GROUNDING GROWTH: BUILDING A DUAL USE UAV ECOSYSTEM IN PAKISTAN THROUGH POLICY REFORM AND INDUSTRIAL DEVELOPMENT

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ABSTRACT

The rapid evolution of unmanned aerial vehicles (UAVs) has revolutionised contemporary warfare, as well as the civilian sector. This has brought about the prospects of dual-use ecosystems across the globe. The paper reviews the role of Pakistan in the international UAV market, evaluates its security-driven innovations, new civil uses, and institutional issues. UAVs have become the focus of intelligence, reconnaissance, surveillance, precision attacks, and commercial applications in agriculture, logistics, and disaster management worldwide. Pakistan has reached significant success with state-owned enterprises like PAC Kamra and NESCOM, systems like Shahpar and Burraq, while civilian applications are still undeveloped. Even though Pakistan has international partnerships with China and Turkey, the UAV industry is limited to regulatory fragmentation, supply chain weaknesses, and a lack of innovation in the sector by the Pakistani private sector. The creation of a dual-use UAV ecosystem is therefore a strategic requirement, with improved security, technological independence and economic modernisation. Pakistan can become a balanced UAV industry with international competitiveness through dual-use technology fusion, institutional cooperation, and development of infrastructure.

Keywords: Unmanned aerial vehicles, Dual use, drones, technology

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1. INTRODUCTION

1.1 Background and Rationale

Unmanned aerial vehicles (UAVs) have become one of the most disruptive technologies in the twenty-first century.[1] Their growing versatility has redefined military operations and civilian industries. UAVs are currently being employed in border security, precision strike capabilities, and surveillance around the world, as well as in agriculture, logistics, disaster relief, infrastructure monitoring, and environmental management.[2] This dual use, i.e., the ability to be used in both civil and military applications, makes them one of the pillars of future industrial and strategic growth.

For Pakistan, the relevance of UAVs is especially acute. The country continues to have various security needs, such as border monitoring, counterterrorism activities, and surveillance requirements, where UAVs can be employed in a cost-effective and flexible manner. At the same time, Pakistan is being urged to diversify and modernise its industrial sector to keep up with a fast-digitising global economy. UAV technology is an opportunity that can allow Pakistan to enhance national security and boost the economy at the same time. Civilian applications include law enforcement[3], motorways monitoring[4], media and photography. UAVs with logistical capabilities could also be used to extend service delivery to remote locations.[5]

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[1] Seth J Frantzman, *The Drone Wars* (Bombardier Books, 2021).
[2] Michael Horowitz, Paul Scharre, and Ben FitzGerald, "Drone Proliferation and the Use of Force," *CNAS*, 2025, https://www.cnas.org/publications/reports/drone-proliferation-and-the-use-of-force.
[3] Baisali Ghosh, "Drones for Law Enforcement: Benefits and Use Cases - FlytNow," *Www.flytbase.com*, December 6, 2025, https://www.flytbase.com/blog/drones-for-law-enforcement.
[4] Correspondent, "Punjab Rolls out Hawk Eye Surveillance," *The Express Tribune*, April 22, 2025, https://tribune.com.pk/story/2541443/punjab-rolls-out-hawk-eye-surveillance.
[5] A Reporter, "Robbers Take Away Valuables in Five Hits," *DAWN*, September 7, 2015, https://www.dawn.com/news/1205380.

Pakistan has taken steps towards the development of UAVs indigenously, with the Shahpar-II and Burraq UCAVs being good indicators of growing capability in the defence sector. Nevertheless, the ecosystem remains fragmented with the civil UAVs being regulated by the aviation laws and the defence UAVs being regulated by the strategic export control laws. This disjointed system has not yet allowed Pakistan to develop a well-rounded dual-use UAV ecosystem that would pave the way for integration of civilian innovation with military-led technological development.

