Shifting Paradigms: Navigating Global Air Power Dynamics in The 21st Century—Lessons and A Roadmap for India

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Victory smiles upon those who anticipate the changes in the character of war, not on those who wait to adapt themselves after the changes occur.

– Giulio Douhet

INTRODUCTION

Drones have changed the dynamics of who can project power and in what capacity. In Ukraine, cheap First-Person View (FPV) drones and Loitering Munitions (LMs) have been used very effectively against the enemy front lines and the coordination and medical evacuation efforts.[1] In India, the use of drones and

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1. "War and the Modern Battlefield: Insights from Ukraine and the Middle East", Centre for Strategic and International Studies (CSIS), May 28, 2025, https://www.csis.org. Accessed on September 29, 2025.

anti-drone systems was widely observed during Operation Sindoor, and they played an important role as key elements of air operations. The Houthi drone strikes impacted commercial ships in the Red Sea, leading to the re-routing of ships and multinational naval responses against them.[2] These shifts align with the rapid pace of advancement in autonomous Artificial Intelligence (AI) systems and human-machine teaming. This forms the cornerstone of projects such as the Air Combat Evolution (ACE) programme, where the X-62A Variable In-flight Simulation Test Aircraft (VISTA) conducts AI-versus-human dogfight tests.[3] Air power is transforming due to the widespread use of the Unmanned Aerial Systems (UAS) and AI. These have reduced decision cycles, expanded the range of combat missions and moved the risk away from manned aircraft.

THE SPECTRUM OF CONFLICT AND DRONE ROLES

Conventional warfare has become hybrid, blending grey zone tactics with conventional combat. Wars have become continuous and protracted, as seen in the Ukraine-Russia and Israel-Hamas conflicts. The concept of No War, No Peace (NWNP) has become irrelevant due to the induction of AI and drones in the case of the major military powers. Air power is central to these conflicts, as it has both deterrence and offensive capabilities due to its reach and faster deployment capabilities.

Conventional Warfare: Drones are capable of constant Intelligence, Surveillance and Reconnaissance (ISR). They can assist with artillery cueing and precision strikes using low-cost

2 "The Houthis' Red Sea Attacks Explained", International Crisis Group. Accessed on October 4, 2025.

3. United States of America Air Force Research Laboratory, "USAF Test Pilot School and Defense Advanced Research Projects Agency (DARPA) Announce Breakthrough in Aerospace Machine Learning", April 17, 2024, https://www.darpa.mil, Accessed on September 29, 2025.

munitions, leading to deep strikes. Ukraine has demonstrated a rapid pace of innovation and the use of drones not just for recreational purposes, but as heavier FPV combat aerial systems.[4]

Hybrid Warfare: In Nagorno Karabakh, Azerbaijan used drones and LMs for ISR, and to target air defences and armour.[5]

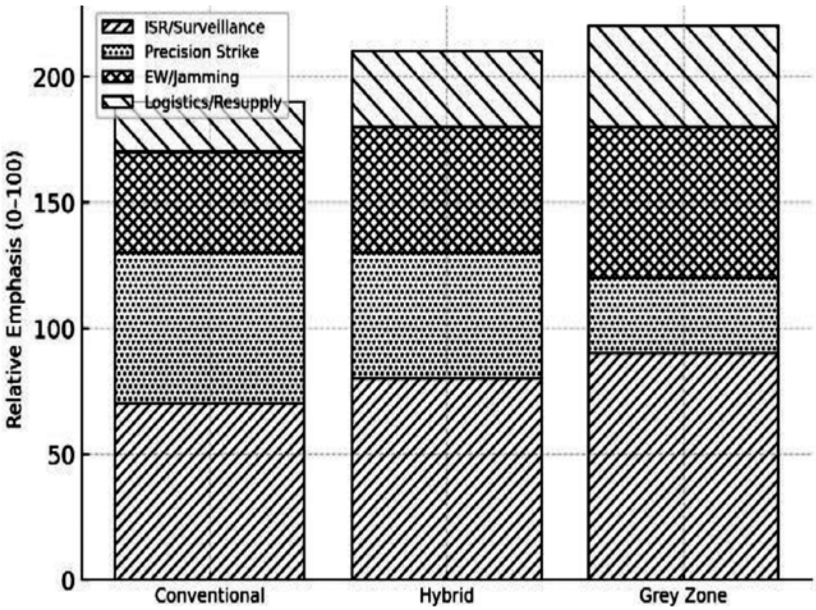
Grey Zone Conflict: LMs and hobby drones can enable coercion, which is short of open war. This was observed in the Red Sea crisis.[6]

DRONE MISSIONS ACROSS CONFLICT TYPES

Fig 1 illustrates the different types of missions across conventional, hybrid, and grey zone conflicts where drones have been used. This reveals a consistent pattern despite the different nature of these conflicts. Most drone use is for ISR in all three types of conflicts. This underscores their critical role in generating Situational Awareness (SA) and their use for targeting. Precision strike is the second-highest use case. This reflects the value of drones in delivering just-in-time firepower with precision. Electronic Warfare (EW) and jamming capabilities comprise another use case of drones/UAS. This highlights the importance of drones in disrupting enemy systems. Logistics remains a smaller but more important use case for drones, which can help sustain operations.

