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SP's aviation

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SHARP CONTENT FOR A SHARP AUDIENCE

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"THE EXTRAORDINARY SUCCESS OF AIR OPERATIONS (DURING OP SINDOOR) IS A TESTIMONY TO THE PREPAREDNESS, RESILIENCE AND RESOLVE OF THE MEN IN BLUES."

– AIR CHIEF MARSHAL A.P. SINGH, CHIEF OF THE AIR STAFF, IAF

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DR SAMIR V. KAMAT, SECRETARY DDR&D AND CHAIRMAN - DRDO. TAKING INDIA TOWARDS THE INDEPENDENT R&D CAPABILITIES

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COVER IMAGE
In an exclusive interview, DRDO Chairman Dr Samir V. Kamat highlights India's push for self-reliance through indigenous technologies marking decisive strides towards next-generation systems and platforms and reduced foreign dependence.

(***Cover Photo**: PIB*)
COVER DESIGN BY: *SP's Team*

INDIA'S INDEPENDENCE DAY SPECIAL

REGULAR DEPARTMENTS

BACA Awards 2017 SPECIAL CONTRIBUTION TO BUSINESS AVIATION

Aerospace Media Awards — Asia
11th February 2020 – Singapore

As we celebrate our 79th Independence Day, I think it will only be appropriate to share my thoughts as follows. We aspire to become a global power and therefore its prudent to adopt dynamic and flexible foreign policies coupled with strategic decisions that respond to changing times in the interest of our nation. Engaging constructively with all international players will be the key towards ultimate goal of our country emerging as a powerful economy.

WE ARE IMMENSELY GRATEFUL TO AIR CHIEF MARSHAL A.P. SINGH for his message on India's Independence Day. The Chief of the Air Staff underscores that IAF's path forward will be defined by technological transformation, multi-domain integration, and emerging capabilities, driven by self-reliance, adaptability, and strategic foresight to meet future challenges.

Our lead story in this issue is an exclusive interaction with Dr Samir V. Kamat, Secretary DDR&D and Chairman DRDO. Speaking to Manish Kumar Jha, Dr Kamat outlines DRDO's advances in next-generation aerial platforms and systems. Kamat reveals DRDO's advances in hypersonic glide and cruise missiles powered by indigenous scramjets, promising unmatched speed and interception evasion. He explains quantum sensing for submarine detection from aircraft or UAVs, progress on the Kaveri dry engine for unmanned platforms, and AMCA stealth technologies. Kamat stresses indigenous IP ownership framing a vision of Atmanirbharta in next-gen aerial warfare systems.

In another success story, Manish Kumar Jha charts ISRO's rapid rise—from lunar and Martian missions to futuristic in-orbit docking and human spaceflight. He details landmark achievements like SpaDeX docking, NISAR launch, and the upcoming Bharatiya Antariksh Station, alongside Next Generation Launch Vehicles, Venus and lunar sample missions. The piece also analyses private sector breakthroughs in propulsion, reusable rockets, and hyperspectral imaging.

In an analytical report on IAF's urgent need to stem declining squadron numbers, Manish Kumar Jha examines the prospects of interim imports like the US F-35 or Russian Su-57 while accelerating indigenous AMCA development under a new PPP model. Delays in Tejas Mk-1A deliveries and Mk-2 rollout exacerbate the gap, especially against China's J-20 deployments and Pakistan's planned J-35 acquisition. The report underscores the strategic imperative to close these gaps while modernising through indigenous platforms.

Also, to plug the gap in India's fighter squadrons, Air Marshal Anil Khosla (Retd) explores the evolution of combat drones globally and in India, tracing a shift from imports to indigenous systems like DRDO's Archer and HAL's CATS Warrior, alongside MQ-9B Sea/Sky Guardian acquisitions. He outlines advantages like persistence, precision, and reduced risk to pilots, as well as future trends in AI autonomy, swarm tactics, and stealth.

Swaati Ketkar provides a comprehensive look at the transformation of India's defence MRO sector, which is rapidly moving towards full self-reliance under the Atmanirbhar Bharat vision. She highlights major initiatives that have been undertaken demonstrating India's growing maintenance independence. She emphasises that these projects not only reduce dependence on foreign OEMs but also embed global OEMs into India's industrial base, creating export opportunities.

On the Civil Aviation front, as India's skies grow busier, the need for experienced professionals across all aviation roles becomes critical to ensure safety and efficiency. In his analysis, Sanjay Julka warns that rapid fleet growth without seasoned expertise risks safety. Drawing lessons from US, Chinese, and Indian aviation booms, he stresses bolstering pilot, technician, ATC, and regulatory capacity as India's aviation growth demands a robust pipeline of skilled professionals to match its ambitious trajectory.