1.2 Research Questions

This paper is guided by two central research questions:

1. What policy reforms are necessary for Pakistan to build an integrated dual use UAV ecosystem?

2. How can industrial development and public–private partnerships support the growth of UAV technology in Pakistan?

1.3 Research Methodology

The research design used in this study was qualitative in nature and based on policy analysis and comparative case study. The main sources are official Pakistan regulations, including the Civil Unmanned Aircraft Rules (2024), policy documents of the Ministry of Defence Production, and export control regulations within the Strategic Export Control Division. Additional data is taken out of reports issued by the defence industry, publications by think tanks, and academic studies of dual-use technologies.

The methodology is interpretive and analytical as opposed to statistical and aims at tracing policy gaps, identifying institutional overlaps, and mapping opportunities of reform. The study will synthesise the experience of other countries

with the realities of Pakistan, and in this way, formulate recommendations that can be implemented by policymakers.

2. LITERATURE REVIEW

Research on Unmanned Aerial Vehicles (UAVs) has expanded significantly in the last twenty years as the use of drones has become widespread in the military as well as in the civilian sector.[6] The literature on UAVs encompasses technical innovation, regulatory frameworks, strategic implications, and industrial development.

There have been two main strands of scholarship on UAVs across the world. The first focuses on military usage, with analysis of UAVs as intelligence, surveillance, and reconnaissance (ISR) and strike platforms. UAV Navigation (2020) discuss the role of UAVs in changing the nature of modern warfare, as UAVs allow precision targeting, reducing the risk to the lives of pilots and improve situational awareness.[7] The report also identifies a second strand of UAV development focused on civilian and industrial applications.[8] Research on UAVs is also found in agriculture, where drones are employed in crop spraying, irrigation surveillance and yield estimation.[9] In logistics, UAVs are being used for last-mile delivery.[10] Kamarulzaman et al. (2023) highlight the application of UAVs in disaster management, environmental monitoring, and urban

[6] Christian Alwardt, "Arms Control of Unmanned Weapons Systems - Joint Air Power Competence Centre," *Joint Air Power Competence Centre - NATO's Advocate to Air and Space Power*, January 16, 2021, https://www.japcc.org/chapters/c-uas-arms-control-of-unmanned-weapons-systems.
[7] P W Singer, *Wired for War: The Robotics Revolution and Conflict in the Twenty-First Century* (New York: Penguin Books, 2010), https://media-1.carnegiecouncil.org/import/studio/PWSinger_WiredWar.pdf.
[8] "CIVIL USES for UAVS: PREPARED by a BRIEF OVERVIEW CIVIL USES for UAVS: A BRIEF OVERVIEW UAV NAVIGATION," December 2020, https://www.uavnavigation.com/sites/default/files/docs/2020-12/civil-uses-uav-dec-2020.pdf.
[9] Sirisha Potluri et al., *AI in Agriculture for Sustainable and Economic Management* (CRC Press, 2024).
[10] Almodather Mohamed and Moataz Mohamed, "Unmanned Aerial Vehicles in Last-Mile Parcel Delivery: A State-of-The-Art Review," *Drones* 9, no. 6 (June 6, 2025): 413, doi:https://doi.org/10.3390/drones9060413.

planning. This collection of work shows how drones are transforming industries by increasing efficiency, cost-effectiveness, and opening new markets.[11]

Lastly, the dual-use technology[12] has been a common topic in global research. The UAVs represent the grey area between civilian and military technology, and raise questions of arms control, export controls and technology transfer. Policy research institutions and arms-control scholars argue assert that states need to be keen on formulating policies that will maximise economic gains and at the same time protecting national security interests.

There is relatively little research on UAVs in Pakistan, which is more strategic and defence-oriented. Articles published by Pakistani think tanks and military establishments regularly point to the use of UAVs in counterterrorism operations,[13] controlling the borders,[14] and conventional deterrence. The indigenous systems like Shahpar-III, Shahpar-II, Burraq, and Uqab are analysed mainly with respect to their military application with little or no mention of wider industrial applications.[15]

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[11] Aisyah Marliza Muhmad Kamarulzaman et al., "UAV Implementations in Urban Planning and Related Sectors of Rapidly Developing Nations: A Review and Future Perspectives for Malaysia," *Remote Sensing* 15, no. 11 (January 1, 2023): 2845, doi:https://doi.org/10.3390/rs15112845.

