Journal of Aerospace & Security Studies
2022 | Volume I | pp. 21-35

Evolving Role of UAVs: A Case of Pakistan

Abdullah Rehman Butt

Abstract

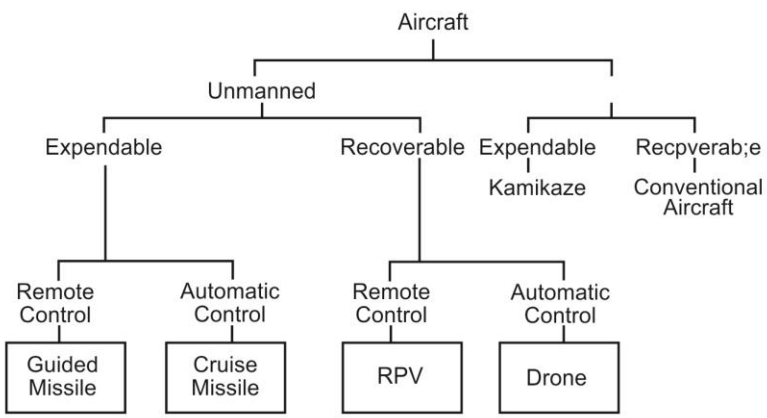
The use of Unmanned Aerial Vehicles (UAVs) has grown significantly in recent years. Because of their efficiency, precision, low cost, and lower risk, UAVs have seen rapid adoption in civil, commercial, and military sectors. The vast array of their applications, spanning from entertainment to national security, has prompted global technology giants and governments to invest in this field. Their role will continue to develop as technology advances and they are likely to become more effective, safer, and dependable in the future. In Pakistan, UAVs are being used in the civil and military domains. This paper aims to shed light on the evolving role of UAVs in both these domains, shed light on Pakistan's existing UAV capabilities and their applications, and suggest a way forward for the country to get maximum gains out of this technology in the future.

Keywords: Unmanned Aerial Vehicles, UAVs, Drones, Military, National Security.

Introduction

Unmanned Aerial Vehicles (UAVs) have evolved and impacted every facet of human life over the last few years. The revolution in this technology domain is not only changing the human perception of traditional real-time data collection, transportation, and logistics but also about how future wars will be fought. Owing to their evolving role and versatile applications, there exists no universally accepted definition of UAVs. Likewise, it is arduous to distinguish between various types because of their overlapping characteristics. However, the US Army Doctrine Reference Publication (ADRP) defines UAV as 'an aircraft that does not carry a human operator and is capable of flight with or without human remote control.'[1] However, UAVs are only one element of a large group of aerial platforms and vehicles. These are further divided into two categories as shown in Figure 1:

Figure 1: Manned and Unmanned Aircraft Family Tree



Source: Michael Armitage, *Unmanned Aircraft* (London: Brasseys, 1988).

[1] *ADP 1-02 Terms and Military Symbols*, report (Washington, D.C.: Headquarters Department of the Army, August 14, 2018), fas.org/irp/doddir/army/adp1_02.pdf.

Expendable unmanned aircraft include aerial vehicles that cannot be redeemed after their usage, e.g., cruise missiles. While others are recoverable, UAVs, that are further classified into two categories, i.e., drones and Remotely Piloted Vehicles (RPVs), cannot be. A drone can be best defined as 'an autonomous and automatic pilotless aircraft that carries at least a mechanism to sustain stable flight or its course will be programmed some way.' While an RPV can be described as 'a pilotless aircraft that transmits mission-related data to a remote controller and reacts to his command and inputs.'[2] The boundaries between the different types of UAVs are still ill-defined, because some have features of both the aforementioned categories and degree of autonomy sometimes also varies. In this paper, the term 'UAVs' will be used for recoverable Unmanned Aerial Vehicles.

