DRONES: REDEFINING AIR WARFARE AND FUTURE CONFLICTS

A PICHIPOO RAJA

DRONE PROPHECIES

The *Marine Corps Gazette* is a professional journal of the US Marine Corps that has been in publication since 1916. An article was published in the issue of 1989 written by four serving officers and a Marine Corps historian on the topic, "The Changing Face of War: Into the Fourth Generation". It spoke of blurred lines of conflict and a diffused battlefield. One of the most accurate predictions it made was about the evolution of drones. It said, "The growth of robotics, remotely piloted vehicles, low probability of intercept communications, and artificial intelligence may offer a potential for radically altered tactics. In turn, growing dependence on such technology may open the door to new vulnerabilities, such as the vulnerabilities to computer viruses.[1]" This is such an accurate forecast that it almost appears to be surreal. The proliferation of drones in both civilian and military applications is remarkable and has experienced exponential growth. The ubiquitous nature of drones has been exploited for battlefield

Wing Commander **A Pichipoo Raja** is a serving officer in the Indian Air Force. He is a helicopter pilot and is currently a Senior Research Fellow at the Centre for Aerospace Power and Strategic Studies. He is also Programme Director, Warfare and Aerospace Strategy Programme.

1. *Marine Corps Gazette* 1989. Accessed at <https://www.academia.edu/7964013/ The_Changing_ Face_of_War_Into_the_Fourth_Generation>

requirements in almost all recent conflicts. The huge presence of drones on the battlefield, with an almost complete absence of conventional air power in some recent conflicts, has raised questions about the relevance of manned aircraft. Elon Musk, one of the most innovative people of the current century, tweeted in November 2024, "Manned fighter jets are obsolete in the age of drones anyway. Will just get pilots killed.[2]" He even went on to call the people building the most advanced aircraft like the F-35, "idiots". These remarks raise the question of whether drones have replaced manned aircraft. This paper seeks to examine the impact of drones on future conflicts.

AIR POWER BASICS

Billy Mitchel, one of the early proponents of air power, defined it as, "Air power is the ability to do something in or through the air and as the air covers the whole world, aircraft are able to go anywhere on the planet[3]". This emerges from the physical characteristics that the air domain offers. Namely:

(a) **Reach**: Water covers 75 per cent and land covers 25 per cent, and only air covers 100 per cent of the Earth. Therefore, using the medium of air, one can travel anywhere unrestricted

(b) **Elevation**: Air offers the ability to climb anywhere and retain the upper ground

(c) **Speed**: Because of the lack of obstacles in the medium and reduced friction, air provides the fastest means of travel.

These together bring mobility and responsiveness (fastest to respond to a situation). Thus, air power became a preferred tool for responding to contingencies/conflicts throughout the world. Further, the ability to reach the battlefield from the air enabled the combatant to engage an adversary

2. Tweet by Elon Musk. Accessed at < https://x.com/elonmusk/status/1861070432377737269>. Accessed on June 14, 2025.
3. William Mitchell, *Winged Defense: The Development and Possibilities of Modern Air Power—Economic and Military* (University of Alabama Press, 2010), p. 6.

without committing to boots on the ground. This also led to the situation as depicted by Johns Hopkins Professor Eliot Cohen, "Air power is an unusually seductive form of military strength, in part because, like modern courtship, it appears to offer gratification without commitment[4]." However, while air power saw increased application, there were occasions when it could not deliver the desired results. The next section examines the performance of air power in conflicts of the past century and the associated reasons.

AIR POWER IN SMALL WARS

William McNeil, in his classical book, *The Pursuit of Power*, published in 1986, traces the evolution of wars over a millennium. Regarding modern wars, he states, "Wars in such a world would sink back to proportions familiar in the industrial past. Outbreaks of terrorism, guerrilla action and banditry would give expression to human frustration and anger. But organised war as we know of the last century, would disappear[5]." Though organised war didn't disappear, it certainly diminished. Terrorism rose along with guerrilla action. Offensive air power, a key element of organised war, failed to deliver in these conflicts. James Corum studied the small wars of the century in the book *Air Power in Small Wars: Fighting Insurgents and Terrorists*. He concludes "The support role of air power (eg recce, transport and so on) is usually the most significant in guerrilla warfare[6]". He adds that the ground attack role of aircraft became important when war became conventional. Thus, there is reasonable evidence to conclude that against combatants employing guerrilla warfare, offensive air power employment has fared poorly. How they evaded and survived aerial attacks is discussed next.