4. "The Russia-Ukraine Drone War: Innovation on the Frontlines and Beyond", Centre for Strategic and International Studies (CSIS), May 28, 2025, https://www.csis.org. Accessed on September 29, 2025.
5. Eado Hecht, "Drones in the Nagorno–Karabakh War: Analyzing the Data," *Military Strategy Magazine*, Vol. 7, No. 4, 2022; Phillip Andrews, "Lessons from the Nagorno-Karabakh 2020 Conflict," August 2021.
6. Kevin D. McCraine, "Lessons from the Red Sea: Considerations for Naval Strategy in the 21st Century", US Naval Institute, May 2024.

Fig 1: Drone Mission Emphasis Across Conventional, Hybrid and Grey Zone Conflicts



Source: Author's synthesis.[7]

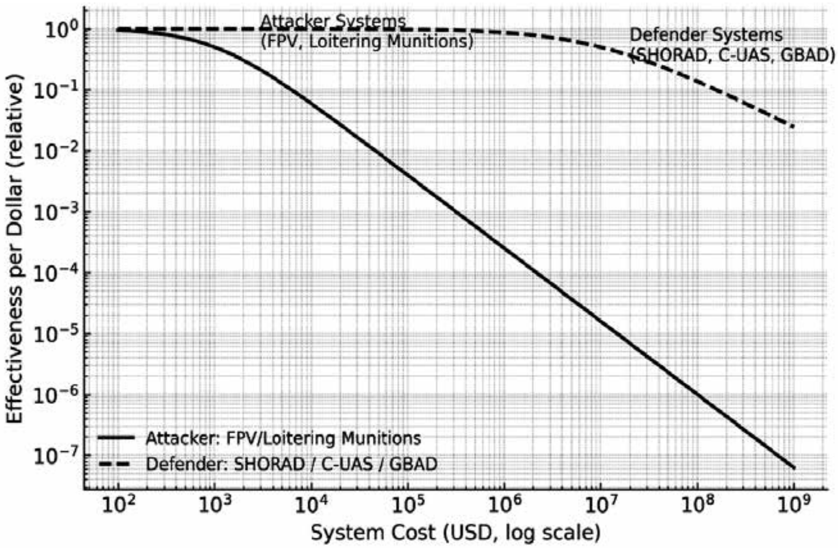
COST–EXCHANGE DYNAMICS IN DRONE WARFARE

The cost–exchange dynamics in drone warfare brings out that low-cost FPV drones and LMs achieve peak effectiveness per dollar at the lower end of the cost matrix (≈10^2–10USD). This is achieved by forcing defenders to counter cheap drones with expensive Counter-UAS (CUAS) systems. Defensive systems, such as Short-Range Air Defence (SHORAD), CUAS and Ground-Based Air Defence (GBAD), show efficiency in the mid-cost range (≈10–10USD). They achieve this through a system of layered defence structures, sensor–shooter integration, and cheaper

7. Phillip Andrews, "Lessons from the Nagorno-Karabakh 2020 Conflict", August 2021; "The Global Economic Consequences of the Attacks on Red Sea Shipping Lanes", Centre for Strategic and International Studies (CSIS), May 28, 2025; n. 2.

munitions. However, both attackers and defenders experience diminishing returns beyond ≈10USD. This is due to the fact that the procurement and sustainment costs start to outweigh the gains achieved by marginal capability increases. Strategically, the attackers benefit from saturation tactics, while the defenders must invert the cost curve by fielding low-cost/high-volume interceptors (hard kill), soft kill solutions like jamming, and adopting multilayered defences. For policy-makers, avoiding the "USD-1M vs USD-1K" trap demands procurement strategies and Research and Development (R&D) priorities that align capability with cost.[8]

Fig 2: Illustrative Cost–Exchange Dynamics in Drone Warfare



Source: Author's model.[8]

8. "High-Tech Drones Turn Ukraine's Front Line into a Deadly Kill Zone, Complicating Evacuations," Associated Press, August 17, 2025; IQPC/IDGA, The US Counter Unmanned Aerial Systems Market Report, 2024–2029.