[12] "Dual-Use Export Controls | SIPRI," *Www.sipri.org*, accessed August 11, 2025, https://www.sipri.org/research/armament-and-disarmament/dual-use-and-arms-trade-control/dual-use-export-controls.

[13] Shahana Gul et al., "ROLE of DRONES in MODERN WARFARE: CASE STUDY of INDIA-PAKISTAN CONFLICT, MAY 2025 ISSUE BRIEF INSTITUTE of STRATEGIC STUDIES ISLAMABAD," 2025, https://issi.org.pk/wp-content/uploads/2025/08/IB_Gul_Shahana_Aug_21_2025.pdf.

[14] Aleena Saeed, Yasmin Ghazala, and Jalil, "DRONES: THE NEW FRONTIER in GEOPOLITICAL ARENA ISSUE BRIEF INSTITUTE of STRATEGIC STUDIES ISLAMABAD," 2024, https://issi.org.pk/wp-content/uploads/2024/03/IB_Aleena_Mar_26_2024.pdf.

[15] Eesar Mehdi and Toseef Ahmad Bhat, "Understanding Pakistan's Unmanned Aerial Vehicle (UAV) Programme | International Centre for Peace Studies," *International Centre for Peace Studies*, March 28, 2024, https://www.icpsnet.org/comments/Pakistan-Unmanned-Aerial-Vehicle-UAV-Programme.

2.1 Gaps in Scholarship

The existing body of literature reveals several gaps that this study seeks to address:

1. Fragmentation between civil and defence perspectives: The majority of Pakistani studies view UAVs as a defence technology or as a small-scale civil innovation without considering them as a comprehensive dual-use environment.

2. Limited industrial analysis: There is a paucity of scholarly research that evaluates the industrial capacity of Pakistan in the development of UAVs, including supply chains, financing processes and the role of the government and the private sector.

3. Neglect of comparative insights: Although the international literature has extensive case studies of UAV ecosystems in Turkey, China, and the United States, Pakistani literature has not made any systematic comparison of these models with local contexts.

4. Policy design focus: Little research addresses the necessity of harmonised UAV policy in the state of Pakistan that integrates regulatory oversight, encourages privately driven innovation, and provides adherence to international export control regimes.

5. Civilian application underexplored: The potential of UAVs in agriculture, disaster management, logistics, and environmental monitoring have not been explored in Pakistan, yet they could serve as an important driver of the economy.

3. UAV LANDSCAPE AND STRATEGIC CONTEXT

The popularity of UAVs has not only changed the nature of modern warfare but also opened up new opportunities in various civilian sectors. To determine Pakistan's potential and constraints in developing a dual-use UAV ecosystem, it is important to place its path in the global context of UAV development, evaluate where its capabilities stand, and determine why a comprehensive ecosystem is a strategic necessity.

3.1 Global UAV Trends and Dual-Use Applications

In the last twenty years, UAVs have evolved to become mainstream technologies with civilian and military applications. Over 100 states across the world currently use UAVs and a number of private companies are investing in research, production, and use of drone technologies.[16]

On the military front, UAVs have been used mostly in ISR, target acquisition and precision strikes. The US was the first to explore this field with the Predator and Reaper drones.[17] Turkey developed Bayraktar TB2 and Akıncı platforms deployed successfully in Syria, Libya, and the South Caucasus.[18] China developed its own military UAVs while actively selling low-cost export versions to Asia, Africa and the Middle East. On the civilian side, UAVs are revolutionising industries such as agriculture, logistics, disaster management, and infrastructure and environment.

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[16] Ryan Pickrell, "Nearly 100 Countries Have Military Drones, and It's Changing the Way the World Prepares for War," *Business Insider*, September 27, 2019, https://www.businessinsider.com/world-rethinks-war-as-nearly-100-countries-field-military-drones-2019-9.

[17] Imperial War Museums, "A Brief History of Drones," *Imperial War Museums*, 2024, https://www.iwm.org.uk/history/a-brief-history-of-drones.