4. Quoted in Mark Clodfelter, "The Limits of Airpower or the Limits of Strategy", *Joint Forces Quarterly* 78, 2015, pp. 111-124.
5. William H. McNeill, *The Pursuit of Power: Technology, Armed Force, and Society Since* A.D. 1000. (Chicago: University of Chicago Press, 1982), p. 384.
6. James S. Corum, and Wray R. Johnson, *Airpower in Small Wars: Fighting Insurgents and Terrorists*, (University Press of Kansas, 2003), p. 427.

AIR POWER SANCTUARIES

While air is present all over the globe and air power can theoretically reach everywhere, in practice, it cannot. Constricted spaces such as dense forests, narrow mountain valleys, or populated cities, inside buildings or in trenches, offered no room for the operation of manned fighter aircraft due to their size, speed, and manoeuvrability. Additionally, where air power could reach was also dependent on where it was based. In the absence of adequate operating bases or a lack of capability for in-flight refuelling, some portions of the surface of the Earth remained inaccessible to manned aircraft (like oceans). Fighters operating from aircraft carriers, helicopters and vertical landing aircraft like the F-35 B, operating from unprepared surfaces[7], reduced this zone of inaccessibility but could not eliminate it. Therefore, a gap existed between theoretical reach and practical reach, creating inaccessible zones.

In other cases of diffused battlefields like dense cities, combatants camouflaged themselves, hid with non-combatants, and used them as shields. They couldn't be effectively targeted from the air without the risk of collateral damage. This imposed political restrictions on the employment of air power. They adopted guerrilla tactics and were immune to air attacks.

Thus, a combination of factors like lack of bases, constricted spaces and populated areas prevented manoeuvre, and created pockets wherever air power could not reach. This gap between where air was available but air power could not reach created sanctuaries. These sanctuaries offered protection from aerial strikes. In conflicts where there were adequate sanctuaries, the results from offensive air power employment were sub-optimal. The same would be explained with reference to history in the next section.

IMPACT OF AIR POWER ON CONFLICTS: AN ASSESSMENT

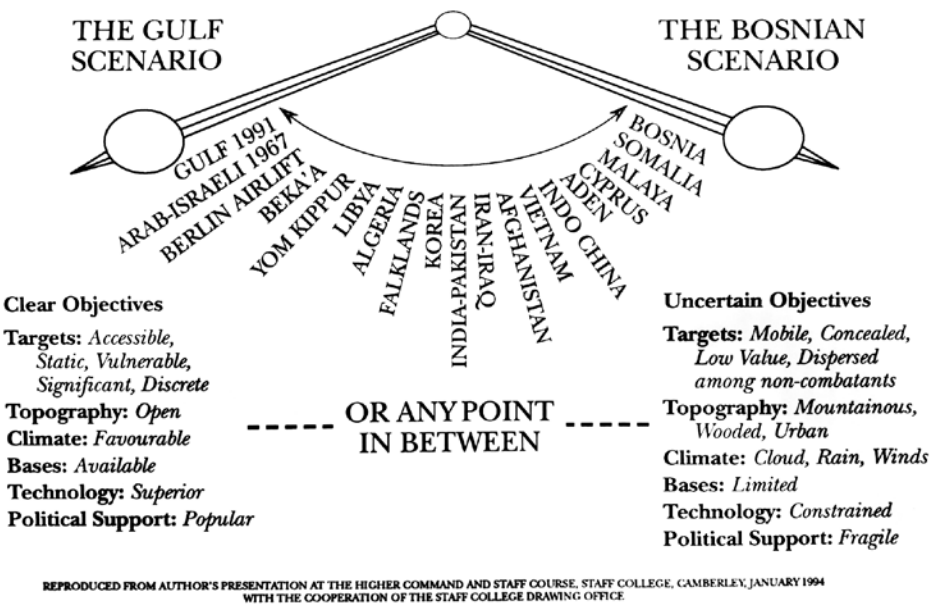
Air Vice Marshal Tony Mason, a former Royal Air Force (RAF) fighter pilot, assessed the performance of air power over the past century in his book, *Air*