EVIDENCE OF GROWING USE OF UAS FROM RECENT CONFLICTS

Ukraine–Russia War

The Ukraine–Russia War in recent times, become the most drone-intensive conflict in history. Ukraine has employed the Turkish Bayraktars (TB-2s), European systems and indigenous drones; their main use has been for ISR and precision strikes against Russian ammunition dumps, oil depots, and aircraft on the ground. Russia has been responding with drone tactics by combining the Orlan-10 reconnaissance Unmanned Aerial Vehicles (UAVs) with the Lancet LMs to cause interdiction effects.[9]

Nagorno-Karabakh

During the Nagorno-Karabakh War in 2020, the use of drones in the conflict between the two countries came into prominence. The Azerbaijani forces used the Bayraktar TB-2s from Türkiye and Harop drones from Israel to attack the Armenian forces and defence systems. Although UAVs were useful, artillery and Electronic Warfare (EW) still played crucial roles in this conflict.[10]

Red Sea—Houthi Campaigns

The Red Sea is an important route for commercial shipping lanes. Ships were targeted in the Red Sea by the Houthi rebels using drones supplied by Iran. They not only targeted commercial ships but also Saudi oil infrastructure with drones. These UAVs led to re-routing of international maritime traffic, hence, increased cost.

9. Jack Watling and Nick Reynolds, *Ukraine at War: Paving the Road from Survival to Victory* (London: Royal United Services Institute, 2022). Accessed on September 29, 2025.
10. Michael Kofman, "The Second Nagorno-Karabakh War, Two Weeks In," *War on the Rocks*, October 2020, https://warontherocks.com. Accessed on September 29, 2025.

Use of drones in this case amplified their increasing use of grey zone strategies by non-state actors.[11]

Syrian Civil War

The Syrian insurgent groups such as the Islamic State of Iraq and Syria (ISIS) modified commercial drones for the delivery of bombs; meanwhile, Russia employed the Orlan-10 and Forpost UAVs to provide ISR and for spotting enemy artillery to help the Syrian forces. This conflict highlighted both innovation by the insurgent groups and adaptation of UAS for conventional military use.[12]

Libyan Civil War

The Libyan War became a significant case study as it was the first battlefield where opposing groups engaged in drone-on-drone warfare. The United Arab Emirates (UAE) backed Libyan National Army (LNA) faction used the Chinese Wing Loong II drones. Meanwhile, the Government of National Accord (GNA) faction used the Bayraktar TB-2s supplied by Türkiye. This war led to an environment of UAV-driven proxy conflict.[13]

Ethiopia–Tigray Conflict

In Ethiopia, the government forces depended on the TB-2s supplied by Türkiye, along with the Mohajer-6 from Iran and Chinese drones to strike the Tigray People's Liberation Front (TPLF) forces. Drone operations shifted the momentum toward

11. Jean-Loup Samaan, "Missiles, Drones, and the Houthis in Yemen," *Parameters*, 50, No. 4, Winter 2020–21, pp. 25–36, https://press.armywarcollege.edu/parameters/vol50/iss4/10/. Accessed on September 29, 2025.
12. Wim Zwijnenburg, *Unmanned Ambitions: Turkey's Drone Program and Its Implications in Syria and Beyond* (Utrecht: PAX for Peace, 2020), https://paxforpeace.nl. Accessed on September 29, 2025.
13. Eric Schmitt, "In Libya's Proxy War, Drone Combat Shows the Future of Warfare", *The New York Times*, November 19, 2020, https://www.nytimes.com. Accessed on September 29, 2025.

the government and its victory. This highlights the strategic impact of UAVs in civil wars.[14]

Yemen Civil War

The Houthi rebels have been using the Iranian-supplied UAVs such as the Qasef and Samad variants to target Saudi Arabia since 2015. In 2019, they conducted the Abqaiq–Khurais attack on the Saudi Aramco facilities and demonstrated how drones could deliver strategic impact at low cost.[15]

Sudan

The Sudanese Armed Forces (SAF) and the Rapid Support Forces (RSF) used commercial drones for ISR and carrying out strikes in urban areas against each other. This demonstrates the fast pace of adoption of UAVs in irregular warfare.[16]

China

China has integrated drones into its South China Sea strategy for ISR. It has also become a global UAV exporter. Exports primarily comprise the Wing Loong and CH-series systems, widely sold to the Middle Eastern states. These are reshaping regional military balances.[17]

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14. "Crisis in Ethiopia: The Drone Factor", International Crisis Group, https://www.crisisgroup.org. Accessed on September 29, 2025.
15. Michael Knights, "The 2019 Saudi Aramco Attacks: The Strategic Logic Behind Houthi Drone Warfare," *Policy Watch* 3176, Washington Institute for Near East Policy, September 2019, https://www.washingtoninstitute.org. Accessed on September 29, 2025.
16. Kathryn Tyson, "Drones Over Sudan: Foreign Powers in Sudan's Civil War," *Critical Threats* (American Enterprise Institute), January 27, 2025, https://www.criticalthreats.org/analysis/drones-over-sudan-foreign-powers-in-sudans-civil-war. Accessed on September 29, 2025.
17. Francesco F. Milan and Aniseh Bassiri Tabrizi, "Armed, Unmanned, and in High Demand: The Drivers behind Combat Drones Proliferation in the Middle East," in Ash Rossiter, ed., *Robotics, Autonomous Systems and*

Pakistan

Pakistan has developed the Unmanned Combat Aerial Vehicle (UCAV) such as the Burraq, which it has been using against militants since 2015. Pakistan has also deployed UAVs for ISR along the border with India. This signals the integration of drones into both counter-insurgency and inter-state rivalry.[18]

During Operation Sindoor, the Pakistan Air Force used UAVs such as the Asisguard Songar and YIHA-III LMs in swarms. Their primary role was reconnaissance, spotting radar and mass saturation strikes. India's multi-layered Air Defence (AD) systems, such as the Akash Teer, CUAS and AD guns neutralised most of them, thus, making the attacks ineffective.

