Cutting-Edge Dynamics of Drone Technologies:
Military Strategies and Peaceful Innovations

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Abstract:

This article examines recent evidence and expert opinions on the pros and cons of unmanned aerial vehicles (UAVs), commonly known as drones. It analyzes the nuanced advantages and disadvantages of utilizing drones for both peaceful and military purposes. Rather than advocating for a blanket ban on drones due to their potential use in targeting individuals, such as al-Qaeda operatives in Pakistan or Russian soldiers in the Ukraine-Russia conflict, the article adopts a comprehensive approach by engaging with contemporary literature that assesses the complex implications of drone technology.

The analysis highlights the potential benefits of drones in peaceful applications, including enhanced surveillance capabilities and their role in humanitarian efforts

like disaster response and environmental monitoring. It also addresses significant ethical, legal, and operational concerns related to military use, such as accountability, the risk of civilian casualties, and the implications for international military power dynamics.

Based on this assessment, the article presents specific recommendations for the international community and regional groups, emphasizing the establishment of regulatory frameworks that promote responsible drone use, prioritize transparency and accountability, and ensure compliance with international humanitarian law, thereby fostering international dialogue and cooperation.

This paper examines recent advancements in drone technology, emphasizing their dual roles in military operations and peaceful applications. It explores how drones are transforming both conflict and peace efforts, analyzing their benefits and risks. By evaluating their use in warfare and humanitarian contexts, the study offers a cutting-edge perspective on the opportunities and challenges posed by drones. Understanding these developments is essential for navigating the complexities of modern drone technologies and their impact on global security and peacebuilding efforts.

Introduction, Objectives and Scope

This study aims to explore the objectives and key sections surrounding drone technologies, beginning with a brief history and evolution of these innovations. It will delve into humanitarian uses, focusing on the impact of drones in civilian contexts and their peaceful applications. The study will also examine military developments, highlighting key innovations and emerging combat applications. Additionally, it will address ethical considerations associated with drone use and provide policy recommendations to navigate the complexities of

these technologies. By outlining these aspects, the research seeks to offer a comprehensive understanding of the multifaceted roles drones play in both military and humanitarian spheres.

In the evolving realm of warfare, Unmanned Aerial Vehicles (UAVs) or drones, are aircraft operated without a human pilot onboard. They can be remotely controlled or fly autonomously using pre-programmed plans and sensors. UAVs serve various applications, including military operations, disaster response, environmental monitoring, agriculture, and transportation, offering efficiency and safety in challenging environments. As instruments poised to redefine military conflict and humanitarian peacebuilding, drones embody both promise and peril.

Objectives of study. This article briefly reviews expert claims about the merits and demerits of using drones for peaceful (e.g. recreational) and military (e.g. nonrecreational) purposes. For example, they can serve as valuable tools for police, legal forces, and disaster relief, excelling in surveillance and reconnaissance. However, the demerits of this technological marvel are being made manifest as states and actors employ them for remote strikes in inaccessible locations, and against civilians**.**

The expanding role of drones necessitates strengthening international and national law; increasing surveillance: and conducting more rigorous oversight with more stringent regulations. This article puts forward precise and solid recommendations for the international community and regional groups of nations to consider. In future, striking a balance between the positive potential and inherent risks of UAVs will be important in terms of military strategies and peaceful innovations.

Autonomous Weapons Systems (AWS) are systems that, once activated by human operators, utilize sensor data processing to select and engage targets with lethal force without further human intervention. These systems operate independently, making real-time decisions based on their programming and the data they collect, raising significant ethical and operational considerations in warfare and security contexts. Given the rapid advances in the research and development of new technologies in the field of Artificial Intelligence (AI), which could facilitate the development of novel and sophisticated autonomous weapons, this article examines drones as humanitarian and potential weapon systems that,

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once activated, can identify, select, and engage targets either with or without lethal force and either with or without further intervention by human operators.