[18] Denis Fedutinov, "Turkey with Its Bayraktar TB2 among the World's Top UAS Manufacturers," *CISS | Caspian Institute for Strategic Studies*, April 20, 2022, https://caspian.institute/product/denis-fedutinov/turkey-with-its-bayraktar-tb2-among-the-world-s-top-uas-manufacturers-38049.shtml.

3.2 Pakistan's Current UAV Capabilities

Pakistan has made significant advancements in the field of UAV development. There are a number of state-owned companies under the Ministry of Defence Production (MoDP) dominating the field.[19]

Global Industrial & Defence Solutions (GIDS) has been central to UAV design and production. It has produced the Shahpar-II,[20] a Medium Altitude Long Endurance (MALE) UAV with an ISR range of 250 kilometers and an endurance of 14 hours. The Shahpar-II is also a significant milestone in the indigenous capability that incorporates the advanced sensors, real time data links and autonomous flight capabilities.

The National Engineering and Scientific Commission (NESCOM) developed the Burraq UCAV,[21] the first armed drone of Pakistan. In use since the mid-2010s, Burraq had been used in counterterrorism operations, indicating that Pakistan can develop and deploy lethal UAV systems. NESCOM has also partnered in mini and tactical UAVs. National Radio & Telecommunication Corporation (NRTC)[22] has also designed small tactical drones and communications systems necessary to command and control UAVs.

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[19] Muhammad Abdullah et al., "Potential and Prospects of Defence Production in the Context of Industrial Development in Pakistan," *Khyber Journal of Public Policy*, no. 2 (2023), https://nipapeshawar.gov.pk/KJPPM/PDF/CIP/36th/P7.pdf.

[20] Quwa Team, "GIDS Shahpar-2 Unmanned Aerial Vehicle (UAV)," *Quwa - Pakistan Defence News Coverage & Analysis* (Quwa, December 2024), https://quwa.org/pakistani-drones/gids-shahpar-2-unmanned-aerial-vehicle-uav/.

[21] Bilal Khan, "Background on the Burraq Armed UAV," *Quwa - Pakistan Defence News Coverage & Analysis* (Quwa, September 8, 2015), https://quwa.org/daily-news/background-on-the-burraq-armed-uav/.

[22] Maryam Aslam, "National Radio & Telecommunication Corporation," *National Radio Telecommunication Corporation*, 2020, https://www.nrtc.com.pk/more_products.html.

In the civilian sector, SUPARCO develops UAVs as scientific and monitoring tools, such as aerial surveys, disaster mapping and remote sensing.[23] There are also a few startups and privately-owned companies testing drones in agriculture, aerial photography, and logistics. Nonetheless, the private innovation is still restricted by the high prices, lack of funds, and uncertainty in regulations, largely due to the absence of a well-defined end user to create sustained demand.

International collaborations have also been beneficial to Pakistan. Pakistan co-produces and operates UAVs such as Wing Loong series and Rainbow (CH) drones with China.[24] Collaboration with Turkey has involved exposure to the Baykar UAV ecosystem,[25] but Pakistan has not yet followed the Turkish example of a privately led ecosystem. The UAV ecosystem in Pakistan remains largely defence-centric with most of the production and deployment being done by defence organisations. Civilian uses, individual business, and industry-academia partnership are undeveloped, and thus the wider economic and social impact that UAVs can have is not being achieved.

3.3 Strategic Necessity for a Dual-Use Ecosystem

Security and economic development are intertwined imperatives that necessitate the need to build a dual-use UAV ecosystem in Pakistan. From a security perspective, UAVs are essential to Pakistan's counterterrorism, border surveillance, and conventional deterrence strategies. The evolving nature of the threat environment, including challenges on the eastern and western borders, necessitates persistent ISR

[23] "Aerial Remote Sensing Services | SUPARCO," *SUPARCO*, 2025, https://suparco.gov.pk/products-services/aerial-services/.

[24] Franz-Stefan Gady, "China, Pakistan to Co-Produce 48 Strike-Capable Wing Loong II Drones" (The Diplomat, October 9, 2018), https://thediplomat.com/2018/10/china-pakistan-to-co-produce-48-strike-capable-wing-loong-ii-drones/.