India

India has acquired Heron drones from Israel and is in the process of getting the MQ-9 B from the USA. Further, the Indian defence forces are pursuing the development of indigenous armed UAVs to strengthen their capabilities. UAVs have become a key component of India's posture against Pakistan and China along contested borders.[19]

Europe

The UK, France and Italy in Europe have used the Reaper drones in Mali, Iraq and Syria for anti-terrorism operations. Meanwhile, Europe has started initiatives like the Euro Medium-Altitude-

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Contemporary International Security (London: Routledge, 2020), pp. 33–54, https://doi.org/10.4324/9781003109150-3. Accessed on October 9, 2025.

18. Rizwana Abbasi and Muhammad Saeed Uzzaman, *Changing Patterns of Warfare between India and Pakistan: Navigating the Impact of New and Disruptive Technologies* (London: Routledge, 2023), https://doi.org/10.4324/9781003340171. Assessed on September 29, 2025.
19. Ben Schneider, "India's Drones: Assessing the Rationale for Unmanned Aerial Vehicle Acquisition," *Cornell International Affairs Review,* 12, no. 1, 2018, pp. 47–62, https://journals.library.cornell.edu/tmpfiles/CIAR_12_1_2.pdf. Accessed on September 29, 2025.

Long-Endurance (MALE) programme with the aim of reducing dependence on US and Israeli systems.[20]

Iran

Iran has developed many types of drones such as the Shahed and Mohajer, as part of its strategy. It has deployed them in Iraq and Syria and is also supplying them to proxies such as Hezbollah, Hamas, and the Houthis. It famously captured a US RQ-170 Sentinel in 2011 and reverse-engineered its design.[21]

USA

The USA had pioneered the use of drones in counter-terrorism operations. Its main UAS systems in operation in Pakistan, Yemen, Somalia, and Afghanistan are the MQ-1 Predators and MQ-9 Reapers. Today, the US doctrine focusses on UAVs for great-power dynamics against China and Russia.[22]

UCAV AUTONOMY VS CENTRALITY OF MANNED FIGHTERS

While UCAVs are maturing rapidly, their ability to function as fully autonomous strike platforms will still take time. This is due to the limitations of the technology, certification of AI systems, concerns about ethical use, and challenges to the integration of doctrines at present. AI in UCAVs is advancing toward greater autonomy in domains such as autonomous navigation, electronic

20. Dominika Kunertova, *Military Drones in Europe: The European Defense Market and the Spread of Military UAV Technology* (Odense: Centre for War Studies, University of Southern Denmark, 2019), https://portal.findresearcher.sdu.dk/files/159305039/CWS_Military_Drones_in_Europe_Report.pdf. Accessed on September 29, 2025.
21. A. Walter Dorn, Sarah Kreps, and Loch K. Johnson, "Intelligence and Drones," *Intelligence and National Security*, 32, No. 4, 2017, pp. 435–445, https://doi.org/10.1080/02684527.2017.1303127. Accessed on September 29, 2025.
22. Michael J. Boyle, "The Race for Drones," *Orbis,* 59, No. 1, 2015, pp. 76–94, https://doi.org/10.1016/j.orbis.2014.11.002

warfare capabilities and autonomous release of weapons. However, human oversight will remain central for complex decision-making and compliance with the rules of engagement.[23] Moreover, UCAVs alone are unlikely to deliver decisive outcomes in conventional wars. This is because adversaries are employing layered air defences and both hard and soft kill counter-drone measures, thus, reducing their effectiveness.[24] In future, UCAVs will collaboratively work alongside manned aircraft by extending their reach, time over target, and increasing their survivability in contested environments. Fighter aircraft will remain central in air dominance due to their weight of attack and multi-role capabilities. Meanwhile, UCAVs and Collaborative Combat Aircraft (CCA) will act as force multipliers within integrated formations.[25]

Future Role of Fighters and Other Military Aircraft

Fighters are evolving from 'solo hunters' to 'team quarterbacks' that orchestrate shooters and sensors across a distributed formation. In the near term, fifth/sixth generation fleets will lead CCAs and Air Launched Effects (ALEs). By 2035+, aircraft may be 'pilot-optional' in select missions, with autonomy shouldering more navigation, EW and weapons employment tasks.[26] Bombers become arsenal nodes, Airborne Warning and Control System (AWACS) such as the E7/E2D aircraft function as high-bandwidth Command and Control (C2) relays; maritime patrol aircraft guide