Scope: The rapid evolution of drones. Nearly 15 years ago, University of Southampton engineers used a laser 3D printer to assemble by hand, in minutes, a nearly silent drone (Graham, 2011). Drones became inexpensive and widely available, therefore anyone that could use a 3D printer or Google maps could make and fly a drone. Anyone with a smartphone could own and operate a small drone that carried a camera. For less than $350 (US dollars), drone operators flew over institutional complexes, like government buildings, shopping centers and empty fields.

The cost savings promised efficiency since modern drones had vastly more capabilities than the drones of the 1940s and 1950s, which were used to give gunners on bombers target shooting practice. In this century, drones increasingly came to provide valuable military air support. For example, in 2016 the U.S. Marine Corps and the Department of Defense began researching ways for drones to act like teammates with robots on the battlefield. A ground robot with an attached air robot on the battlefield promised to take soldiers and marines out of dangerous situations. Experts predicted robots that plugged into injured troops on the battlefield, monitored their care, and kept them alive with medication and blood transfusions would play a major role in future battlefields (Gallagher, 2016). Soon engineering advances in drone technology and AI actually enabled drones to evade radar defenses, attack manned airplanes, and carry conventional bombs.

The evolution of drone tactics was mainly due to low intensity conflicts including in Mexico and the Middle East, particularly as drug cartels began repurposing commercial agricultural and inspection drones for reconnaissance purposes. In 2010, Iran's then President Mahmoud Ahmadinejad unveiled the "Ambassador of Death" drone. The Aeryon Scout drone manufactured in Waterloo, Ontario made international headlines when Libyan rebels purchased one for $100,000 and used it to collect video intelligence of Moammar Gadhafi's compounds (Simpson, 2015, p. 2). By September 30, 2024, Russia was able to launch several waves of drones targeting Kyiv, with Ukrainian air defense units successfully defending the city during the attack which lasted over five hours. Russia and Ukraine continue to launch air attacks, targeting each other's energy, military and transport infrastructure, including each other's nuclear power plants. The drone attacks on nuclear stations in the Russia-Ukraine war provide warnings

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for other countries – indeed, the legacy of drone strikes on nuclear sites has already made evident that nuclear power plants and waste disposal sites in other countries, like the United States and Canada, could become targets in conflict zones (Simpson, 2024). The next two sections analyse the nuanced advantages and disadvantages of utilizing drones for both peaceful and military purposes. Rather than advocating for a blanket ban on drones due to their potential use in targeting individuals, such as al-Qaeda operatives in Pakistan or Russian soldiers in the Ukraine-Russia conflict, the article adopts a comprehensive approach by engaging with contemporary literature that assesses the complex implications of drone technology.

Humanitarian Uses: Civilian Impact and Peaceful Roles

Agricultural, environmental and infrastructure monitoring and inspection. Drones have already revolutionized forest operations due to their role in mapping, monitoring, and inventory procedures. Drones enable real-time tracking of changes in forested landscapes, facilitating effective monitoring of threats such as fire outbreaks and pest infestations. They swiftly survey large areas and contribute to tree harvesting and planting. For example, drones equipped with thermal cameras can enable early detection of wildfires, enabling timely response and contributing to sustainable land management (Buchelt, 2024). In another example of their revolutionary role of monitoring, drones can also monitor wildlife species providing accurate and effective monitoring of one the world's rarest primates, the Hainan gibbon, providing hope for recovering of the last surviving population in a tropical rainforest national park in China (Song, 2023, p. 1).

Low-cost drones are increasingly used for data collection, transportation, and infrastructure surveillance, offering more efficient and sustainable solutions compared to traditional methods. They can cover large, hard-to-reach areas quickly, reducing the need for human intervention and labor. Drones are effective during and after natural disasters, precisely positioning themselves to aid in building smarter cities globally. A recent international survey shows drones can significantly assist with disaster evacuation planning, road safety, and highway infrastructure management. They are also widely employed for affordable air quality and particulate monitoring (Gohari, 2022).