All this and more in this issue of *SP's Aviation*. Welcome aboard and we wish you safe landings!

JAYANT BARANWAL
PUBLISHER & EDITOR-IN-CHIEF

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Operation-Proven Defense: IAI's Edge for India's Security

In today's fast-evolving threat landscape, defense superiority demands **speed, precision, and seamless coordination.**

During Operation Rising Lion, Israel faced the largest coordinated missile and UAV assault in its history - hundreds of ballistic and cruise missiles, **drone swarms**, and high-volume rocket attacks. The response was swift and decisive, powered by IAI's game-changing technological solutions.

Combat-Proven Performance

IAI's **multi-layered defense** architecture protected critical assets and civilian centers, enabling real-time decision-making under extreme operational pressure - and **keeping the nation safe.**

- **Barak** shielded airspace and naval zones from cruise missiles and UAVs.
- Advanced **MMR** and Green Pine radars provided early detection and guided interceptors with pinpoint accuracy.
- **Heron** UAVs maintained persistent ISR over vast theaters, feeding real-time intelligence into the command chain.

- **AI-enabled satellite communications** ensured uninterrupted coordination across land, sea, air, and space.

IAI's systems also played a critical role in enabling deep strikes and achieving **air superiority** during the operation.

Meeting Contemporary Defense Challenges

The modern defense environment is defined by multi-axis missile threats, UAV proliferation, and the strategic need for maritime domain superiority.With its vast and diverse borders, India requires persistent surveillance, resilient connectivity, and rapid-response capabilities.

IAI's combat-proven solutions meet these challenges head-on.

- The trusted Heron UAV family delivers **enduring surveillance** across high-altitude frontiers and deep-sea patrols.
- The scalable Barak system provides **layered air and missile defense**, ensuring strategic stability in high-threat environments.

Connectivity That Saves Lives

IAI's systems are integrated into a unified, AI-powered network, creating **360° situational awareness** that empowers commanders to make fast, informed decision - critical for countering high-volume, multi-vector attacks.

A Trusted Partner for the Future

With four decades of close cooperation, IAI proudly supports India's vision of a self-reliant, next-generation defense ecosystem. In the toughest battles, technology and readiness make all the difference. IAI's vision is to expand local production and development capabilities - to manufacture in India, for India, and for export to the world.

IAI is proud to stand with India - to protect, to partner, and to innovate together.

Empowering a State of Readiness

True security lies in the ability to anticipate, adapt, and respond at a moment's notice. IAI's integrated systems - designed to detect threats early, connect decision-makers seamlessly, and enable rapid, coordinated action - empower nations to maintain **a state of constant operational readiness.**

This readiness ensures that when challenges arise, the response is decisive - **safeguarding sovereignty, stability, and peace.**

AIR CHIEF MARSHAL A.P. SINGH
CHIEF OF THE AIR STAFF
INDIAN AIR FORCE

PHOTOGRAPH: INDIAN AIR FORCE

INDIA's
INDEPENDENCE DAY SPECIAL | CAS MESSAGE

AIR CHIEF MARSHAL A.P. SINGH
PVSM AVSM

It is a heartening to know that SP Guide Publications is releasing its special edition of SP's Aviation on the occasion of 79th Indian Independence Day.

As India celebrates another year of independence, we reflect on the contributions of the Indian Defence Forces in safeguarding our nation's sovereignty. Defence forces responded to the nation's call and demonstrated their prowess in the recently conducted Op Sindoor. The extraordinary success of air operations is a testimony to the preparedness, resilience and resolve of the men in blues.

IAF's journey ahead is one of transformation embracing technological advancements, refining multi domain operations and ensuring seamless integration of emerging capabilities. Self-reliance, adaptability and strategic foresight remain at the core of our evolution, as we stand prepared to meet the challenges of the future. The commitment of Sashakt, Saksham, Atmanirbhar Bharat drives us forward, enabling a future ready force that upholds the nation's security with honour and excellence.

SP Guide Publications has played a pivotal role in chronicling the journey of India's defence forces, providing an insightful narrative that shapes perspectives and informs generations. I extend my compliments to all members of the publication house and wish them continued success in the years to come.

AIR CHIEF MARSHAL
CHIEF OF THE AIR STAFF
INDIAN AIR FORCE

INDIA'S SPACE ODYSSEY: FROM MILESTONES TO THE SPACE FRONTIER PLANS

JOINTLY DEVELOPED BY NASA AND ISRO, THE 'NISAR' IS THE WORLD'S FIRST EARTH OBSERVATION SATELLITE TO CARRY DUAL-FREQUENCY SYNTHETIC APERTURE RADAR

India's space success is well documented with ambitious plans for deep space, planetary exploration, human habitats, and commercial outreach by 2040–47. What is next is the expansion of the Indian space industry and the role of private players. For ISRO, now is time to bridge the gaps.