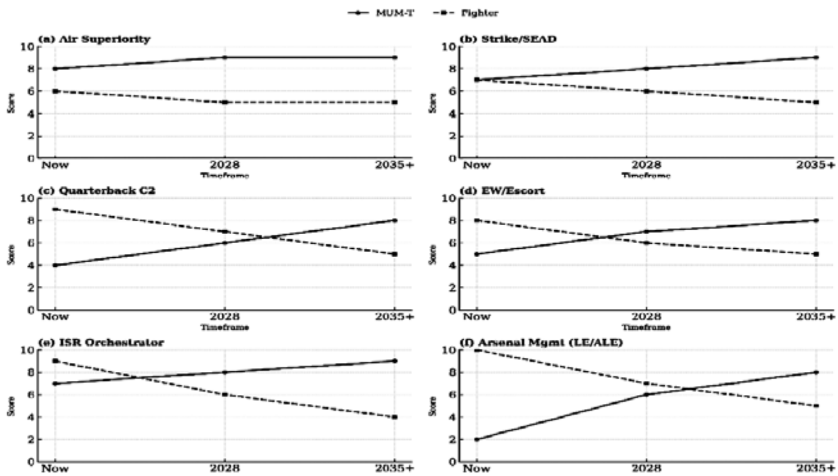
23. United States Air Force, "Autonomous Horizons: The Way Forward", ST TR-15-01, June 2015, https://www.af.mil/Portals/1/documents/SECAF/AutonomousHorizons pdf. Accessed on September 29, 2025.
24. International Institute for Strategic Studies (IISS), *The Military Balance 2023* (London: IISS, 2023).
25. Jeremiah Gertler, *Air Force Next-Generation Air Dominance: Background and Issues for Congress* (Washington, DC: Congressional Research Service, 2022).
26. Sinéad Baker, "The F-35 Could Be 'Pilot Optional' in the Not-Too-Distant Future, Lockheed Martin CEO Says," *Business Insider*, May 30, 2025. Accessed on October 26, 2025, https://www.businessinsider.com/f35-stealth-fighter-to-fly-without-a-pilot-lockheed-ceo-2025-5. Accessed on September 29, 2025.

CCAs for sea denial and aircraft employ ALEs for reconnaissance, targeting and decoying.[27]

MUM-T Concepts and Architectures

Manned-Unmanned Teaming (MUM-T) utilises secure datalinks, software autonomy, and human-in-the-loop control, to distribute risk and multiply effects. Launched Effects/Air Launched Effects (LEs/ALEs) enhance ISR and EW capabilities. At present, air forces are pursuing CCAs with modular payloads. A key design principle is to keep humans focussed on command while delegating sensing, navigation and subtasks to autonomy [28] (DARPA, 2024; Army.mil, 2025)

Fig 3: Future Fighter Roles with Growing MUM-T



27. Jon Harper, "Army Issues Solicitation for 'Launched Effects' Autonomous Drones," *Defense Scoop*, August 6, 2025, https://www.defensescoop.com/2025/08/06/army-launched-effects-solicitation-autonomous-drones/. Accessed on September 29, 2025.
28 Air Combat Evolution (ACE) Programme Update, Defense Advanced Research Projects Agency, 2024, https://www.darpa.mil; United States of America Army, "Army UAS and Launched Effects Summit Begins at Fort Rucker," August 12, 2025, https://www.army.mil. Accessed on September 29, 2025.

The Projected Role Balance of MUM-T Versus Fighter Aircraft Across Mission Areas: Data illustrates the growing importance of MUM-T from the present through 2028 and 2035+, with MUM-T surpassing traditional fighter roles across air superiority, strike/Suppression of Enemy Air Defences (SEAD), quarterback C2, EW/escort, ISR orchestrator, and arsenal management (LEs/ALEs).

GROWTH OF LOYAL WINGMAN / CCA AND MUM-T

United States: In 2025, the US Congress began evaluating the need for the CCA programme. This laid emphasis on autonomy, with incorporation of AI, survivability in highly contested environments, and integration with legacy platforms. Initial plans designated the F-22 Raptor as the lead manned aircraft for teaming with the CCA. This set the stage for advanced manned-unmanned operations in contested airspace.[29]

Australia: Boeing and the Royal Australian Air Force (RAAF) successfully demonstrated the control of two MQ-28 Ghost Bat autonomous aircraft, along with a third digital twin. The airborne E-7A Wedgetail was a manned platform during a live trial over Woomera, South Australia.[30]

Europe: Airbus' remote carriers are AI-enabled drones (stealthy or non-stealthy) designed to support crewed fighters like the Next Gen Fighter (NGF). They will perform tasks such as reconnaissance, electronic warfare and strikes. This was revealed in July 2024 as part of the Future Combat Air System (FCAS)/ Système de Combat Aérien du Futur (SCAF) programme. This