Commercial package delivery. Autonomous Drone Delivery (ADD) modes are expected to become an important pillar of the future logistics industry for small parcel delivery in 'the last mile', as well as meal delivery service for fast

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food (e.g., pizza, etc.) and restaurants. The pizza and food giant Domino's Pizza has already started, collaboratively with New Zealand startup Flirtey, testing delivery services employing drones. In future, consumers worried about staying at home – perhaps due to more COVID19 related lockdowns – combined with the danger of exposing delivery people to illness and pandemics will mean delivery companies start to develop creative ideas such as the use of delivery robots in many cities around the world (Benarbia, 2021). How will these new delivery services prevent commercial drone collisions and traffic accidents?

The newer developing drones are increasingly able to avoid other aircraft and obstacles. Right now, most drones do not have the capability to sense and avoid other aircraft and obstacles and it is easy to understand why that poses problems. Those systems require visual observers along the route of every flight to help the drones avoid hazards. While it is still relatively easy to use existing technology to fly a light payload a short distance that is within the operator's line of sight, according to researchers Jung and Kim (2017) it is a very different challenge to build a network that can deliver to customers across large communities outside the operator's line of sight. Yet as Jung and Kim highlight, one corporation, Amazon is already working with the United States' Federal Aviation Administration (FAA) and local officials to obtain permission to conduct deliveries of commercial packages and soon they predict drones could promise small parcel delivery, including meal delivery.

We can also expect more news reports about disputes about customer injuries related to handling drones. We can reliably foresee that when multiple trucks work with multiple drones in a 'drone assisted pickup and delivery problem' (DAPDP) through a mixed integer linear program (MILP), there are bound to be safety concerns. We can either limit the use of drones to deliveries only or accept that the adoption of any new technology is safety sensitive, and thus, more customer injuries related to drones will foment public controversy. As during the pandemic, when police used drones equipped with cameras and loudspeakers to monitor and enforce public compliance with social distancing rules, there were concerns that privacy rights were being breached in a 'police state' atmosphere.

Medical supplies and disaster relief delivery. Drones may be able to bring powerful lifesaving capabilities to medical situations in which time is critical; moreover, they may also bring efficiency and cost savings to non-urgent medical situations. In some places, such as Rwanda and Ghana, UAVs are already saving

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lives by transporting blood products and other medical supplies (Graboyes, 2020). Critically time-dependent delivery and faster intervention by drones carrying medical supplies is already leading to improved patient outcomes (Roberts, 2023). In future, interventions for many medical emergencies could include the delivery of equipment that aids in cardiac arrests, strokes, drug overdoses, seizures, and trauma.

Drones promise efficiency and cost savings. Unmanned drones can carry high-resolution still cameras, video cameras, and thermal cameras so they are useful for aerial surveillance during disasters, as well as less expensive for use in search and rescue operations. Larger drones are being used to deliver essential supplies to people stranded in isolated areas (Papyan 2024, 169–186). Drones can operate in challenging environments, without people on board to control them. For example, unmanned vehicles that operate in the air can track wide, isolated expanses such as the Arctic much less expensively than manned aircraft. Drones can also stay in dangerous airspaces longer than manned aircraft, so they were used at Japan's crippled Fukushima nuclear power plant to survey the damage. Drones are capable of hovering over disaster-stricken areas that may be challenging for rescue teams to access directly, enabling them to pinpoint locations where people might be trapped. Drones can cover larger areas in shorter timeframes compared to ground-based rescue efforts or specially trained search dogs. They also employ thermal imaging technology to detect body heat and human signals like shouting.