Over the past few years, there has been a significant increase in the applications of UAVs. Because of their efficiency, accuracy, low cost, and lesser risk, their adoption rate has seen momentous growth in civil, commercial, and military domains. A report published by the Ohio University estimated in 2018 that there would be around 7 million UAVs active in the airspace system by 2020.[3] As per statistics released by the United States Federal Administration of Aviation (USFAA), 873,144 UAVs were registered (382,404 for commercial use and 490,740 for personal use) in the US alone for civil uses till January 2021.[4] The size of the global UAV

---

2 Michael Armitage, *Unmanned Aircraft* (London: Brasseys, 1988).

3 Ohio University, "The Benefits and Challenges of UAVs," Blog, February 3, 2020, https://onlinemasters.ohio.edu/blog/the-benefits-and-challenges-of-uavs/.

4 Federal Aviation Administration, "Drones by the Numbers," United States Department of Transportation, Accessed June 11, 2021, https://www.faa.gov/uas/resources/by_the_numbers/.

market reached USD 25.9 billion in 2019 and is anticipated to cross USD 133.5 billion by 2026.[5]

The acquisition of UAVs by the armed forces for defence-related purposes, commercial usage including mapping, surveying, tracking, precision farming, product distribution, and industrial uses in aerospace, mining, telecommunication, and logistics are key drivers fuelling the growth of the global UAV market. Owing to this growth in the UAV market, many leading aerospace technology enterprises, including Boeing, Saab AB, Lockheed Martin, Elbit Systems, AeroVironment, and Textron, among others, have invested in the development and manufacturing of a diverse range of UAVs.

However, UAV manufacturing companies have been facing serious setbacks since the outbreak of COVID-19. The major portion of global supplies of the batteries, sensors, cameras, and other plastic parts of UAVs come from China. Because of the pandemic, the disruption in global supply chains has halted the exports of these essential parts, therefore, the production rate of UAVs has been adversely affected worldwide.[6]

Pakistan started its indigenous UAVs development programme back in the late '90s. Though the country has achieved significant milestones in the indigenous development of UAVs for military purposes, it has not been able to reap the benefits of this technology as other developing countries are reaping, especially on the commercial side. The aim of this paper is to shed light on the evolving role of UAVs in both civil and military domains, to review Pakistan's existing UAV capabilities and their applications, and to

---

5 "Unmanned Aerial Vehicle (UAV) Market Size is Projected to Reach USD 133.5 Million by 2026 - Valuates Reports," *CISION Newswire*, July 20, 2020, https://www.prnewswire.com/in/news-releases/unmanned-aerial-vehicle-uav-market-size-is-projected-to-reach-usd-133-5-million-by-2026-valuates-reports-879169104.html.

6 "Unmanned Aerial Vehicle (UAV) Market Size is Projected to Reach USD 133.5 Million by 2026 - Valuates Reports," *CISION Newswire*.

suggest a way forward for the country to get maximum gains out of this technology in the future.

Evolving Role of UAVs

The history of UAVs is as old as the history of aviation itself. Due to technological advancements, availability, and low cost, the role and applications of UAVs have witnessed a significant expansion in both civil and military domains over the past few decades. Artificial Intelligence (AI), advance network connectivity and datalinks, next generation sensors, satellite-based GPS, increased compatibility of weapon systems with UAVs, and continuously improving airspace management systems are the key factors contributing to this evolution.[7] Experts, such as United States Air Force General James Michael Holmes (former head of Air Combat Command), are of the opinion that UAVs might take over all the roles traditionally performed by manned aircraft, in the future: 'UAVs could start replacing manned fighters in mid-2020.'[8] Although this foresight has a higher probability of becoming a reality in the future as today's technology allows UAVs to carry out the entire mission with no or little human interference, still UAV/unmanned aircraft technology would need a lot of time, human-like superior information processing speed, improved response algorithms, increased situational adaptability, and enhanced memory capacity

---

7 Charles L. Barry and Elihu Zimet, "UCAVs-Technological, Policy, and Operational Challenges," *Defense Horizons 3* (National Defense University Press, October 1, 2001), https://ndupress.ndu.edu/Media/News/News-Article-View/Article/1215552/ucavs-technological-policy-and-operational-challenges/.