By MANISH KUMAR JHA

ISRO'S EVOLVING AMBITIONS—FROM LUNAR AND MARTIAN missions to futuristic docking tests and advanced radar systems have certainly placed India among the select group of countries that are trying to scale space frontiers, as far as into the cosmic unknown. In a giant leap, ISRO achieved its first-ever in-orbit docking between two satellites—SDX01 and SDX02—under the SpaDeX mission, launched aboard PSLV-C60 in December. By January 16, India became the fourth nation among the highly coveted world of space technologies to master such a critical capability. From here, it paves the way for future space stations and complex in-space operations.

EARTH IN HIGH DEFINITION: LAUNCH OF NISAR
On July 30, 2025, ISRO and NASA successfully launched NISAR aboard GSLV-F16 from Sriharikota. This cutting-edge satellite uses dual-frequency SAR (L-band from NASA and S-band from ISRO) with SweepSAR technology and a 12m mesh reflector to scan the entire globe every 12 days, in all weather and lighting conditions. NISAR offers millimetre-scale surface change detection—crucial for monitoring glaciers, land deformation, floods, vegetation patterns, and more. With an open-data policy, it fuels global climate science, disaster response, and environmental management.

PHOTOGRAPH: ISRO

(LEFT) SUCCESSFUL COMPLETION OF HUMAN RATING OF CE20 CRYOGENIC ENGINE FOR THE GAGANYAAN PROGRAMME; (RIGHT) AGNIKUL LAUNCHES WORLD'S FIRST ROCKET WITH FULLY 3D PRINTED ENGINE.

HUMAN SPACEFLIGHT & NATIONAL SPACE STATION
Beginning with the Gaganyaan Programme, India's human spaceflight project is hitting its stride with three planned uncrewed missions (Gaganyaan-1 to -3) launching through 2026, followed by the first crewed mission (Gaganyaan-4) around early 2027.

Bharatiya Antariksh Station (BAS): Formally approved in 2024, the first module (BAS-1) is expected to launch in 2028, with a full-fledged station operational by 2035—ushering India into the league of nations with its orbital outpost.

NEXT-GEN LAUNCHERS, VENUS MISSION & LUNAR SAMPLE RETURNS
ISRO's Next Generation Launch Vehicle (NGLV) includes a semi-cryogenic, partially reusable rocket— "Soorya"—capable of lifting 5–16 t to geostationary transfer orbit (GTO), with plans for vertical recovery and methane-LOX propulsion.

One of the complex tasks in India's futuristic space roadmap is the Venus Orbiter Mission (VOM). Green-lit in 2024, this mission is set to launch on March 29, 2028, reaching Venus orbit by July 2028, to unravel mysteries of our sister planet.

Building Chandrayaan-4 & 5 is equally a landmark mission, especially with international collaboration. ISRO is advancing lunar exploration, with Chandrayaan-5—collaborating with Japan Aerospace Exploration Agency (JAXA)—tasked with delivering a robust rover to the Moon's surface.

ISRO's futuristic roadmap further includes ecosystem expansion & infrastructure scaling, like the third launch pad. ISRO's infrastructure is expanding with a third launch pad at Sriharikota expected to be operational by March 2029 to support its growing mission portfolio.

PRIVATE SECTOR AND STARTUPS IN SPACE: A CREDIBLE STORY
India's private space players are pushing technological frontiers. From green propulsion and 3D-printed rockets to hyperspectral imaging constellations and modular satellites, many private entities which started as recently as a decade ago are maturing in critical space technologies. Backed by IN-SPACe and progressive policy support, these companies are not only bolstering India's self-reliance but are positioning it as a global space-tech hub by 2030.

The 2023 Space Policy has catalysed private sector involvement in India's space sector—from engine manufacturing to satellite components. Projects like Ethereal and Agnikul are investing in rocket engine and vehicle facilities in Tamil Nadu.

Space-Tech Centre in Bengaluru: A ₹10 crore Centre of Excellence is underway to foster innovation in Earth observation,

PHOTOGRAPHS: ISRO, NARENDRAMODI / X

satellite manufacturing, AI-based communications, and more, anticipating a surge in skilled space professionals by 2035.

One of the key players in space, Skyroot Aerospace, has come up with a credible success story in building rockets & propulsion. Skyroot has developed Vikram-S, India's first privately built rocket. Recently test-fired, the Kalam-1200 solid booster, the largest rocket stage by an Indian private firm—signals its readiness for the upcoming Vikram-1 orbital launch in 2025.