During emergencies, swarms of UAVs could be deployed for search and rescue operations. Although still under development, autonomous flocking behavior of UAVs in demanding outdoor conditions could be motivated by search and rescue applications. Researchers are proposing novel approaches for decentralized swarm navigation in the direction of a candidate object of interest (OOI) based on real-time detections from onboard cameras (Horyna 2023). This means that advances in drone design and control including operational resiliency of swarms of UAVs could positively affect disaster management, crowd control, emergency communications, and searches for victims. The concept of UAV swarms may seem far-fetched but advances in engineering and experimental results could herald transformations in innovative emergency responses. This section explained that drones are being used in peaceful ways including for crime, law enforcement and search and rescue. But they can also be used during conventional battlefield warfare to gain strategic and psychological advantages over adversaries.

Military Developments: Key Innovations and Emerging Combat Applications

Military operated drones are exerting sanctioned and non- sanctioned functions within societies. In one widely reported incident (Simpson, 2015, 1), an off duty, drunken U.S. intelligence agency employee flew a drone that crashed inside the White House complex. He admitted to the Secret Service that he had been drinking at an apartment nearby, and it was not until the next morning when he awoke, that he learned his drone had evaded White House radar, which is supposed to warn of larger threats, like manned airplanes and incoming missiles. Fast forward a decade, and it is widely understood that drones are being increasingly used by Ukrainian and Russian defense forces to target moving vehicles and fleeing soldiers (Kramer, 2023, 1). All these sorts of incidents indicate that inexpensive drones, readily available on legal and black markets can be used to target military strikes against combatants and civilians.

Targeted military strikes against combatants and civilians. As the U.S. Army War College warned nearly a decade ago, drones could be used to take down aircraft and might move as semiautonomous swarms of UAVs (Bunker, 2015). To cite one example, the United States conducted at least 378 air and drone strikes in Yemen from 2002 to 2023. Primarily targeting members of AL Qaeda, these strikes killed over 1,000 people including more than 125 civilians. The American military and CIA has also used drones outside the battlefields of Iraq, Afghanistan, and Libya. Of these, most occurred in Pakistan, with the rest in Yemen and Somalia. There were 420 US drone strikes in Pakistan between 2006 and 2016 with more than 3,000 deaths in Pakistan. Cumulatively more than 2,000 suspected militants and an unknown number of civilians have been killed (Weiss, 2024, 1). To emphasize, drone strikes in battlefields can kill soldiers as well as civilians.

Within the target states, drone strikes provoke polarized reactions, with some expressing negative emotions and anger, while others show positive responses. These strikes have also led to a rise in anti-U.S. protests and increased online searches for radical Islamist content (Mahmood, 2023). Notably, there is widespread agreement that around two dozen senior followers of Osama bin Laden have been killed in recent years. In response, al-Qaida has used drone footage to celebrate their martyrdom and recruit additional followers (Smith, 2010). As the wars in Gaza, Lebanon and Ukraine continue, desperate soldiers are learning very quickly to use Chinese, Korean, Russian and Western technology to kill their adversaries with drones.

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Moreover, civilian drones are being repurposed to target soldiers. For example, fleets of inexpensive, mostly off-the-shelf drones are helping Ukrainian forces evade and target sophisticated Russian defense systems. Ukraine buys them from commercial supplies, who also sell to aerial photographers or hobbyists around the world, along with parts such as radios, cameras, antennas, and motors (Kramer, 2023). The doctrine of war is changing as drones that cost hundreds of dollars are destroying Russian machines costing millions of dollars.

Leadership decapitation and targeted killings of militants. States often publicize targeted killings of militants by drones as significant, but civilians may fail to perceive such military strength as a win. In Afghanistan, for example, drone strikes were primarily conducted by NATO, the US Air Force, or other US government drone operators (Jadoon, 2024). Whether leadership decapitation through killing or capturing of top leaders of militant groups contributes to winning the hearts and minds of civilian populations depends on perceptions. Notably, at Creech air force base in Nevada and at CIA headquarters, civilian protestors regularly carried placards that were opposed to pilots who kill people in Afghanistan and Iraq as if they were playing video games in airconditioned offices (Simpson, 2016b). Initially in the Afghanistan War, the U.S. government intended to use military drones against highly valued targets, like key leaders of al-Qaida. But according to experts, approximately 2 percent of the deaths caused by drones since 2004 were high valued, while the remainder were actually lower ranking operatives. U.S. President Barack Obama admitted "a lot of these strikes" were in Pakistan's tribal areas, but who was targeted and under whose authority could only be guessed at.