7. "F-35 Lightning II". Accessed at < https://www.lockheedmartin.com/content/dam/lockheed-martin/aero/documents/F-35/F-35_Brochure_3-2020.pdf>

Power: A Centennial Appraisal. He presented his findings in a graphical form (reproduced in Fig 1) that depicted the extremes of performance. He listed the factors affecting the employment of air power as follows:

(a) Objectives.
(b) Political support.
(c) Topography.
(d) Climate.
(e) Bases.
(f) Technology.
(g) Type of target.

Fig 1: The Air Power Pendulum (Reproduced from *Air Power: A Centennial Appraisal*)



REPRODUCED FROM AUTHOR'S PRESENTATION AT THE HIGHER COMMAND AND STAFF COURSE, STAFF COLLEGE, CAMBERLEY, JANUARY 1994 WITH THE COOPERATION OF THE STAFF COLLEGE DRAWING OFFICE

Objectives influence all forces and, therefore, can be assigned to all forms of the military, and are not restricted to air power alone. Political support did influence the employment of air power in two ways: firstly, in terms of

When conflicts happened in mountainous terrain or forests, or crowded cities, offensive air power produced sub-optimal outcomes. There was difficulty in picking up targets in such terrain.

resources allotted; and, secondly, in terms of rules of engagement. Restrictive rules of engagement at times were analogous to fighting with one hand tied behind the back. The other aspects of topography, bases, technology and targets had unique effects on the employment of air power. When conflicts happened in mountainous terrain or forests, or crowded cities, offensive air power produced sub-optimal outcomes. There was difficulty in picking up targets in such terrain. In cities, there were concerns regarding collateral damage. In plains or deserts with no cover, air power performed brilliantly. Thus, wherever sanctuaries, as described in the previous section existed, the results were sub-optimal. The gap between theoretical reach and practical reach translated into what air power could potentially do vis-à-vis what it could not. However, drones seem to challenge this outcome. Thus, the immunity of guerrillas derived from the sanctuaries of air power is getting diminished due to drones, especially the smaller ones. The next section will explain how this manifests.

DRONE REVOLUTION: A GAME CHANGER IN ACCESS AND REACH

Drones come in all sizes, big and small. They are the only form of DIY (Do-It-Yourself) air power since the early days of air power. Anything, anywhere, can fly now. There are enough videos on social media of the most insane models of drones. In one case, there is a drone made from a discarded wooden crate, with motors on its four sides, a strapped-on battery with an empty Coca-Cola bottle at its bottom. It is just a flying box.[8] Drones can be operated through multiple methods. They can be used for surveillance, transport and even attack as demonstrated by their use in modern conflicts. The smaller ones don't need a runway or sophisticated infrastructure for

8. Tweet by Sam Bendett. Accessed at <https://x.com/sambendett/status/1924466240094896306/ photo/1>

launch. Thus, they can be operated from anywhere. They have now truly liberated air power. Further, some drones, especially the ones that are controlled through fibre optics, can fly inside buildings, tunnels, etc. Thus, the places that manned aircraft could not reach are now within the reach of unmanned platforms, especially the smaller ones.

Drones have effectively expanded the reach of air power inside forests, cities and even tunnels and buildings, destroying the erstwhile sanctuaries. The earlier immunity of guerrillas from air power is now gone.

The aspect of collateral damage has also been solved by the use of First Person View (FPV) drones. Some allegedly have facial recognition features as well. In any case, a trained operator can identify the target and destroy it. In the killing of former Hamas leader Yahya Sinwar, he was identified through a drone flown inside the building where he was staying.[9] Some drones have mini-computers like the Raspberry Pi/ Jetson onboard that offer some Artificial Intelligence (AI) capability, like image recognition.[10] Thus, drones have effectively expanded the reach of air power inside forests, cities and even tunnels and buildings, destroying the erstwhile sanctuaries. The earlier immunity of guerrillas from air power is now gone. However, the theories of employment of air power were developed during the age of manned aircraft. Some of the popular theories of air power, and whether they are compatible with the employment of drones, will be assessed next.