8 Garrett Reim, "UAVs could Start Replacing Manned Fighters in Mid-2020s: USAF," *Flight Global*, February 28, 2020, https://www.flightglobal.com/military-uavs/uavs-could-start-replacing-manned-fighters-in-mid-2020s-usaf/136978.article.

to finally replace manned aircraft.[9] Following are some factors in support of UAVs in comparison with manned aircraft:

Low Production Cost

UAVs are much cheaper than manned aircraft in terms of their per-unit production cost. With the sophistication of technology, the per-unit cost of manned aerial platforms increases from one generation to the next. For instance, the cost of the F-4 Phantom in 1962 was around USD 6 million, while the cost of the F-15 was USD25 million in 1974.[10] On the other hand, UAVs provide much cheaper options to modern militaries.

Operational and In-Service Cost

Operational and maintenance costs of traditional manned aircraft are much higher than that of UAVs. These costs are not only growing with time but have also reached twice the per unit production cost. For instance, according to data by the US Department of Defense, per hour operational cost of the F-35A is USD 28,455.[11] Likewise, data by the USAF Tactical Air Command found that the cost of replenishment of spare parts of F-15A aircraft during its in-service life was USD 10.7 million, while the depot maintenance cost was USD 5.8 million, respectively.[12] On the other hand, the operational cost of MQ9 Reaper (Predator B) was USD

9 Office of the Secretary of Defense, *Unmanned Aircraft Systems (UAS) Roadmap, 2005-2030*, report (Virginia: Pentagon, August 4, 2005), https://fas.org/irp/program/collect/uav_roadmap2005.pdf.

10 Armitage, *Unmanned Aircraft*.

11 Niall McCarthy, "The Hourly Cost of Operating the U.S. Military's Fighter Fleet," *Forbes*, August 16, 2016, https://www.forbes.com/sites/niallmccarthy/2016/08/16/the-hourly-cost-of-operating-the-u-s-militarys-fighter-fleet-infographic/.

12 Armitage, *Unmanned Aircraft*, pp. 99-100.

3,234 per hour.[13] Moreover, the cost of the air crew of manned aircraft and the cost of their training are also important aspects in comparing the cost effectiveness of both systems.[14]

Deployability

With relatively lower cost, a greater range of movement, ability to fly on lower altitudes and in different directions, and with less risk involved in flying in adverse environments, UAVs are more readily and effectively deployable than traditional manned aircraft.[15]

Reconnaissance and Imaging

UAVs are better at taking high quality aerial images and real-time data in both peace and war times.[16]

Precision

Due to their size, speed, manoeuvrability, and application-oriented programming, UAVs equipped with modern navigation capabilities provide more precision in both civil and military applications.[17]

Civil Applications of UAVs

Civil applications of UAVs are categorised into personal, commercial, and government applications. For personal use, UAVs, specifically quadcopters (or quadrotors), are used for photography, videography, gaming, and other recreational purposes. A report by

---

[13] Association for Unmanned Vehicle Systems International, "Are UAS More Cost Effective than Manned Flights?," October 24, 2013, https://www.auvsi.org/are-uas-more-cost-effective-manned-flights.

[14] Armitage, *Unmanned Aircraft*, p.100.

[15] Ohio University, "7 Pros & Cons of Drones and Unmanned Aerial Vehicles," Blog, May 11, 2021, https://onlinemasters.ohio.edu/blog/the-pros-and-cons-of-unmanned-aerial-vehicles-uavs/.

[16] Ibid.

[17] Ibid.

Philly by Air estimated that there were 1.32 million personal UAVs and 990,000 operators registered in the US alone at the end of 2019. *Insider Intelligence* had predicted that sales of personal drones would exceed USD 12 billion by the end of 2021,[18] and 'total global shipments to reach 2.4 million in 2023 – increasing at a 66.8 percent compound annual growth rate (CAGR).' This growth is expected in the agriculture, construction and mining, insurance, media and telecommunications, and law enforcement sectors.[19]

In the commercial domain, UAVs have become an essential part of the daily business functions of various industries. These include telecommunication, journalism and news coverage, aerospace, food delivery, inventory management, advertising, live entertainment, sports coverage, courier and shipments, film industry, and tourism. The drone services market size is expected to grow from USD 4.4 billion in 2018 to USD 63.6 billion by 2025.[20]

UAVs are also playing an important role in improving governance systems and sustainable development of nations around the world. Government agencies are using UAVs for urban planning, infrastructure development, mining, inspecting the energy sector, waste management, monitoring of maritime activities, weather forecasting, precision agriculture, disease control, pandemic

[18] "Drone Technology Uses and Applications for Commercial, Industrial and Military Drones in 2021 and the Future," *Business Insider*, January 12, 2021, https://www.businessinsider.com/drone-technology-uses-applications.