According to the Pew Global Attitudes Project, only 17 percent of Pakistani respondents to a 2012 poll approved of American drone strikes against the leaders of extremist groups, even if they were jointly conducted with the government of Pakistan. Most Pakistanis disapproved, and most people polled internationally in 2012 indicated strong opposition to the U.S. drone campaign. According to Cronin writing in 2013, the opposition was strongest in Muslim majority countries, including traditional U.S. allies, such as Turkey (81 percent against), Jordan (85 percent against), and Egypt (89 percent against). In the context of leadership decapitation and targeted killings of militants, we should next examine the use of drones for military surveillance, including convoy protection.

Military surveillance including convoy protection. Autonomous Weapons Systems (AWS) equipped with drones can provide assistance with the delivery of military surveillance. In future, swarms of drones could provide convoy protection. Providing the swarm is large enough and the formation radius can be achieved without risking collisions, researchers are using evolutionary algorithms to obtain stable formations in all types of scenarios (Stolfi, 2024). Drones can protect governmental and military convoys, yet with the protection of convoys, organized repression is also possible.

Drones used in warfare significantly reduce the risk to the operators' lives. One clear and perceived advantage is the ability to eliminate al-Qaida, Taliban, or ISIS-inspired militants from the air without putting North American lives in immediate danger. Military applications of drone technology may either precede or follow peaceful technological developments. For instance, Somali pirates could soon use portable drones to track vulnerable ships; South American drug cartels could deploy drones to monitor political convoys susceptible to kidnapping; and North Korean operatives might breach South Korean or Japanese airspace carrying biological weapons, like anthrax. Although these scenarios may seem improbable, the rapid pace of drone technology development makes them increasingly plausible.

Drug trafficking and illegal drug cartels. To reiterate, these sorts of scenarios may seem farfetched, but a recent U.S. Army War College report warns there is also the possibility that human controlled drones could be used for drone up shootings (like walk up shootings). Drug trafficking in heavily used airspace is also certain to cause catastrophic incidents. Drones are emerging as a tool for law enforcement agencies as well as drug cartels in the Mexican drug war. Cartels are using drones to transport extra heavy load cargo and weapons into the U.S. Then using drones, drug smugglers can conduct surveillance, evade detection, and transport contraband across borders (Schmersahl, 2018). For example, a drone laden carrying crystal meth crashed into a supermarket in Tijuana, Mexico, because three kilograms (6 pounds) of illegal narcotics was too much for it to carry (Simpson, 2015, p. 1). Today, Mexican drug cartels have introduced a new rank within their hierarchy known as 'droneros' or drone operators. In Mexico, drone parts are readily available for purchase on platforms like eBay and Amazon, allowing for modifications. Consequently, tracking the number of drones sold on grey or black markets is extremely challenging. Recent projections for the legal drone market forecast a volume increase of 11.5% in Mexico by 2024 (Kramer,

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2023). However, obtaining accurate data on the number of illegal drones remains elusive, much like measuring how drones are contributing to uncertainties in military balances of power, which will be our next focus.

Drones foster uncertainties about military balances of power. Although drones are unlikely to completely transform the global order, they could lead to more frequent use of low-intensity force, as demonstrated in Russia's war in Ukraine. Both Russia and Ukraine have employed drones in various capacities to support their military operations. These UAVs are extensively used for intelligence gathering, surveillance, and reconnaissance, providing real-time data on enemy positions, troop movements, and battlefield conditions, which aids in monitoring defenses and planning attacks.