AIR POWER THEORIES

Air power is just over a hundred years old. Therefore, the body of academic work on the subject is also limited. A comparison of some of the prominent theorists of all time reveals that they had a lot of commonalities in their

9. Raw footage of Yahya Sinwar's last moments. Accessed at <https://www.youtube.com/watch? v=YqkSaMuuzzY>
10. n. 8.

ideas.[11] Firstly, they all agreed that control of the air was a prerequisite for the prosecution of all other campaigns. Secondly, they all preferred to engage large or concentrated targets. Trenchard called them "vital centres". Douhet recommended targeting cities and, thereafter, other industrial centres. Billy Mitchell and others at the Air Corps Tactical School came up with the Industrial Web theory, targeting munition factories and other important factories involved in war production. Mitchell encouraged targeting of important communication centres. He also demonstrated the vulnerability of battleships to aerial attacks. Slessor argued for interdiction, that is, military targets beyond the battlefield that feed the war (ammunition, supplies, reinforcements, etc). John Warden, the latest of the theorists, came up with the Five-Rings Warden's model in the late 1980s, which had the enemy leadership at the centre. His outer rings had the important centres, with the fielded military at the outermost ring. Thus, all these cases, except the case of leadership targeting by Warden, relied on vital centres or a concentrated point where the weapon had to be dropped. Thus, they were suitable for the calibre of weapons that the manned aircraft could carry. Or to rephrase it, the theories governing the employment of air power were focussed on hitting strong and big targets. Thus, the aircraft were designed to meet these requirements. Small drones, like the FPV drones, carry explosives that weigh less than an artillery shell but have a precision better than most conventional aerial weapons. However, they do not have a theory of employment. This gap is filled by what the author proposes as the Guerrilla Air Warfare theory.

GUERRILLA AIR WARFARE (GUAWA)

Guerrilla warfare has been employed by many combatants in different conflicts and different forms and is not one single homogenous structure. In a previous article in the *Journal of Defence Studies*, the same author had argued that the ongoing Russia–Ukraine conflict since February 2022 saw

11. David R. Mets, *The Air Campaign: John Warden and the Classical Air Power Theorists* (Air University Press, 1999), pp. 12-61.

the employment of guerrilla warfare principles to their fullest in the aerial domain.[12] In a more recent example, on June 1, 2025, Operation Spider Web by the Ukrainian forces targeting the Russian strategic bombers deep inside Russian territory yet again demonstrated the application of the principles of guerrilla air warfare. The same would be analysed in the following section.

Case Study: Operation Spider Web

Guerrilla warfare principles listed by Mao drew from both ancient and contemporary wisdom of the time. The principles of guerrilla warfare as listed by Mao are[13]:

(a) Mobility, agility and dispersion.
(b) Support from the masses.
(c) Sustenance on local resources.
(d) Successful propaganda.

A guerrilla's actions involve targeting the enemy's rear. During Operation Spider Web, the targeted air bases were deep inside Russia and away from the Ukrainian border. Operators were widely dispersed and mobile. In all, 177 drones were used by clandestine operators deep inside Russian territory.[14] This could be achieved through the mobility and agility offered by the drones. They were dispersed to handle four airfields at widely separated geographic locations. The operation was planned and prepared for over eighteen months. Russian commercial trucks were used to transport the drones in containers, implying support from the masses. Further, President Zelensky claimed that the office of the Ukrainian operation was situated next to one of the Federal Security Service (FSB) offices, further indicating the level of support from the masses. The drone operators supposedly used

12. Pichipoo, Raja, "Assymmetric Air Power: Employing Guerrilla Warfare Principles in Air Warfare," *Journal of Defence Studies*, 18, no. 2, 2024, pp. 68-86.
13. Mao Zedong, *On Guerrilla Warfare* Trans., Samuel B. Griffith, II (Chicago, IL: University of Illinois Press, 1961), pp. 94-114.
14. President Zelensky, X Account. Accessed at <https://x.com/ZelenskyyUa/status/1929279052147265990>

the normal 4G mobile communication networks to operate the drones while staying in Ukraine.[15] This implies the entire sustenance of the operation on local resources—in this case, the local resource being the Russian mobile communication networks. The FPV drones shot videos of burning strategic bomber aircraft. This was of huge propaganda value. Thus, guerrilla air warfare in total was once again manifested in the aerial domain. This time again, it was the Ukrainians who demonstrated the employment of guerrilla air warfare. However, they can be replicated by others. This was indicated by Israel's Operation Rising Lion, which borrowed some aspects of guerrilla air warfare and employed them with some modifications.

