt these tactics, potentially leading to new conflicts and destabilization in various regions. This proliferation underscores the importance of establishing international norms and regulations surrounding the use of drones in warfare to prevent escalation and ensure accountability. Looking ahead, thom the Russia-Ukraine conflict will likely influence military strategies worldwide. The combination of drones and AI in warfare presents both opportunities for operational efficiency and challenges related to ethical considerations and accountability. As nations continue to invest in these technologies, the need for dialogue among international stakeholders becomes crucial to address the implications of autonomous weapons and to uphold humanitarian principles in armed conflict

In conclusion, the Russia-Ukraine conflict has clearly showcased the transformative impact of drones and intelligence on modern military tactics. As warfare continues to evolve, it becomes increasingly crucial for the international community to actively engage in shaping the ethical, legal, and operational frameworks that will regulate the use of these advanced technologies. Striking a balance between military innovation and the protection of humanitarian principles is essential to ensure that the future of warfare aligns with international standards and prioritizes the safety and dignity of civilian populations.

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