Drones also play a crucial role in guiding artillery fire by identifying and designating targets, resulting in more precise strikes. Kamikaze drones are designed to crash into targets and explode on impact, with Iranian-made Shahed drones being notably prominent in Russian operations. Meanwhile, Ukraine is utilizing drones equipped with electronic warfare systems to jam Russian communications and GPS signals. Additionally, drone footage is leveraged for propaganda, showcasing strikes to enhance their image and demoralize opponents as part of psychological warfare efforts. In short, while drones may not yet be decisive in inter- and intrastate conflicts, they have the potential to enable remote-control repression, long-range offensive strikes, and psychological warfare, making them vital components of military strategy in future conflicts.

Ethical Considerations and Policy Recommendations to Enhance Peace and Prevent Armed Conflict

This final section examines the ethical considerations surrounding drones and offers policy recommendations. One notable example is the use of trained animals, such as birds of prey, to capture rogue drones, a practice successfully implemented in the Netherlands and France. Dutch national police have trained eagles to intercept drones, which initially garnered attention as an amusing news story. However, this practice raises significant ethical concerns regarding the treatment of animals and their protection from potential harm during such operations (Gazek, 2018).

To address these issues, it is crucial to strengthen international law and norms surrounding drone usage, including refining the vocabulary and nomenclature related to drones. Establishing clear definitions and guidelines can help promote accountability and ensure that ethical considerations are integrated into drone operations globally. This includes developing comprehensive frameworks that govern the deployment of drones, protecting both human and animal rights, and fostering responsible practices in both military and civilian contexts.

Strengthen international law and norms, including the terminology related to drones. In my view, the international community and individual states will need to substantively strengthen international law and norms governing the use of drones in armed conflicts. The first obstacle is that there is no consensus definition of Lethal Autonomous Weapons Systems (LAWS) in existing international law. There is a grassroots effort to insist that the autonomous functions in weapons systems must not be designed to be used to conduct attacks that would not be the responsibility of the human command under which the weapon system would be used. But this is easier said than done. Any future legal norms governing the use of drones in armed conflicts and the use of force may look clear on paper, but the changing nature of modern conflict could render them almost incoherent in practice.

It seems obvious that weapons systems should be developed such that their effects in attacks can be anticipated and controlled, as may be required, in the circumstances of their use, by the principles of distinction and proportionality, and that attacks conducted with reliance upon their autonomous functions should be the responsibility of the human command under which the system was used. But this means shared agreement upon 'meaningful human control' will need to be reached. We will need new definitions, and thresholds, referring to the thresholds of application of human judgment and intervention necessary to ensure the maintenance of human agency, responsibility, proportionality, and accountability in undertaking decisions regarding the use of any such weapons, and the ability of human operators to effectively supervise any such weapons.

Problematically, there is as yet no consensus definition of LAWS in existing international law. Nevertheless – according to Report of the 2021 session of the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons – there can be some kind of shared agreement that:

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States should commit not to use, or to develop, produce, acquire, possess, deploy or transfer with a view towards use, any weapons system based on emerging technologies in the area of lethal autonomous weapons systems that can perform the critical functions of selecting and engaging to apply force against targets without further intervention by a human operator, if: (a) It is of a nature to cause superfluous injury or unnecessary suffering, or it is inherently indiscriminate; or (b) Its autonomous functions are designed to be used to conduct attacks outside a responsible chain of human command and control; (c) The incidental loss of civilian life, injury to civilians, and damage to civilian objects expected to result from the use of the weapon to conduct attacks cannot be reasonably foreseen or are not fully understood by a human operator; or (d) It is otherwise incapable of being used (Report of the Group of Governmental Experts on Emerging Technologies in the Area of Lethal Autonomous Weapons, 2023, Executive Summary).