In fact, Skyroot innovates using carbon-composite structures, 3D-printed components, and is exploring reusable stages and green fuels to drive cost-efficiency and scalability.

Another pioneer in Indian space ecosystems, AgniKul Cosmos has built the world's largest single-piece 3D-printed rocket engine from Inconel, a heat-resistant superalloy—patented in the US, a leap forward in additive manufacturing.

AgniKul has also ventured into launch systems, developing the Agnibaan launch vehicle, powered by multiple Agnilet engines, which is capable of placing 100 kg into LEO. It also operates India's first private mobile launchpad and control centre at Sriharikota.

In the world of propulsion innovation, Bellatrix Aerospace is another indigenous and homegrown entity under the ISRO's thrust on building private players has shown immense potential. Bellatrix's work in electric and green satellite propulsion and their ARKA hall-effect thrusters and RUDRA green monopropellant HPGP systems are being tested onboard ISRO platforms, aiming to replace traditional toxic propellants.

They are also working on space taxi plans -- the "Pushpak" Orbital Transfer Vehicle (OTV) to reposition satellites mid-mission—a game-changer for orbital logistics.

In Satellites & Payloads, Dhruva Space offers full-stack solutions from satellite design to deployment and ground operations. Their CubeSat deployers have already flown on PSLV missions. They're expanding with a new spacecraft manufacturing facility in Hyderabad.

One of the most interesting propositions which has come from the private space players is Pixxel. Pixxel's work in earth observation is full of potential in civil and military applications. It is building a hyperspectral imaging satellite constellation that captures detailed Earth data for environmental, agricultural, and resource monitoring.

Boosting further on the space startups ecosystems, ISRO continues outreach via initiatives like 'Space on Wheels' and educational events to inspire the next generation of space scientists—emphasising India's peaceful space vision and commercial potential worth lakhs of crores.

Additionally, there are notable players like EtherealX, GalaxEye, OrbitAID, and Digantara, which are working on reusable rocket engines, private SAR assets, on-orbit servicing, surveillance satellite constellations, and more.

(TOP) REUSABLE LAUNCH VEHICLE (RLV) 'PUSHPAK'
(ABOVE) SPADEX MISSION: SUCCESSFUL DEMONSTRATION OF DOCKING AND POWER TRANSFER

PHOTOGRAPHS: ISRO / X, ISRO

ISRO'S CHALLENGES: BRIDGING GAPS AND EXPANDING DUAL-USE CAPABILITIES

Scientific feat is always propelled by the fact that technology is rapidly moving, especially in the space domain. ISRO, with its staggering success and pioneering work in India, is bound to look at some of the critical areas and address gaps.

ISRO stands at the cusp of transitioning from a civil-dominated programme to one with stronger dual-use (civil-military) applications. However, this transition is challenged by technological gaps, infrastructure constraints, and geopolitical demands.

While ISRO has demonstrated Reusable Launch Vehicles (RLVs) -- RLV-TD glide tests, it lacks a fully operational reusable launch system—vital for cost-effective heavy payload delivery and rapid deployment.

Next is, crucially the cryogenic and semi-cryogenic engines. Indigenous cryogenic engines (e.g., CE-20 on GSLV Mk III) have matured, but ISRO still trails behind in semi-cryogenic methalox propulsion systems critical for reusable boosters and future Next-Gen Launch Vehicles (NGLV).

ISRO also need to work on in-orbit servicing & assembly. With SpaDEx docking success, ISRO is beginning in-space operations, but lacks robotic arms, autonomous rendezvous tech, and orbital refuelling systems essential for space station maintenance and logistics.

In the area of AI & autonomy in satellites, ISRO satellites still rely on Earth-based control. There's limited real-time onboard AI for autonomous manoeuvring, threat detection, or self-repair—a key feature in modern space defence systems.

MILITARY-SPACE APPLICATIONS

The one area that India needs to address is the reconnaissance & surveillance using space assets. India has RISAT (radar), CARTOSAT (optical), and EMISAT (ELINT), but lacks high-resolution, rapid-refresh imaging constellations like Starlink or NRO-class assets. Tactical satellite relays are still in infancy.

ISRO also need to work on space-based navigation (SBAS). While the NavIC is operational, but lacks full global coverage and encrypted military channels (like GPS M-Code), making secure battlefield coordination vulnerable.

Expanding on the similar gaps, despite the 2019 ASAT test and its impeccable success, India lacks sustained capabilities in space situational awareness (SSA), directed energy systems, and co-orbital interceptors.

In defence and secure communication, the GSAT-7 series supports defence communications, but high-throughput, jam-resistant, and quantum-encrypted channels are still under R&D, primarily via DRDO collaborations.