29. Congressional Research Service (CRS), *Collaborative Combat Aircraft: Congressional Considerations*, 2025; "Initial Integration Plans Designate the F-22 as the Lead Platform," *The War Zone*, July 3, 2025.
30. Stephen Kuper, "RAAF's MQ-28 Ghost Bat Advances Autonomous Teaming Missions," *Defence Connect*, July 18, 2025. https://www.defenceconnect.com.au. Accessed September 26, 2025

marks a key step in Europe's push for autonomous air combat systems.[31]

Türkiye: In 2025, Türkiye began serial production of its Kızılelma UCAV and successfully evaluated the ANKA-3 as a loyal wingman, hence, advancing its autonomous air combat capabilities.[32]

Russia: Russia's advanced S-70 (Okhotnik) got shot down over Ukraine. This highlighted the need to adapt to CUAS systems in contested areas. However, by mid-2025, the Russian forces adapted their drone tactics and started using stealth UCAVs, FPVs and LMs to attack Ukrainian supply lines. They, thus, achieved effects like battlefield air interdiction in contested airspace.[33]

China: China's MUM-T strategy combines artificial intelligence innovation with centralised command. Multiple CCA and UCAV designs are emerging for the People's Liberation Army Air Force (PLAAF). RAND observes that this reflects a software-centric approach to MUM-T.[34]

India: Hindustan Aeronautics Limited (HAL) displayed the Combat Air Teaming System (CATS) during the recently held Aero India. This brought into focus its role in the future MUM-T

31. Airbus, "Remote Carriers Unveiled as Part of FCAS/SCAF Program," *The War Zone*, July 2024, https://www.airbus.com/en/newsroom/stories/2024-07-remote-carriers-unveiled-as-part-of-fcasscaf-program. Accessed on September 29, 2025.
32. "Turkey Has Begun Serial Production of the Kızılelma Unmanned Combat Aircraft," *Defense Post*, March 2025; "Turkey's ANKA-3 Demonstrates Wingman Tests," *Tur Def*, 2025.
33. Tyler Rogoway, "Russia's S-70 'Hunter' Drone Was Reportedly Shot Down in Ukraine," *The War Zone*, November 8, 2024, "Russian Drone Innovations Are Achieving Effects Akin to Battlefield Air Interdiction," Institute for the Study of War (ISW), August 7, 2025.
34. "The People's Liberation Army's Approach to MUM-T," RAND Corporation, August 12, 2025; Warren, A., and A. Hillas. "'Xi Jinping Thought': Lethal Autonomous Weapons Systems and Military Modernization with Chinese Characteristics," *The Journal of International Relations Research*, 2022.

with the Tejas, and its importance for India's modernisation.[35] New Space Research & Technologies (NRT) is developing the Combat Air Vehicle (N-CCAV) for naval requirements[36]

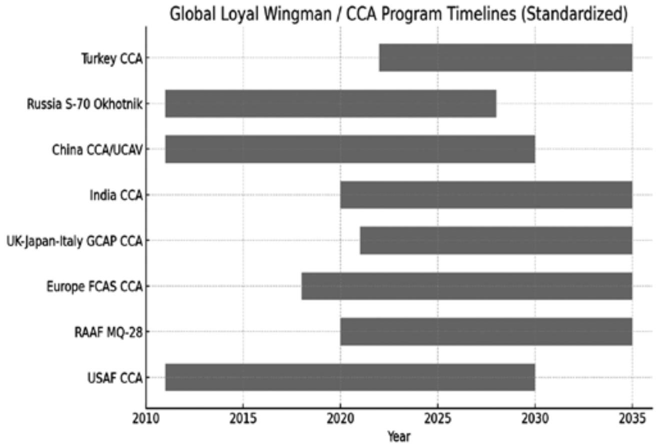
Furthermore, India is acquiring the MQ-9B for ISR and targeting. Also, the Defence Research and Development Organisation (DRDO) is developing the High-Altitude-Long-Endurance (HALE)/Medium-Altitude-Long-Endurance (MALE) UAS as well as potent Counter-Unmanned Aircraft Systems (CUAS).

GLOBAL LOYAL WINGMAN/CCA PROGRAMME TIMELINES

The global race to develop loyal wingman and CCA platforms reflects a definite shift in air power strategy, with major programmes advancing in parallel, though on different timelines. The US Air Force's (USAF's) CCA/NGAD (Next Generation Air Dominance), Australia's MQ-28 Ghost Bat, Europe's Future Combat Air System (FCAS) remote carriers, and the UK–Japan–Italy Global Combat Air Programme (GCAP) aim to integrate autonomous, stealthier, and networked UCAVs into future force structures by the mid-2030s. Emerging powers like India and China, Russia and Türkiye are also investing heavily into CCAs, highlighting the strategic importance of MUM-T. Fig 4 illustrates the progress in these domains. During this period, operational readiness, interoperability, and doctrinal innovation will determine which nations will have a decisive edge in contested air domains in the future.