IMPACT OF GUERRILLA AIR WARFARE ON FUTURE CONFLICTS

Almost all air power theorists agree on the need for control of the air to be successful in any operation on the surface. However, drones have made it almost impossible to create the desired control of the air. The Israeli Air Force, one of the most potent air forces in the world, during the ongoing Israel-Iran War, has repeatedly appealed to its people to take precautions against air attacks since "air defence is not hermetic"[16]. Drones come in all sizes and shapes. This is a challenge for any radar system since a radar needs to be programmed to the chosen type of target objects it is designed to detect. This is to avoid picking up noise and spurious returns. This challenge exists in terms of target speed as well. Current drones in operation fly as slowly as hover to several hundred kilometres per hour. Another aspect is the low height at which they can fly, which makes them virtually undetected till they are close to the target. Some drones are even flown below the tree-top level, between dense buildings, further preventing any radar from picking them up. Further, the combatants can also saturate any air defence system by launching a large number of drones in a limited geographical space at the same time. Therefore, these limitations imposed on the air defence

15. "How Ukraine's Operation 'Spider's Web' Redefines Asymmetric Warfare". Accessed at <https://www.csis.org/analysis/how-ukraines-spider-web-operation-redefines-asymmetric-warfare>
16. Israel Air Force X Account. Accessed at <https://x.com/IAFsite/status/1936207830656164290>

systems by the drones require a huge variety of air defence systems to tackle them. This is practically not possible due to a lot of other constraints. Thus, even countries with huge conventional air power cannot establish air superiority over adversaries through the guerrilla route. Therefore, in the absence of control of the air, favourable outcomes on the ground cannot be guaranteed. The conflicts can drag on, with no military solutions.

Secondly, since the guerrilla air power cannot be easily defeated, the conventional forces need to think three-dimensionally in setting up their defences. Earlier, like in the case of the Gulf War in 1991, it was possible to carry out sequential operations. First, achieve air superiority and then induct the ground forces into the combat. This is no longer the case, with the emergence of drones. The last time a US soldier on the ground died from an attack by an enemy aircraft was on April 15, 1953.[17] This impeccable record was broken on January 29, 2024, when three US servicemen were killed in a drone attack in Tower 22 in Jordan.[18] Thus, the traditional superiority has been challenged. It would be safe to assume constant harassment from the air as a prominent feature of future conflicts. Traditional classifications of the degrees of control of the air and their impact on ground operations need a rethink.

Thirdly, the air power capability of any country was believed to be the outcome of its industrial and technical capabilities. Countries with large military-industrial complexes dominated the skies and tilted the outcomes in air warfare. This perception was largely influenced by the US experiences in conflicts of the past century. Drones have challenged this belief. Operation Spider Web is a classical example of how basic commercial drones employing guerrilla warfare and using local resources can inflict significant damage on the strategic bombers of an adversary. To execute such an attack using conventional means would have been prohibitively expensive and almost

17. "Air and Space Superiority", Accessed at < https://www.af.mil/News/Article-Display/ article/ 466893/air-and-space-superiority/>
18. "3 U.S. Service Members Killed, Others Injured in Jordan Following Drone Attack", US Department of Defense News, January 29, 2024. Accessed at <https://www.defense.gov/ News/ News-Stories/Article/Article/3659809/3-us-service-members-killed-others-injured-in-jordan- following-drone-attack/>

Drones also provide options for new forms of military-industrial complexes to emerge. In guerrilla warfare, it is essential to rely on local resources or salvage enemy equipment. Both Russia and Ukraine have demonstrated salvaging old ammunition and turning it into ordnance for drones.