[25] BaykarTech, "Baykar Subsidiary to Conduct R&D Studies at Pakistan's NASTP," *Baykar Tech*, 2023, https://www.baykartech.com/en/press/baykar-subsidiary-to-conduct-rd-studies-at-pakistans-nastp/.

and flexible force multipliers. Indigenous UAVs mitigate the reliance on foreign suppliers to improve strategic autonomy. Moreover, there are increasing incidents of terrorist organisations deploying UAVs.[26] This necessitates a production incentive for the private industry.

Economically, the UAVs have a transformative potential for the civilian sectors of Pakistan. The agricultural sector, which absorbs a significant portion of the workforce, could use drone-enabled precision farming to maximise production and minimise wastage of resources. Disaster-prone areas could have an opportunity to use UAVs for rapid response, and new e-commerce and logistics industries could incorporate drones to create cost-efficient delivery networks. Developing an industrial base of UAVs would also generate high-tech employment, entrepreneurship and would make Pakistan an exporter to developing markets.

Therefore, the design of a dual-use UAV ecosystem is not an option but a necessity. It is an avenue to ensure national defence and at the same time to modernise industries and boost the economy.

4. POLICY AND INSTITUTIONAL LANDSCAPE

The policy and institutional framework of the unmanned aerial vehicle (UAV) in Pakistan is changing with the changes in the global technological trends, national security needs and commercial opportunities. Although much has been achieved in the recent years, such as specific legislation, regulatory restructuring, and defence-led industrial efforts, the framework is still fragmented. A clear picture of the current

[26] Thomas Pledger, “The Role of Drones in Future Terrorist Attacks” (The Association Of The United States Army, February 2021), https://www.ausa.org/sites/default/files/publications/LWP-137-The-Role-of-Drones-in-Future-Terrorist-Attacks_0.pdf.

regulatory framework, defence manufacturing dynamics, export control regime, and policy gaps that exist must be understood to determine how Pakistan can develop a coherent dual-use UAV ecosystem.

4.1 Existing Regulatory and Policy Framework

The civilian regulation of UAVs in Pakistan is based mainly on aviation law and regulatory documents of the Pakistan Civil Aviation Authority (PCAA) and is informed by wider legislative and institutional reforms.

4.1.1 Civil Unmanned Aircraft Rules, 2024

The latest development in Pakistan in the regulation of UAVs is the Civil Unmanned Aircraft Rules, 2024, which was issued under the Civil Aviation Act.[27] The rules present the initial comprehensive legal framework of the operation of UAVs in civil airspace. They demand that UAVs must be registered with the CAA and be given unique identification numbers so that they can be tracked and monitored by the authorities. The UAVs are classified according to the type of use (recreational, commercial, research, and government) with distinguished safety and compliance requirements.

A distinctive aspect of these regulations is that they require Remote Pilot Licensing (RPL),[28] which is based on the manned aviation principles but modified to the UAV environment. This guarantees that UAV operators meet minimum standards of competence, technical knowledge and operational discipline. Licensing also

[27] Hafsa Sarfraz, "REGULATORY CONSTRAINTS in USING DRONE TECHNOLOGY," accessed September 3, 2025, https://file.pide.org.pk/pdfpideresearch/discourse-2024-04-18-regulatory-constraints-in-using-drone-technology.pdf.
[28] Tahir Niaz, "Registering Drones Mandatory under New CAA Rules," *The Nation*, June 17, 2024, https://www.nation.com.pk/17-Jun-2024/registering-drones-mandatory-under-new-caa-rules.

depends on the type of UAV, with more rigorous training and certification required on larger and more complex platforms.

In addition to these technical controls, the 2024 regulations provide accountability regulations, including requiring a minimum insurance policy coverage by commercial UAV operators, the requirement to keep flight records, and the ability of authorities to suspend or revoke licences in the case of non-compliance. The change in regulations is an indication that Pakistan has acknowledged the fact that UAVs are no longer specialised tools but part of the commercial, industrial and even humanitarian practices.