Back in 2016, the U.S. Stimson Task Force on Drones warned that when basic concepts, like 'battlefield', 'combatant' and 'hostilities' no longer had any clear or stable meaning, 'the rule of law' was threatened (Simpson, 2016a). In less than a decade, the situation has become vastly more complicated. Many more rules and regulations will be needed to govern what are now called Unmanned Combat Aerial Vehicles (UCAVs). New terms are being coined, like 'loitering munitions' which are expendable missiles capable of staying airborne for some time until they identify a target and attack. All sorts of battlefield glossaries and domestic dictionaries will be needed to train operators and observers with shared meanings that will be necessary in the age of drone warfare. New glossaries shared across borders and languages could also assist in obtaining more transparency at municipal, state-level, national, regional, and international levels.

Regional groups of states should outlaw fully autonomous lethal weapons systems. In the short term, regional security organizations that promote peace, stability, and democracy in North America, Europe, and beyond should also be able to agree on diplomatic efforts to stabilize situations and advance peace processes. Groups of states, such as the United Nations (UN), European Union (EU), North Atlantic Treaty Organization (NATO), or the Organization for Security and Co-operation in Europe (OSCE), could establish new regulations. Similarly, regional organizations like the African Union (AU), Association of Southeast Asian

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Nations. (ASEAN), and specialized agencies of the UN, like the International Civil Aviation Organization (ICAO) could commit to the following:

- Outlaw fully autonomous lethal weapon systems that operate entirely outside human control and lack a responsible chain of command.
- Regulate other lethal weapon systems featuring autonomy to ensure compliance with international humanitarian law by maintaining human responsibility and accountability, ensuring appropriate human control, and implementing risk mitigation measures.

At this time in all major or well-established drone programs, the technology remains under the firm control of individuals and no modern drone program is fully automated. However, the physical and moral distance between drone operators and their targets may gradually desensitize operators from the act of killing and make targeted killings easier. Moreover, the distinctions between combatants and civilians may further erode due to the technology itself. Therefore, international agencies, regional groups of states and agencies must act quickly to outlaw fully autonomous lethal weapons systems.

Replicate newer North American laws and regulations. Such recommendations suggest that the international community and regional associations develop appropriate ethical norms that include robust oversight and accountability mechanisms. In this context, examples from North America are particularly insightful. The Federal Aviation Administration is a United States government agency responsible for regulating regulating and overseeing all aspects of civil aviation. Notably, the FAA offered new guidance on July 14, 2023, regarding the boundaries of federal, state, and local authority to regulate what they call 'Uncrewed Aircraft Systems' (UAS). There will be robust federal pre-emption in aviation safety and airspace efficiency. Although debates emerged in the United States as to whether the compact, nimble nature of drones and the low altitudes at which they would conduct operations merited new or revised laws at the state and local level, the FAA's new Fact Sheet clearly articulates the scope of federal authority and demonstrates the federal government's intent to "clip the wings of state and local regulators when it comes to UAS regulation and laws that impact the airspace generally" (JDSPUA, 2023).

Canada's Minister of Transport, Omar Alghabra also announced on June 23, 2023, new and proposed Beyond Visual Line of Sight (BVLOS) drone rules, which are

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among the first in the world ((Transport Canada, 2023). The proposed rules require drones to be capable of detecting and avoiding other air traffic to ensure safety. They introduce a new class of pilot certification including exams for operators who conduct lower-risk BVLOS operations, yet still permit drone operations such as package delivery to remote communities, first responder operations, and natural resources and wildlife surveys to take place, among many other potential uses. Canada's new regulations will affect recreational as well as commercial operators, subjecting them to costs relating to obtaining Advanced Certificates, Level 1 Complex Certificates, and drone registration services. The Canadian government will include fees for issuing certificates, taking certification exams, and collect fees to rebalance costs from Canadian taxpayers of providing the new governmental services. It seems from these North American examples that more citizen and drone registration, combined with operational authorization provisions, like stringent exams, advanced certificates, and more licenses would be advantageous as well as prescient.