impossible, considering the depth at which these are located. A comparison of the effort required can be observed in the same *Marine Corps Gazette* article in 1989. On the aspect of stealth, the article noted, "Today the United States is spending 500 million USD apiece for stealth bombers. A terrorist's stealth bomber is a car with a bomb in the trunk—a car that looks like every other car"[19]. Operation Spider Web used the exact idea when Ukraine used commercial containers and trucks to launch drones into the Russian air bases.[20] It did not have stealth bombers like the B-2, which cost 1.157 billion a piece in (1998 constant) billion dollars.[21] Thus, traditional tools like net assessment that are used to evaluate each country's capabilities and threats need a relook.

Fourthly, drones also provide options for new forms of military-industrial complexes to emerge. In guerrilla warfare, it is essential to rely on local resources or salvage enemy equipment. Both Russia and Ukraine have demonstrated salvaging old ammunition and turning it into ordnance for drones. During Operation Rising Lion by Israel into Iran, the Tasnim News Agency of Iran showed videos of a drone manufacturing unit operated by Israel situated inside Iran[22]. This comprises a defence cottage industry that merges with any other small-scale industry. The other type of industrial structure that is developing is the community-led approach. There have

19. *Marine Corps Gazette*, 1989. Accessed at <https://www.academia.edu/7964013/The_Changing_Face_of_War_Into_the_Fourth_Generation>
20. The video shows a truck loaded with modular cabins setting off on its mission. Accessed at <https:// x.com/KyivPost/status/1930197001209061841>
21. "B-2 Spirit". Accessed at <https://www.af.mil/About-Us/Fact-Sheets/Display/Article/104482/b-2-spirit/>
22. "Security Forces Located a Clandestine Drone-Manufacturing Site in Shahr-e Rey, South of Tehran", Tasnim News Agency, June 16, 2025. Accessed at <https://x.com/Tasnimnews_EN/status/1934378342037287155>

been fund-raisers by volunteers that fund drone development. People contribute their coding time, computing resources or even garage spaces to manufacture drones. This level of local or community participation in the aerospace industry is unprecedented and upsets the existing calculations of how much a country can produce and deploy by merely looking at its military- industrial complex. Another interesting aspect is the speed of innovation. These new industrial models are driven by immediate battlefield needs and are devoid of bureaucratic hurdles that large organisations face. Thus, the rate of innovation is fast. The larger companies are waking up to this reality and are finding ways to absorb some of the innovations into their products.

A counter-measure holiday is the period of arrival of a new technology or weapon and the period when its counter-measure (a weapon or system that can neutralise it) is available. During this period, the new system gives exaggerated results.

WHAT HAPPENS WHEN BOTH SIDES EMPLOY DRONES IN GUERRILLA AIR WARFARE

Edward Luttwak introduced a term, "counter-measure holiday", in one of his interviews that was telecast as a podcast. A counter-measure holiday is the period of arrival of a new technology or weapon and the period when its counter-measure (a weapon or system that can neutralise it) is available. During this period, the new system gives exaggerated results. Over a period of time, counter-measures in tactics and systems are developed that minimise the impact. In an anonymous post on X, it was joked that drones are being shipped to the Russian battlefront alongwith with a box of gingerbread. When the units receive the package, if they find the bread to be spoiled, it is an indication that the counter-measure for the drone in the package is already available on the battlefield. Such is the rapid scale of drone counter-measures development. Therefore, it would be incorrect to extrapolate the initial outcomes to be the future trend. Further, Professor Justin Bronk of RUSI, during a talk, opined that military-industrial complexes have solved

far more difficult challenges like Ballistic Missile Defence (BMD). Therefore, it is only a matter of time before Counter-Unmanned Aerial Systems (CUAS) receive the attention, and appropriate counter-measures are developed.[23]