4.1.2 Institutional Restructuring: PCAA and PAA

The bifurcation of the Pakistan Civil Aviation Authority into two entities i.e., the regulatory PCAA and the operational Pakistan Airports Authority (PAA)[29] has also impacted UAV governance. This restructuring, sought to depoliticise and professionalise the management of civil aviation has brought clarity in institutional mandates. The PCAA has been relegated to regulatory matters, including UAVs, while the PAA is responsible for the airports and navigation services. In the case of UAVs, this distinction will mean that the organisation issuing the licences and enforcing the regulations is not simultaneously involved in operating infrastructure, minimising the conflicts of interest. Nonetheless, coordination challenges are still present, as UAV activities overlap with both air navigation services and airport security operations.

[29] "PCAA | Pakistan Civil Aviation Authority," *Civil Aviation Authority* , accessed August 20, 2025, https://caapakistan.com.pk/.

Combined, the 2023 Act and the 2024 Rules represent a significant step toward a formalised UAV governance framework. Yet, they are mostly restricted to the civilian aspect, and there is little elucidation of dual-use considerations.

4.2 Export Controls and Dual-Use Compliance

Since UAVs have a dual-use character, the export control mechanism in Pakistan is critical in defining the ecosystem. The Export Control Act, 2004, which is administered by the Strategic Export Control Division (SECDIV)[30] of the Ministry of Foreign Affairs, forms the legal framework for regulating transfer of sensitive technologies.

4.2.1 SECDIV Control Lists

The 2022 update of the SECDIV control lists[31] specifically includes UAV-related technologies, such as avionics, sensors, navigation systems, and propulsion components. The lists have been used to harmonise with international non-proliferation regimes like the Missile Technology Control Regime (MTCR) and thus, the technologies that may have military use are highly regulated.

This presents opportunities and limitations to Pakistan. On the one hand, the compliance with the comprehensive export controls enhances the international position of Pakistan as a responsible owner of technology, decreasing the chances of sanctions. Conversely, it limits the importation of sophisticated subsystems and makes export of locally produced UAVs, particularly to sensitive markets, difficult. UAV

[30] "SECDIV," *Strategic Export Control Division*, 2021, https://secdiv.gov.pk/.

[31] "SECDIV," *Strategic Export Control Division*, 2021, https://secdiv.gov.pk/news/pakistan-notifies-revised-control-lists-under-the-export-control-act-of-2004-.

manufacturers are subject to complicated licensing processes that have the potential of hindering industrial development.

Export control is therefore a double-edged sword[32]: it can prevent the diversion of the UAV technologies to destabilisation activities but also strengthen the barrier between the defence and civilian sectors. Lack of more transparent dual-use compliance routes means that commercial UAV startups are struggling to access key technologies or markets abroad.

4.2.2 Impact on UAV Trade

Export controls thus act as a double-edged sword: they protect against diversion of UAV technologies for destabilising purposes but also reinforce the silo between defence and civilian sectors. Without clearer dual-use compliance pathways, commercial UAV startups face difficulties in accessing critical technologies or expanding into foreign markets.

5. BUILDING A DUAL-USE UAV ECOSYSTEM

5.1 Dual-use Technology Integration

To build a sustainable UAV ecosystem in Pakistan, dual-use technology integration should be the centre of the approach. UAVs have a variety of potential uses in precision agriculture, disaster response, and logistics as well as surveillance, reconnaissance, and defence. This necessitates cooperation between the military and the civilian organisations not only as a desirable but also as a necessary aspect. At present, the UAV research and development in Pakistan is confined to the defence-

[32] "UAV EXPORT CONTROLS and REGULATORY CHALLENGES Working Group Report" (STIMSON, n.d.), https://www.stimson.org/wp-content/files/file-attachments/ECRC%20Working%20Group%20Report.pdf.

centred institutions whereas civilian utilisation is disjointed and poorly financed. Filling this gap will demand a concerted strategy of shared R&D, knowledge sharing and co-investment in platforms that can be used to support both national security and economic growth.