Develop comprehensive background checks, manufacturer restrictions and cross-border transparency. It is recommended that more comprehensive background checks for prospective drone buyers could be even more advantageous. Restricting sales of certain types of drones to authorized users would add more layers of security. Moreover, drone manufacturers themselves could implement limits on UAVs by restricting their capabilities, range, and geographical operating areas to prevent misuse.

In the future, Global Navigation Satellite Systems (GNSS) equipped with restrictions and enforced geofences could be implemented based on strict risk assessments and specific threat landscapes in high-risk countries, states, provinces, and municipalities. The development of emerging technologies related to drones should involve significant input from local, provincial, state, federal, and international levels. The growing controversies surrounding recent isolated drone incidents highlight the need for stronger drone regulations worldwide, which require immediate and comprehensive contributions from all levels of government.

Increased transparency and disclosure among specialized international institutions (such as the UN's ICAO and North America's FAA and Transport Canada) will be essential. Enhanced information sharing among nations and collaboration on joint cross-border initiatives will become increasingly important. International cooperation is necessary to conduct background checks on potential

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drone purchasers, work with manufacturers to implement restrictions, and develop both passive and active countermeasures.

Legal and ethical issues surrounding transparency will also require improved disclosure practices. International and regional groupings of countries, including organizations like the International Criminal Police Organization (INTERPOL) must exchange intelligence, technology, and best practices. Institutions such as the ICAO and NATO should learn from other nations and industries by studying geofencing technology, no-fly zones, and methods to disable drone swarms.

Conclusion

This article explored recent evidence and expert opinions on the pros and cons of unmanned aerial vehicles, commonly known as drones (and now less commonly referred to as Uncrewed Aircraft Systems). It examined the nuanced advantages and disadvantages of using drones for both peaceful and military purposes. Instead of advocating for an unattainable ban on drones due to their use in targeting individuals – such as Hamas-soldiers in the Gaza strip or Hezbollah-related operatives in Lebanon – this article took a more comprehensive approach. It engaged with a wide range of cutting-edge contemporary literature that evaluates the complex implications of drone technology.

The analysis emphasized the potential benefits of drones in their peaceful applications, such as improved surveillance capabilities and their role in humanitarian efforts like disaster response and environmental monitoring. Conversely, it also brought attention to significant ethical, legal, and operational concerns related to their military use, including issues of accountability; the risk of civilian casualties; and the implications for international military power dynamics.

Based on this assessment, the article presents specific recommendations for the international community and regional groups of states. These recommendations emphasize the establishment of regulatory frameworks that promote the responsible use of drone technology. Such frameworks should prioritize transparency, accountability, and compliance with international humanitarian law, fostering dialogue among nations to ensure that drone deployment aligns with broader ethical standards, and aligns with evolving international legal norms. Ultimately, collaborative approaches will be essential in navigating the complexities of drone technologies, enabling the harnessing of their potential benefits for peaceful

innovations while effectively addressing the challenges posed by their misuse in military operations.

Biographical Note

Erika Simpson is an influential figure in international relations and peace research, serving as an Associate Professor at Western University and President of the Canadian Peace Research Association. She authored *NATO and the Bomb* and has published in reputable journals, including the *Brown Journal of World Affairs*, *International Journal*, *Peace Review*, and *Policy Options*. Dr. Simpson frequently contributes to Canada's *Hill Times* and shares her insights with outlets like the Postmedia Network, CTV Television, and CBC Radio. She has held significant roles in the Canadian Pugwash Group and serves as a reviewer for the Canadian Institute for Military and Veteran Health Research and the Social Sciences and Humanities Research Council of Canada. Her contributions have earned her numerous fellowships, including the Alton Jones, Barton, Liu Institute, and NATO Fellowships. In 2015, she received a lifetime achievement award from the Voice of Women in Canada for her impactful work in peace writing.

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