35. "First Public Appearance for HAL CATS Warrior Autonomous UCAV at Aero India 2025," *EDR Magazine*, February 12, 2025;"Aero India 2025 – Momentum Towards the Future," *Royal Aeronautical Society*
36. Indian Navy Collaborates With New Space To Develop Loyal Wingman," *Marine Insight*, February 11, 2025, Accessed on October 26, 2025, https://www.marineinsight.com/shipping-news/indian-navy-collaborates-with-newspace-to-develop-loyal-wingman. Accessed on September 29, 2025.

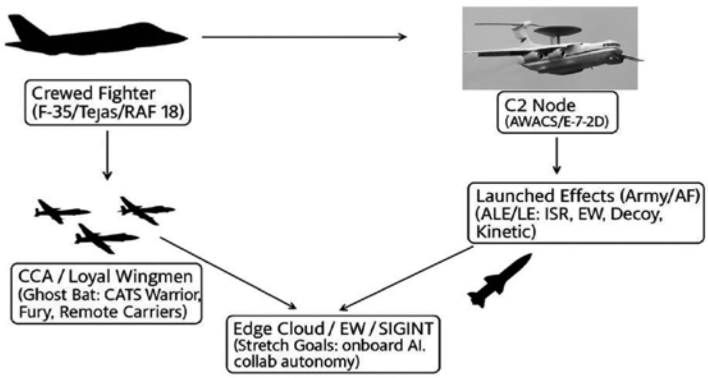
Fig 4: Global Timelines of the Loyal Wingman and CCA



Source: Author's compilation.[37]

MUM-T CONCEPT IN NETWORK-CENTRIC WARFARE

Fig 5: Conceptual Model of Manned–Unmanned Teaming in Network-Centric Warfare



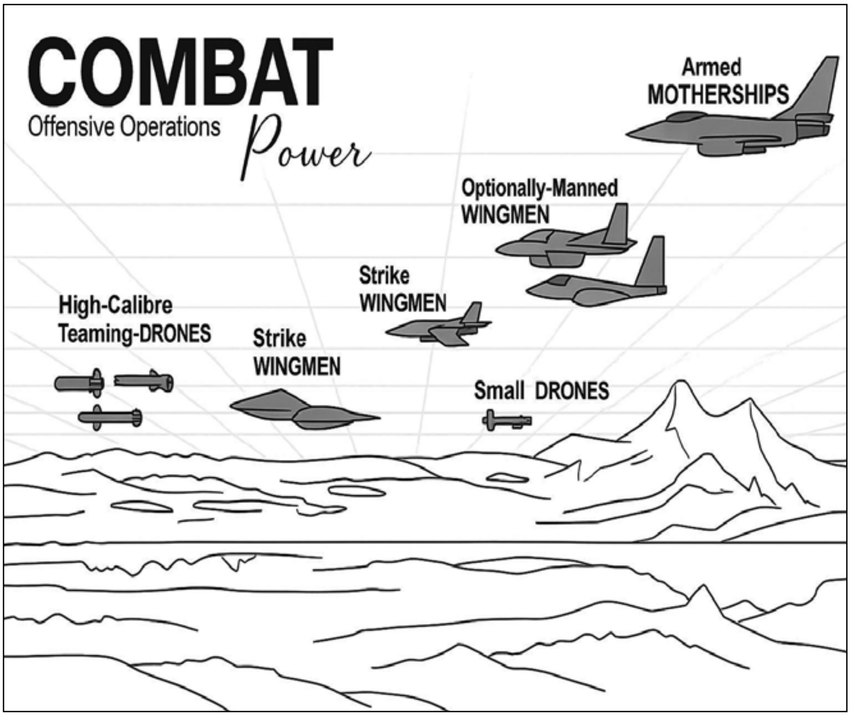
Source: Author's schematic.

37. "Remote Carriers Unveiled as Part of FCAS/SCAF Program," *The War Zone*, July 2024; "Boeing and the Royal Australian Air Force Demonstrated the MQ-28 Operating Alongside the E-7A Wedgetail," Boeing, June 16, 2025; Congressional Research Service (CRS), *Collaborative Combat Aircraft: Congressional Considerations*, 2025; "The People's Liberation Army's Approach to MUM-T," RAND Corporation, August 12, 2025.

Combat with CCA

Fig 6 below vividly captures the future of air warfare, highlighting a layered ecosystem of crewed and unmanned assets working in coordination over contested terrain. This concept involves 5th generation armed motherships, stealthy UCAV/optionally piloted wingmen, swarming drones and autonomous high-calibre teaming platforms. The image reflects a shift to autonomous coordination and multi-domain integration to distribute risks and increased weight of attack. This highlights how the future of air combat will unfold . This will rely on seamless human-machine teaming and real-time battlefield intelligence.