Examples from countries like China[33] show that civil-military fusion accelerates innovation while reducing costs by avoiding duplicative efforts. Pakistan could adopt a similar model where military-developed UAV technologies are gradually transferred to the private sector for commercialisation in fields such as agriculture, energy inspection, and delivery services. Conversely, civilian innovations in AI, autonomy, and lightweight materials can strengthen defence capabilities. Establishing joint venture funds and a national innovation policy for UAVs would institutionalise this fusion, ensuring both sectors benefit from shared expertise and infrastructure. Such synergy would not only enhance technological self-reliance but also create export opportunities.

5.2 Triple Helix Model

Without a multi-stakeholder collaboration, a robust UAV ecosystem cannot be created. Universities, research institutes, think tanks, state owned enterprises (SOEs), and startups should be connected into a single network of innovation. Government funding and industry collaboration should support academic institutions in basic research in the field of aerodynamics, propulsion, and artificial intelligence. Engineering universities can establish special laboratories on UAV research, which

[33] Alex Stone and Peter Wood, “A BluePath Labs Report by CHINA’S MILITARY-CIVIL FUSION STRATEGY a VIEW from CHINESE STRATEGISTS” (China Aerospace Studies Institute), accessed August 25, 2025, https://www.airuniversity.af.edu/Portals/10/CASI/documents/Research/Other-Topics/2020-06-15%20CASI_China_Military_Civil_Fusion_Strategy.pdf.

would be sponsored by defence and industrial players, to develop a talent pool of engineers and designers.

Think tanks will be able to influence the development of regulatory frameworks and predict future trends in the world, so that the policies of UAVs are consistent with national security requirements and global market potential. With their financial and industrial capabilities, SOEs can take the prototypes and scale them up to production-ready models and also offer the requisite manufacturing infrastructure. Startups, in turn, introduce flexibility and disruptive innovation that may subsequently be expanded with state assistance and create niche applications in agriculture, logistics, and mapping.

The government can stimulate this cooperation by creating UAV innovation hubs, where universities, startups, and SOEs can collaborate with the representatives of the defence industry. These hubs would not only eliminate duplication but also facilitate the cross-pollination of ideas. Given adequate funding and incentives, Pakistan can develop a vibrant UAV industry that can meet the defence requirements as well as economic development.

5.3 Infrastructure Needs

No UAV ecosystem can thrive without dedicated infrastructure. Pakistan currently lacks formal UAV testing ranges and certification authorities, forcing developers to operate in fragmented regulatory spaces. Establishing national UAV testing and evaluation ranges, supervised by a joint civil-military authority, would allow for safe trials of both commercial and defence UAVs. These ranges would be critical for validating endurance, payload capacity, navigation systems, and resilience in diverse terrains, from deserts to high-altitude areas.

Certification is also important. A dedicated UAV regulatory body under the PCAA can formulate airworthiness, safety, and licensing procedures for manufacturers and operators. This would give confidence to investors, insurers, and international partners and bring Pakistan in line with global norms of the UAV trade.

Lastly, modern UAVs are enabled by data. It is necessary to develop AI and data processing facilities specific to UAV operations that can process the huge amounts of imagery, sensor readings, and real-time analytics that such systems produce. Such centres may have the potential to support precision agriculture, urban planning and border security applications. With the addition of AI expertise to UAV operations, Pakistan may jump several steps ahead as an autonomous systems powerhouse, becoming a force to reckon with in the UAV market.

5.4 Challenges

5.4.1 Limited Incentives for Marketing

Public sector developers and producers traditionally have very little incentive to market their products. Their role has been oriented toward meeting state demand rather than cultivating a consumer or commercial base, which results in an absence of strategies to create or expand an end-user market.

5.4.2 Rationale for Offloading Production

From a policy and economic standpoint, it seems logical to offload production responsibilities to the private sector. In theory, this would encourage efficiency, innovation, and responsiveness to market demand.

5.4.3 Constraints in the Private Sector

However, two interrelated challenges undermine this transition. First, the private sector often struggles with maintaining uniform quality standards, raising serious concerns about reliability and safety. Secondly, instead of seeking out new end users or investing in marketing, many private firms prefer that the public sector itself absorb their output, thereby replicating the same demand vacuum.