[19] "Drone Market Outlook in 2022: Industry Growth Trends, Market Stats and Forecast," *Insider Intelligence*, April 15, 2022, https://www.insiderintelligence.com/insights/drone-industry-analysis-market-trends-growth-forecasts/.

[20] "Drone Technology Uses and Applications for Commercial, Industrial and Military Drones in 2021 and the Future."

monitoring, healthcare, law enforcement, emergency response, humanitarian aid, and disaster relief.[21]

Military Applications of UAVs

In the military domain, early development of the concept of pilotless aircraft for military purposes is associated with the idea of the 'Flying Bomb' during World War I. However, unmanned aircraft were employed by the US Armed Forces during the Vietnam War to perform the traditional roles previously held by manned aerial platforms.[22] During that period, the US defence forces were reluctant to recognise and publicise the significance of unmanned aerial platforms because of cultural resistance within its Armed Forces. However, after successful demonstration of the utility and effectiveness of these platforms in the Yom Kippur War and Operation Desert Storm, the US started to invest in the development of UAVs openly and other modern militaries followed suit.[23] The use of Unmanned Combat Aerial Vehicles (UCAVs) and RPVs in military operations in Syria, Afghanistan, and in the Nagorno-Karabakh conflict has elucidated the significance of this technology in contemporary warfare. According to the Center for the Study of the Drone at Bard College, at least 95 states around the globe are operating military UAVs.[24] Another report predicted that the market

---

[21] "How Drones Will Impact Society: From Fighting War to Forecasting Weather, UAVs Change Everything," *CB Insights Research*, January 9, 2020, https://www.cbinsights.com/research/drone-impact-society-uav/.

[22] Isaac Keister, "Technology and Strategy: The War in Vietnam," (Senior Thesis, Western Oregon University, Oregon, 2016), p. 33.

[23] Committee on Armed Services, *Intelligence Successes and Failures in Operations Desert Shield/Storm: Report of the Oversight and Investigations Subcommittee of the Committee on Armed Services, House of Representatives, One Hundred Third Congress, First Session*, report (Washington, D.C.: Senate CAS, 1993).

[24] "38 Ways Drones Will Impact Society: From Fighting War to Forecasting Weather, UAVs Change Everything," *CB Insights Research,*

size of military UAVs is estimated to reach USD 23.78 billion by the end of 2027.[25]

In contemporary times, both remotely piloted and autonomous UAVs (also called UCAVs) are being used for three kinds of broader roles in the military domain:

1. **Intelligence, Surveillance, and Reconnaissance (ISR):** In ISR role, UCAVs are employed in operational missions to collect and disseminate real-time data for target identification and battlefield awareness at both tactical as well as strategic levels by using high-resolution sensors, e.g., theatre ISR, portable ISR systems, and small unit ISR.
2. **Attack:** In the attack role, UCAVs engage a target with the payload they carry. Attack missions may include air-to-air and air-to-ground attacks, reactive or preemptive attacks, Suppression or Destruction of Enemy Air Defence (SEAD/DEAD), etc.
3. **Combat Support:** In combat support missions, UCAVs are used for jamming, electronic attacks, communication relay, delay, early warning, logistics, fire support to ground troops, and training purposes. [26]

Apart from above mentioned military roles, modern defence forces are developing networked, autonomous, all-weather, multirole, smaller but lethal Unmanned Aerial Systems (UAS) that will not only shape the future battlefield but will also change warfare. The

January 9, 2020, https://www.cbinsights.com/research/drone-impact-society-uav/.

[25] "Drone Technology Uses and Applications for Commercial, Industrial and Military Drones in 2021 and the Future."