In the same manner, when both sides copy each other's tactics and employ similar systems, the result can be indecisive. This is even more relevant in the case of unmanned systems. Paul Schare, in his book, *The Army of None*, describes a lab experiment of a simulated conflict between drones. When similar drones were pitted against each other in an autonomous fight, the result was found to be an eventual stalemate[24] because most of the systems, capabilities and algorithms in the fight were almost similar. Thus, even with the proliferation of unmanned systems, it is the human who influences the outcomes. However, a caveat here: on April 14, 2025, for the first time, an autonomous drone beat humans in drone racing. The incident was recorded at the Abu Dhabi Autonomous Racing League (A2RL) and was by an Artificial Intelligence (AI) powered drone developed by a team from the Delft University of the Netherlands.[25] Car manufacturer Tesla also claims that its self-driving cars have a ten-fold safety performance over human drivers from the recorded data.[26] Therefore, while machine vs machine may end in a stalemate, man vs machine might produce different outcomes. Similarly, how each man employs his machine determines the outcome.

The outcome of (man + machine) vs (man + machine) will not be a stalemate.

ILLUSION OF CAPABILITY

A small drone has a fair degree of ease of use. Therefore, getting a drone off the ground is easy even for an amateur. It can fly a pre-defined route and

23. 13th Eminent Speaker Series Talk on The Future of Manned Aircraft by Professor Justin Bronk. Accessed at < https://www.youtube.com/watch?v=IIwCR94BWHI>
24. Paul Scharre, *Army of None: Autonomous Weapons and the Future of War*. (WW Norton & Company, 2018), pp. 17-19.
25. "Autonomous Drone from TU Delft Defeats Human Champions in Historic Racing First", April 15, 2025. Accessed at < https://www.tudelft.nl/en/2025/lr/autonomous-drone-from-tu-delft-defeats- human-champions-in-historic-racing-first>
26. "The Bigger Picture on Autopilot Safety", January 29, 2024. Accessed at < https://www.tesla.com/blog/bigger-picture-autopilot-safety>

execute its mission without any input from the operator. Its controls often resemble the joysticks of video games. These appear so simple to operate that the ease of use is often misconstrued as the operator's capability. Just because it can be handled easily doesn't mean it can be handled at an expert level with ease. This is the illusion of capability that every modern common user device, from smartphones to drones, induces in the unsuspecting user. While a basic smartphone user would be capable of using social media, booking tickets or taking videos using their phone, an expert movie-maker would be able to record, edit and produce high-resolution movies from the same device. Thus, the spectrum of outcomes from the same product varies widely based on the capabilities of the user. Drone competitions have circuits with obstacles like trees, where the operator's skills come into question. Further, a drone operator is also the designer-cum-maintainer-cum-payload expert-cum-operator. Therefore, a combination of such capabilities is essential in a drone combatant. Or a drone team should involve members with these capabilities. The physical capabilities of the proliferated drones are hardly different from each other. What sets them apart is the user's capabilities and tactics. This needs distinct concepts and structures to develop and deploy.

Structural Reforms to Adapt to the Drone Era

Machines are already a part of human lives in more ways than we can imagine. Some of our cognitive load has been taken over by machines, creating dependencies. A study published in *Nature* on the impact of the use of the Global Positioning System (GPS) for navigation by humans concluded that "the greater the use of GPS, the greater the decline in spatial memory over time.[27]" The study also recommended some ways to preserve human navigation skills while using GPS, as spatial orientation is an essential human survival requirement. Thus, a go with the flow approach for

27. Louisa Dahmani, and Véronique D. Bohbot. "Habitual Use of GPS Negatively Impacts Spatial Memory During Self-Guided Navigation," *Scientific Reports*, 10, no. 1, 2020: 6310.

The skill sets required to employ drones on the battlefield effectively are new and different from those of other arms of the military. Some of the skills required include the ability to manage explosives, spectrum (communication), computer programming and flying.

inducting drones on the battlefield can affect survival instincts on the battlefield.

There is significant evidence to establish that drones have transformed warfare. In the ongoing Russia-Ukraine conflict, 70[28]-80[29] per cent of casualties have been caused by drones.