However, the most pressing part is the launch cadence as ISRO's current infrastructure limits launches to ~6–8 per year. In comparison, SpaceX surpasses 100 annually. ISRO's third launch pad (expected ~2029) may ease this, but delays persist.

Last but another crucial element is talent & funding. While ISRO's budget (~1.8 billion) is frugal, it restricts rapid innovation. ISRO also faces a talent crunch, with private startups absorbing much of the emerging propulsion and software talent.

The budgetary and talent issues will also help India resolve some of the issues in the areas of export control and technology denial, as India's non-signatory status to MTCR in the past and current restrictions on cryogenic tech, radiation-hardened components, and advanced sensors impede rapid advancement.

To evolve into a full-spectrum space power with military and civil parity, ISRO must fast-track work on autonomy, high-throughput communication, reusable launchers, and SSA. Strategic collaboration with DRDO, private startups, and international allies will be essential to close these gaps by the early 2030s.

GROUP CAPTAIN SHUBHANSHU SHUKLA'S MISSION ON BOARD AXIOM-4 HAS ESTABLISHED A CLEAR PATH FOR INDIA'S PROGRESS TOWARDS INDEPENDENT SPACE TRAVEL

PHOTOGRAPH: SPACEX / X

WHY IT MATTERS: ISRO'S TRAJECTORY

From docking satellites to beaming real-time Earth data, and preparing humans for space, ISRO is scripting India's space era. With ambitious plans for deep space, planetary exploration, human habitats, and commercial outreach by 2040–47, it's clear: India is ascending as a space powerhouse. SP

EXCLUSIVE

DRDO'S HYPERSONIC CRUISE MISSILE IS AMONG THE FIRST IN THE WORLD

DR SAMIR V. KAMAT, SECRETARY DDR&D AND CHAIRMAN DRDO

PHOTOGRAPH: PIB

A hypersonic boom, which could set forth Extended Trajectory-Long Duration Hypersonic Cruise Missile (ET-LDHCM) up to Mach 8-10, to next-gen AESA, to applying quantum sensing to the anti-submarine warfare, DRDO is proving true to the R&D within its name. In an Exclusive interaction, **Samir V. Kamat, Secretary DDR&D and Chairman DRDO**, speaks with **Manish Kumar Jha** on the full and comprehensive range of military technology development, some of them futuristic and ground-breaking for India.

Manish Kumar Jha (Manish Jha): The DRDO recently broke new ground by conducting test of a scramjet engine, which will enable critical hypersonic weapon technology for India. How complex and indigenous is the scramjet engine development, and how will it be a game changer for DRDO's next generation missile advancement?

Samir V. Kamat (Kamat): Hypersonic Cruise Missile is a class of weapons that can travel more than 5 times the speed of sound (> 6100 Kmph) for long duration and is powered by scramjet i.e., Air breathing engine. Air breathing propulsion systems, having supersonic combustion, plays a critical role for long-duration cruise conditions.

DRDO achieved a significant milestone in the field of Hypersonic Weapon Technology, when it conducted long-duration Active Cooled Scramjet Subscale Combustor ground testing. The development of this scramjet engine is fully indigenous. It will be a game changer as the hypersonic missiles are very difficult to track and intercept. It gives you an assured retaliation capability, even if the other country has good air defence. The missile is difficult to detect and even if detected, it is difficult to intercept them.

PLATFORMS AND SYSTEMS DEVELOPED BY DRDO:
(CLOCKWISE FROM TOP LEFT) THE ADVANCED MEDIUM COMBAT AIRCRAFT (AMCA); THE UPGRADED LCA TEJAS MK2 IS UNDER DEVELOPMENT; LRDE DESIGNED AND DEVELOPED UTTAM AESA RADAR FOR LCA (TEJAS) AIRCRAFT; BRAHMOS-NG (NEXT GENERATION) SUPERSONIC CRUISE MISSILE

PHOTOGRAPHS: SARTHAK BARANWAL/ SP GUIDE PUBNS, DRDO_INDIA / X, SPOKESPERSONMOD / X, SP GUIDE PUBNS

We are working on two types of hypersonic missiles, hypersonic glide missile and hypersonic cruise missile. We have finished one development trial of Hypersonic glide missiles and in next 2-3 years we should be able to complete its development and will offer it to the Users.

For development of Hypersonic Cruise missiles, which is based on scramjet, we are currently proving the scramjet on the ground, and then we have to prove it in flight. Then there are other challenges in respect to the cruise missiles, and, I hope that in next five years it will get converted into weapon system. Hypersonic missiles are being flown by select few countries in the world, but they are not the hypersonic cruise missile. They are flying hypersonic glide missiles only.