[26] National Research Council, *Autonomous Vehicles in Support of Naval Operations* (Washington, D.C.: National Academies Press, 2005).

concepts of drone swarming, manned-unmanned mix, and 'Loyal Wingman' are the pertinent examples in this regard.[27]

Case of Pakistan

Pakistan has not been able to reap the full potential of UAV technology because of its cultural and economic predispositions, and lack of awareness and capacity. Civil applications of UAVs in Pakistan have been limited to journalism, surveying, and recreational use only. However, recently, this technology was effectively used by government institutions to fight against locust attacks in Punjab and Sindh provinces,[28] as well as by Law Enforcement Agencies (LEAs) for surveillance.[29] In the future, Pakistan can gain maximum benefits from this technology by its effective utilisation in agriculture, forestry, urban planning, mining, disaster management, border management, infrastructure development and monitoring, resource monitoring, and research and development sectors.

On the other hand, Pakistan has made adequate progress in indigenous development of UAVs and their application for military purposes. The efforts of the Pakistan Aeronautical Complex (PAC), Air Weapons Complex (AWC), National Engineering & Scientific Commission (NESCOM), Surveillance & Target Unmanned Aircrafts (SATUMA), and Global Industrial & Defence Solutions (GIDS) are

---

27 Thomas McMullan, "How Swarming Drones Will Change Warfare," *BBC News*, March 16, 2019, https://www.bbc.com/news/technology-47555588.

28 Tasneem Ahmad, "Combating Desert Locust Plague: Drone Technology," *Frontier Post*, June 25, 2020.

29 Haroon Hayder, "Punjab Police to Use Drones to Crackdown Against Kite Flyers," *ProPakistani*, April 21, 2020, https://propakistani.pk/2020/04/21/punjab-police-to-use-drones-to-crackdown-against-kite-flyers/.

commendable in this regard.[30]The details of indigenously developed military UAVs in Pakistan are given in Table 1:

Table 1: Pakistan's Indigenously Developed Military UAVs

Name	Developer	Role	Year	Range
Burraq[31]	NESCOM, PAF	Reconnaissance, Strike	2014	1000 km
Jasoos II[32]	SATUMA	Reconnaissance, Training	2010	100 km
Shahpar[33]	GIDS	Surveillance	2020	250 km
Ababeel[34]	PAC	Strike	2014	140 km
Uqab[35]	GIDS, NESCOM	Reconnaissance	2011	150 km
Mukhbar[36]	SATUMA	Reconnaissance, Surveillance	2012	180 km

Source: Author's own.

[30] Syed Aseem Ul Islam, "Pakistan's UAV Development, Deployment, and Future," *Quwa*, July 5, 2020, https://quwa.org/2020/07/05/pakistans-uav-development-deployment-and-future-2/.

[31] Farhan Bokhari, "Pakistan to Deploy Its Own UAVs over FATA," *IHS Jane's Defence Weekly*, April 2, 2015, https://web.archive.org/web/20150402153944/http://www.pakviewz.com/pakistan-deploy-uavs-fata/.

[32] "Bravo+," SATUMA, Accessed February 9, 2021, http://satuma.com.pk/?portfolio=bravo.

[33] Aseem Ul Islam, "Pakistan's UAV Development, Deployment, and Future."

[34] "Ababeel. Specifications. A Photo," Avia.Pro, September 1, 2016, https://avia-pro.net/blog/ababeel-tehnicheskie-harakteristiki-foto.

[35] "Uqab-UAV System," Global Industrial & Defence Solutions, Accessed June 28, 2021, http://gids.com.pk/uqab-uav.

[36] "Mukhbar," SATUMA, Accessed June 28, 2021, http://satuma.com.pk/?portfolio=mukhbar.

Along with these indigenous military UAV capabilities, Pakistan has also been purchasing advanced UCAVs from China to meet its national security needs. Recently, China exported five multirole CH-4 UCAVs to Pakistan.[37] Moreover, Chinese aerospace company Chengdu Aircraft Industry and PAC Kamra are also collaborating to jointly produce 48 Wing Long UCAVs for the Pakistan Air Force.[38]

Way Forward for Pakistan

The evolving role of UAVs and a significant increase in their applications have posed some legal, regulatory, ethical, and airspace control challenges for Pakistan. The government has taken some important initiatives to promote as well as regulate the applications of UAVs. In December 2020, the Ministry of Science and Technology was directed to establish a committee to formulate a 'Drone Regulatory Act' to promote and regulate the manufacturing and applications of UAVs. A 'Drone Regulatory Authority'[39] will also be established to deal with registration, licensing, authorisation, and regulatory issues related to civil and commercial uses of UAVs. The government needs to expedite this legislation process to develop and boost Pakistan's UAV manufacturing services industry.[40]

---

[37] Gabriel Dominguez, "Pakistan Receives Five CH-4 UAVs from China," *Janes.com*, January 27, 2021, https://www.janes.com/defence-news/news-detail/pakistan-receives-five-ch-4-uavs-from-china.