6. RECOMMENDATIONS

6.1 Security and Governance

UAVs have economic and technological opportunities, but also have governance challenges. The government should come up with a UAV Security Framework that will govern the use, misuse by non-state actors, and protect sensitive information. These are requirements to register all UAVs, establish geo-fencing in restricted areas, and ensure secure communication channels of military-level systems.

Institutional control is also very important A UAV Regulatory Authority should be set up to facilitate liaison between the Pakistan Civil Aviation Authority (CAA), Ministry of Defence Production, and the private industry. This body can make sure that the development of UAVs is in line with the national security concerns and at the same time promote civilian use in agriculture, disaster relief, and logistics.

Simultaneously, cybersecurity measures should be integrated into the design of UAVs to avoid hacking, data theft, or hostile takeovers of the platforms. With the help of incorporating security within the governance frameworks, Pakistan can make sure that its UAV ecosystem develops responsibly.

6.2 Industrial Strategy

Pakistan should have a strong industrial roadmap to develop indigenous UAVs. The government must establish special UAV industrial clusters within existing Special Economic Zones (SEZs). This cluster strategy helps in cutting down expenditures, speeding up knowledge transfer and generating economies of scale.

Public-Private Partnerships need to form a cornerstone of this strategy. Defence agencies like PAC Kamra and NESCOM already have experience in the production of UAVs, but they can work with private companies and universities to open up innovation to dual-use applications. A tiered supplier system must be developed in which SMEs can supply avionics, composites, and AI-driven software and supply it to larger integrators who can assemble entire UAVs.

In addition, there is a need to have an export-oriented industrial policy. The ability to sell UAVs to regional markets in Africa, the Middle East and Southeast Asia will allow Pakistan to sell the UAVs as a cost-effective alternative to the Western or Chinese systems. Aggressive pricing, coupled with after sales services and training programmes, will not only boost the soft power of Pakistan, but also earn it foreign exchange.

6.3 Policy Reforms

A complete legal and regulatory framework is the basis of UAV development. Pakistan does not have a clear and consolidated policy on the use, licensing and manufacturing of UAVs, which is a deterrent to both private investment and international cooperation. The government needs to put in place a National UAV Policy that would distinguish between the military, commercial and recreational use of the UAVs with different levels of licensing and airspace regulations. This framework will

have to align with international civil aviation standards (ICAO guidelines) in order to create interoperability and open export opportunities.

The simplification of UAV component import-export procedures is another reform that is needed. Currently, there are strict controls that deter local manufacturers to obtain high quality sensors, composites and propulsion systems. Pakistan can wean itself off of foreign suppliers by introducing a controlled, yet facilitative import regime and by gradually localising production.

Lastly, the fiscal policies should encourage local production. Tax rebates, lower tariffs on raw materials and subsidies for the UAV startups will provide a competitive environment. Unless such reforms are undertaken, Pakistan will continue to be an importer of UAV technology instead of a manufacturer.

7. CONCLUSION

The evolution of a dual-use UAV ecosystem in Pakistan is not just a technological aspiration but a national imperative. As the security and economic environment in the world undergoes transformation, UAVs have become one of the most versatile and disruptive technologies of the century, transforming not only defence policies but also commercial sectors. To utilise this potential, Pakistan needs to go beyond disjointed policies and capacity shortages in industries to a more comprehensive approach that is focused on the future.

A revamped policy framework, with its foundation in well-defined regulations, public-private collaborations, and investment in research and development, can help make UAV technologies simultaneously contribute to national defence and industrial development.

The urgency is obvious. Unless Pakistan undertakes wholesome reforms, it is likely to be left behind in a fast-moving world where other nations such as Turkey, and China are already making huge strides. Not doing so decisively would not only jeopardise national security, but it would also shut gates to economic opportunities in a sector that is expected to bring in billions of dollars worldwide in the next few years.

The bottom line of grounding growth in UAV technology is to place Pakistan in the position of resilience and competitiveness in a world characterised by innovation. Reforms now will decide whether UAVs will continue to be a lost opportunity or a key to security and prosperity in Pakistan in the decades to come. The decision is imminent and the time to act is now.

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