Manish Jha: What is next after Akash, especially when it worked and proved, showing the efficacy, testing and credibility in real real-time situation?

> "The GTRE has developed Kaveri dry engine, which will go into our unmanned platforms. For a manned platform, we need higher thrust weight class engine, which we hope to do."

Kamat: Our indigenously developed Akash missile system demonstrated its capabilities effectively in the recent conflict. Currently User trials of Akash NG are going on, that would be the next generation, Akash.

India became first country to demonstrate the capability of engagement of 04 aerial targets simultaneously at 25 km ranges by command guidance using single firing unit by Akash Weapon System. We are also working on Akash with longer range capability. Then there is Quick Reaction Surface-to-Air Missile (QRSAM), which is going to be inducted soon.

Manish Jha: What are the features that lead to the new fighter jets being harder to detect by the enemy radars, and does the DRDO plan on upgrading the Indian radar system to detect such jets that would perhaps be used by foreign military forces?

Kamat: Stealth fighter jets are designed to minimise radar detection through a

combination of features including radar-absorbent materials, specialised shaping, and electronic warfare capabilities. The DRDO is actively working on upgrading India's radar systems, including the development of advanced radars. Designed for air superiority, ground strikes, suppression of enemy air defences, and electronic warfare, the AMCA features advanced systems tailored for modern combat. Its stealth profile incorporates a low radar cross-section, achieved through radar-absorbent materials and internal weapons bays, enabling it to evade enemy detection.

In the field of Radar, we are self-sufficient now. Our radars are of world class. We have airborne radars, ship-based radars, cloud-based radars. We are having long range radars meant for tracking ballistic missiles as well as space situational awareness. We have short range battlefield radar as well as land-based radars for surveillance capability. Today we are having the capability to develop any type of radar. DRDO is actively working on upgrading India's radar systems, including the development of advanced radars.

THE GTRE DEVELOPED KAVERI ENGINE FINAL HIGH-ALTITUDE TRIALS AS WELL AS FLYING TEST BED TRIALS ARE UNDERWAY

Manish Jha: What about DRDO's AESA Radar development progress?

Kamat: AESA radar is now ready for our airborne platforms. DRDO's LRDE has designed and developed Uttam AESA Radar for LCA (Tejas) aircraft of the Indian Air Force (IAF). Production clearance was obtained after completion of developmental flight trials. Licensing Agreement for Transfer of Technology (LAToT) was signed between DRDO and HAL, Hyderabad for Limited Series Production of Uttam Radar for LCA Mk-1A. The combined flight trials with Indigenous EW Suite of DRDO is in progress on Tejas. Production Order on Industry Partner is awaited, so as to make Radar available for the 41st Aircraft onwards being produced by HAL for IAF.

Manish Jha: How close is DRDO to operationalising quantum tech against advanced submarine threats, and is this a near-term or decade-long capability?

Kamat: There is quantum computing, quantum sensing and Quantum Communications. Detection of submarines is quantum sensing, where you have quantum interference, where very small changes in the magnetic field is detected.

So, when a submarine passes, because it is made up of steel, it has some magnetic effect i.e., it disturbs the earth magnetic field. So, the small changes in the earth magnetic field can be detected by this magnetic sensor, which can be flying on a UAV or an aircraft. That way you can detect submarines up to a depth of 100-200 meters. It is a very useful technology.

We are working on various types of magnetometers, which can detect picotesla (pT) level changes in the magnetic field. With that we hope that we will be able to detect submarines in the ocean. It is not very futuristic; we hope that we should have this indigenous capability in next 2-3 years.

Quantum Communication through optical fibres, we have demonstrated upto 100 kms. Now, recently we have done free space quantum secure communication using quantum entanglement over a distance of more than one km via a free-space optical link established on the IIT Delhi campus. Free-space Quantum Key Distribution (QKD) eliminates the need to lay optical fibres, which can be both disruptive and expensive, especially in challenging terrains and dense urban environments. With this, India entered into a new quantum era of secure communication which will be a game changer in future warfare.

> "DRDO achieved a significant milestone in the field of Hypersonic Weapon Technology, when it conducted long-duration Active Cooled Scramjet Subscale Combustor ground testing. The development of this scramjet engine is fully indigenous."

Manish Jha: What steps has DRDO taken in the process of developing a higher thrust class engine? And how do you look at the possible collaboration to partner with, the co-development cost and time?

Kamat: We are looking at the co-development of higher thrust class engine and this could be a national mission, where there will be GTRE, there will be the Indian industry and of course there will be a foreign OEM. We will also involve academia and other startups to work with us because this is a capability which the country needs. Lot of discussions has happened but final decision in this regard will be taken by our government. This is one area where we have to become Atmanirbhar.