[38] Vidi Nene, "China and Pakistan to Jointly Produce 48 Wing Loong II Drones," Drone Below, October 11, 2018, https://dronebelow.com/2018/10/11/china-and-pakistan-to-jointly-produce-48-wing-loong-ii-drones/.

[39] Associated Press of Pakistan, "Pakistan to Set up Drone Regulatory Authority," *News International*, December 23, 2020, https://www.thenews.com.pk/print/762933-pakistan-to-set-up-drone-regulatory-authority.

[40] Sana Jamal, "Pakistan to Launch Drone Policy to Boost Local Manufacturing Industry," *Gulf News*, December 22, 2020,

In this regard, provincial and federal government agencies are making efforts to promote and regulate the use of UAVs in their respective domains. For instance, Punjab's Agriculture Department has issued the 'SOP for Agricultural Use of Drones/UAVs.'[41] While this is a positive initiative, there should be a central coordination mechanism to synergise efforts of all government agencies under the Civil Aviation Authority (CAA) which is currently responsible for regulating the uses of UAVs under the Civil Aviation Rules, 1994.[42]

There are several private companies that have been manufacturing UAVs independently or in collaboration with public sector organisations over the last two decades. In order to promote the local UAV industry, the Government of Pakistan needs to facilitate such private companies by introducing regulations, controlling smuggling, and providing tax incentives/subsidies.

Comprehensive guidelines about operational standards, safety, and security of UAVs as well as other aerial objects should be formulated by the government to enable accelerated integration of unmanned vehicles into the national airspace. Likewise, areas of jurisdiction of various national institutions must be clearly demarcated to avoid any confusion, especially, in defence-related applications.

Keeping in view its national security needs and the growing capabilities of its adversary, Pakistan needs to enhance its unmanned aircraft capabilities. Moreover, it should also cater for vulnerabilities (such as jamming, hacking, cyber-attacks etc.) in the Command and Control (C2) of UAVs operations. After India's

---

https://gulfnews.com/world/asia/pakistan/pakistan-to-launch-drone-policy-to-boost-local-manufacturing-industry-1.76066172.

41 Punjab Agriculture Department, "SOP for Agricultural Use of Drones/UAVs," press release, Accessed February 9, 2021, http://www.agripunjab.gov.pk/system/files/UAV.pdf.

42 Pakistan Civil Aviation Authority, "Civil Aviation Rules, 1994, " https://www.caapakistan.com.pk/upload/SF/pdf/CARs%201994.pdf.

demonstration of drone swarming capability in January 2021,[43] Pakistan must also develop kinetic and non-kinetic anti-drone capability to maintain deterrence. International cooperation and technology sharing could play a crucial role in this regard.

Conclusion

Unmanned Aerial Vehicles (UAVs) have become pivotal for the daily businesses of various private as well as public sector entities. The broad spectrum of their applications ranging from recreational activities to national security has persuaded global technology giants and governments to invest in this domain. With persistent technological advancements, the role of UAVs will continue to evolve. They are likely to become safer, more effective, and more reliable in the future. The Government of Pakistan needs to take appropriate measures - including legislation and policy formulation - to facilitate the mass adoption of this technology and accrue maximum benefits in the civil, commercial, and national security domains.

Abdullah Rehman Butt holds an MPhil degree in Strategic and Nuclear Studies from the National Defence University (NDU), Islamabad, Pakistan. His areas of research include Space, UAVs, Warfare, and Strategic Stability Issues in South Asia.

[43] David Hambling, "Indian Army Shows Off Drone Swarm of Mass Destruction," *Forbes*, January 19, 2021.