Fig 6: Illustrative Concept of Combat Power in Operations Using MUM-T and CCA

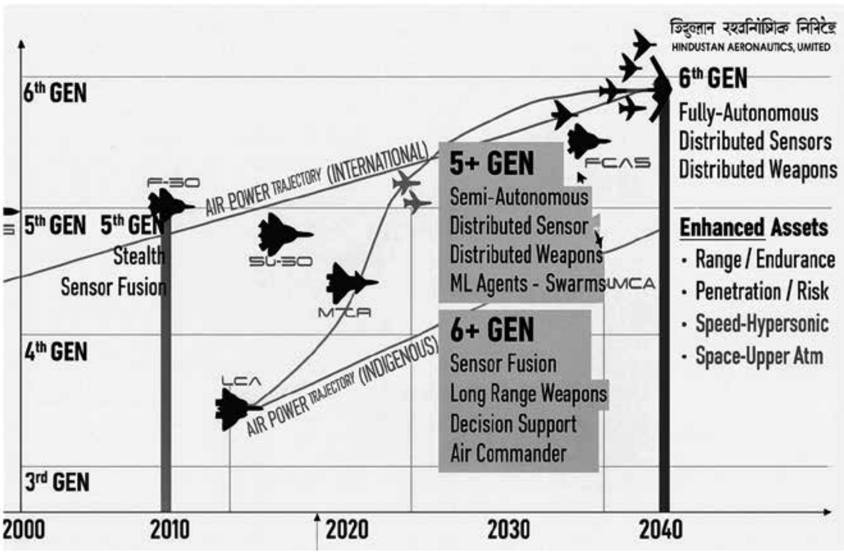


Source: Author's schematic inspiration from New Space Research & Technologies (NRT)

PRESENT GROWTH PATHS IN CCA: WORLD VS INDIA

The timelines in Fig 7 trace the evolution of fighter aircraft from the 4th to the 6th generation globally. This highlights the widening gap between international and Indian air power trajectories. The visual highlights the need for India to accelerate innovation and close the capability gap through indigenous programmes such as sensor data fusion, secure data links, long-range sensors and weapons AI pilots, Advanced Medium Combat Aircraft (AMCA) and collaborative ventures.

Fig 7: Illustrative Timelines for Induction of Offensive Operations Using MUM-T and CCA



Source: Schematics from *HAL Magazine*.

A TIME-PHASED ROADMAP FOR INDIA

The expansion of private industry in India's unmanned and autonomous systems aligns with global innovations in the field. The approach is for state support and military patronage to enable private-sector contributions, which is the worldwide trend too. Unlike manned platforms, unmanned systems face fewer certification barriers, thus, creating space for frequent iterations and development. This is achieved especially by the Micro, Small, and Medium Enterprises (MSMEs) and Information Technology (IT) driven firms. India's large domestic market for UAS spans defence/police and counter-insurgency requirements. Along with India's strengths in IT, AI and swarm technologies, it provides a solid foundation in this domain. Still, a sequenced roadmap is essential for rapid development.

Near-Term (0–2 Years): During the near future, the scale FPV and loitering munition inventories can create UAS defence units with assured spares and repair chains. Also, focus is needed on deploying layered CUAS with clear Rules of Engagements (ROEs). Further, the focus should be on expanding Live, Virtual, and Constructive (LVC) training. Integrating UCAV/UAS feeds of all Services into common C2 (Integrated Air Command and Control System) systems through secure software-defined radios is crucial to achieving this.

Mid-Term (3–5 years): The focus shifts to integrating UAS/UCAVs into the tri-Services as part of the doctrine. Roles include maritime ISR, high-altitude surveillance, and advancing HAL's CATS/private/DRDO CCA prototypes through flight trials. Focus on localising critical components [sensors, motors, engines, batteries, optics, Electro-Optical/Infrared (EO/IR), data links, navigation sensor blocks, Radio Frequency (RF) hardware] with high production capacity.

Long-Term (6–10 years): Emphasis should be on teaming with UCAVs and drone swarms. Further development of "software-defined force" practices for modular upgrades and hardening infrastructure with Unmanned Traffic Management (UTM), resilient CUAS frameworks and secure data links/communications.

The indigenous development of sensors, secure data links, anti-jam antennas, semi-conductors, Micro-Electro-Mechanical Systems (MEMS), nano-electronics, engines, and advanced batteries is crucial to achieve the above timelines. There is a need to combine diplomatic measures to secure the supply chain for these, as it will be a decisive factor.

CONCLUSION

Drones have the capacity to redistribute power between stronger adversaries and small players. This they can achieve by compressing the distance between innovation at the tactical levels, as the strategic effects. Fighters are evolving into rear guards of distributed formations, while CCAs and ALEs provide mass and survivability. For India, the path runs through scaled expendable mass, links and ISR, loyal wingman teaming, and layered CUAS/AD, underpinned by interoperable data doctrine, industry support and regulations.