PHOTOGRAPH: SP GUIDE PUBNS

DRDO CONDUCTS LONG-DURATION ACTIVE COOLED SCRAMJET SUBSCALE COMBUSTOR GROUND TESTING. THE DEVELOPMENT OF THIS SCRAMJET ENGINE IS FULLY INDIGENOUS.

The GTRE has developed Kaveri dry engine, which will go into our unmanned platforms. For a manned platform, we need higher thrust weight class engine, which we hope to do. The Kaveri engine final high-altitude trials as well as flying test bed trials are underway and once that is done, we are ready to integrate it with our Unmanned Platforms.

Manish Jha: Beyond the concept of "Make in India", how has the DRDO worked to ensure core intellectual property ownership in next-gen systems like AMCA and hypersonic to further prevent tech dependencies?

Kamat: DRDO is actively involved in designing and developing critical technologies for advanced systems like the AMCA (Advanced Medium Combat Aircraft) and hypersonic missiles. This includes focusing on key areas like stealth technology, AI-assisted electronic piloting and advanced avionics. DRDO's work on hypersonic technology, including the successful ground testing of a scramjet engine, demonstrates India's progress in this cutting-edge field.

We are generating our own intellectual property. We are doing the design and development on our own. The IP belongs to us. Even when we do co-development of an engine, one of the conditions is that entire IP should belong to India. DRDO is working to ensure core intellectual property (IP) ownership in next-gen systems like the AMCA and hypersonic by prioritising indigenous design and development, fostering collaboration with private players, and leveraging transfer of technology (ToT) agreements strategically.

MANISH KUMAR JHA, CONSULTING & CONTRIBUTING EDITOR FOR *SP'S AVIATION* IN AN EXCLUSIVE INTERACTION WITH DR SAMIR V. KAMAT, SECRETARY DDR&D AND CHAIRMAN DRDO

PHOTOGRAPHS: PIB, DPI, DRDO

This approach aims to reduce reliance on foreign technology and build a self-reliant defence industrial base. DRDO is increasingly engaging with private sector companies and MSMEs in defence R&D and manufacturing. This collaboration is crucial for scaling up production, accelerating technology transfer, and building a robust domestic defence ecosystem.

The "Make in India" initiative is a key driver in this process, encouraging private companies to invest in defence production and contribute to self-reliance. The ToT process is carefully managed to ensure that India retains control over the core IP and can adapt the technology to its specific needs. DRDO also releases updated compendiums like "DRDO Products for Export," showcasing India's defence capabilities to friendly nations and potentially paving the way for further collaborations and ToT opportunities.

Manish Jha: DRDO has developed crucial AIP technology in the shortest time. How would you talk about the DRDO AIP systems induction timeline for the P-75 submarine?

Kamat: DRDO developed AIP is going into the P-75. Our energy module is getting ready hopefully by December this year and then module will be put in a submarine hull, that may take a year or so. After that when the submarine come for refit, this hull containing the AIP i.e., energy module will be joint to the submarine and then it will go through the testing. The land-based prototype of this AIP was proven on the ground last year.

Manish Jha: What measures can be taken to ensure the security of the Indian coastline?

Kamat: For Coastline security, you can have variety of defence systems like Radars, Electro Optic systems etc to detect any threats coming in. Then you can have a coastal battery of guns, missiles like surface-to-surface, surface-to-air etc. An entire network can be built if required. It need not be ship based only, it may also be ground based or shore based. BrahMos is also a good weapon, it can be fired from the shore. Then Guided Pinaka is also very accurate, which can be used against ships which are coming close to our coast.

AS A FORCE MULTIPLIER, THE MQ-9 DRONES MARK A SIGNIFICANT LEAP IN INDIA'S AERIAL WARFARE CAPABILITIES

PHOTOGRAPH: GA-ASI

INDIA'S TRYST WITH COMBAT DRONES

With indigenous initiatives like the DRDO's Archer and HAL's CATS Warrior, alongside procurements of MQ-9B Sea/Sky Guardians, India is positioning itself as a significant player in unmanned warfare, reshaping its military doctrine for the future

By AIR MARSHAL ANIL KHOSLA (RETD)

THE CONCEPT OF UNMANNED FLIGHT DATES BACK TO WORLD War I, but drones became a viable military asset not until the late 20th century. The US military's use of the Predator drone during the 1990s and early 2000s marked a significant turning point. Armed variants of the Predator demonstrated the feasibility of unmanned precision strikes, ushering in a new era of aerial warfare. Since then, countries such as China, Russia, Turkey, and Iran have rapidly developed their combat drone capabilities. Technological advancements in artificial intelligence (AI), sensor miniaturisation, and autonomous navigation have expanded combat drones' capabilities. Modern drones can operate autonomously, engage in complex swarm tactics, and integrate with network-centric warfare systems.