However, this picture is incomplete without assessing how many drones have been expended in the resulting in these casualties. As discussed earlier, the factor that determines the outcomes is not the quality of the machines, but the competence of the operators. The skill sets required to employ drones on the battlefield effectively are new and different from those of other arms of the military. Some of the skills required include the ability to manage explosives, spectrum (communication), computer programming and flying. Therefore, traditional structures won't be optimal, and any battlefield improvisations would not be sustainable in scale. Both Russia and Ukraine had realised this. Ukraine had created the world's first Unmanned Systems Forces on February 6, 2024.[30] What started as a unit became a brigade within the next ten months. This was further reformed on June 20, 2025, bringing all drone units under a single commander, indicating an ongoing process of structural experimentation.[31]

28. "A Thousand Snipers in the Sky: The New War in Ukraine", March 3, 2025. Accessed at <https://www.nytimes.com/interactive/2025/03/03/world/europe/ukraine-russia-war-drones- deaths.html>
29. "Killer Drones Combat Drones Responsible for Almost 80% of all Deaths in Blood-Soaked Ukraine Conflict, Sun on Sunday Probe Reveals", April 17, 2025. Accessed at <https://www.the- sun.com/news/14012701/combat-drones-deaths-ukraine-russia/>
30. "I Signed a Decree Initiating the Establishment of a Separate Branch of Forces—the Unmanned Systems Forces: Address by the President of Ukraine", February 6, 2024. Accessed at < https://www.president.gov.ua/en/news/pidpisav-ukaz-yakij-rozpochinaye-stvorennya-okremogo-rodu- si-88817>
31. "Ukraine Unites Unmanned Systems Forces with top 'Drone Line' Units Under New Command Group", *Kyiv Independent*, June 20, 2025. Accessed at < https://kyivindependent.com/ukraine-creates-new-grouping-of-unmanned-systems-forces/>

The Russian response has been delayed. On June 12, 2025, the Russian president sanctioned the creation of a separate branch of drone troops.[32] Ukrainians, being the conventionally weak side, did not experience significant mental hesitation to deploy guerrilla tactics, whereas the Russians did. That is why a Russian equivalent of Operation Spider Web would possibly never happen, despite Russia possessing better resources than Ukraine to undertake such operations.

Drones have expanded the reach of air power by eliminating the earlier sanctuaries. This has expanded the influence of air power on the conflict outcomes.

In India, the Indian Air Force (IAF) introduced the Weapon Systems Branch in 2022, which comprises a specialised stream of Remotely Piloted Aircraft (RPA)[33] (the nomenclature of unmanned aircraft in the Indian armed forces). This was also the first time since independence when an operational branch was created in the IAF, implying the significance of drones on the modern battlefield.[34]

CONCLUSION

Drones have expanded the reach of air power by eliminating the earlier sanctuaries. This has expanded the influence of air power on the conflict outcomes. The previous failures of air power in insurgencies are now things of the past. Guerrilla air warfare is also now regular, with more sides resorting to such methods. This fundamentally alters the way militaries fight and how military-industrial complexes have influenced air wars. Drones with low entry costs, ease of use, while making air power accessible, are

32 "Russia to Form Drone Troops as Separate Branch of the Military—Putin", TASS News Agency. June 12, 2025. Accessed at < https://tass.com/defense/1972333>

33. "Government Approves Creation of Weapon Systems Branch in Indian Air Force", Press Information Bureau Release, October 8, 2022. Accessed at <https://www.pib.gov.in/PressReleasePage.aspx?PRID=1865989>

34. "India's New Weapons Systems Branch: Key Facts & Figures and What's Special About it", *Economic Times*, October 10, 2022. Accessed at <https://economictimes.indiatimes.com/news/defence/indias-new-weapons-systems-branch-key-facts-figures-and-whats-special-about-it/articleshow/94764450.cms? utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst>

also leading to an illusion of capability. It is the humans who understand and work alongside the machines that determine the outcomes. Therefore, a dedicated effort is needed to learn, adapt and reform the existing structures to suit the new reality. This is the key to producing favourable battlefield outcomes. At this juncture, it would be worthwhile to remember the adage professed by John Boyd, the famous fighter pilot. On the aspect of winning wars, he preached, "It is People, Ideas and Hardware—always in that sequence"[35].

35. James S. Corum, and Wray R. Johnson, *Boyd: The Fighter Pilot Who Changed the Art of War*. (Hachette, 2010), p. 330.