India's journey with combat drones has evolved from reliance on imports to an ambitious push for indigenous development. Initially dependent on Israeli UAVs for surveillance and reconnaissance, India has steadily expanded its drone capabilities, integrating armed drones into its military strategy. The emergence of global drone warfare, exemplified by conflicts has accelerated India's efforts to develop and deploy its combat UAVs.

DRONE WARFARE

Combat drones, or unmanned aerial vehicles (UAVs), have rapidly transformed modern military operations. They offer a range of significant advantages that enhance strategic effectiveness and operational efficiency. These advantages are critical

DRDO IS SPEARHEADING SEVERAL INDIGENOUS DRONE PROGRAMMES, INCLUDING THE ARCHER UAVS, TO BOLSTER INDIA'S CAPABILITIES

PHOTOGRAPH: SP GUIDE PUBNS

for established military powers and smaller nations looking to improve their defence capabilities.

- **Cost-Effectiveness:** One of the most prominent advantages of combat drones is their cost-effectiveness. In contrast to manned aircraft, combat drones are more affordable to produce, operate, and maintain.
- **Reduced Risk to Human Life:** The ability to operate drones remotely means that military personnel are not physically present in the combat environment, which significantly reduces the risk to human life.
- **Persistent Surveillance and Endurance:** Combat drones can remain airborne for extended periods, often hours or even days. Unlike manned aircraft, this endurance allows drones to conduct continuous operations over extended periods without returning to the base for fuel or rest.
- **Precision Strike Capabilities:** Modern combat drones are equipped with advanced targeting systems, enabling them to conduct precise strikes with high accuracy.
- **Operational Flexibility:** Another significant advantage of combat drones is their operational flexibility. Drones are highly versatile and can be deployed in various roles. This adaptability makes drones valuable assets in numerous military operations, enhancing their utility in diverse combat scenarios.

FUTURE TRENDS IN DRONE WARFARE

AI-Driven Autonomy. AI-driven autonomy in drone warfare will revolutionise decision-making, enabling UAVs to analyse data and execute missions independently. This reduces human intervention, enhances speed, and improves operational efficiency, allowing drones to make real-time tactical decisions and adapt to changing battlefield dynamics without relying on constant human oversight.

Swarm Tactics. Swarm tactics involve deploying many drones that can communicate and collaborate autonomously to overwhelm targets. This approach maximises impact, confuses enemies, and complicates defence strategies. Swarms can be used for offensive operations, like saturation attacks, and defensive roles, such as countering incoming threats in coordinated formations.

Hybrid Manned-Unmanned Operations. Hybrid manned-unmanned operations combine human decision-making with autonomous drone capabilities, enhancing flexibility and situational awareness. Human pilots can control UAVs while receiving support from AI systems that automate data processing and mission planning. This synergy allows for optimal control and strategic execution while reducing the cognitive burden on operators.

Miniaturisation and Stealth. Miniaturisation and stealth technologies are enhancing drones' ability to operate undetected. Smaller, quieter UAVs with reduced radar signatures can infiltrate enemy defences, gather intelligence, or carry out strikes without being easily intercepted. These advances improve tactical flexibility and extend the operational range of drones in contested environments.

INDIA'S TRYST WITH DRONES: EVOLUTION AND EXPANSION

India's journey with drones has evolved over the past few decades, driven by security imperatives and technological advancements. Initially dependent on imports, particularly from Israel, India procured drones such as the Heron and Searcher for surveillance and reconnaissance missions along the sensitive borders with Pakistan and China. The 1999 Kargil conflict was a pivotal moment that highlighted the critical role of drones in modern warfare, pushing India to invest in enhancing its UAV capabilities. Over the years, the Indian armed forces have increasingly relied on drones for intelligence, surveillance, and reconnaissance (ISR) operations, with a growing focus on indigenous development to reduce dependence on foreign suppliers.

The Defence Research and Development Organisation (DRDO) has spearheaded several indigenous drone programmes, including the Rustom, Nishant, and Archer UAVs, to bolster India's aerial capabilities. Concurrently, private sector participation has expanded, with startups and defence firms innovating in drone swarms, autonomous systems, and logistics applications. Under the "Atmanirbhar Bharat" (Self-Reliant India) initiative, the government has introduced policy reforms to encourage local production and innovation, positioning India as an emerging player in the global drone ecosystem.

Despite progress, India still faces technological challenges in developing advanced stealth drones and autonomous systems comparable to international standards. While India has made substantial strides in drone development, it faces several critical challenges that must be addressed to achieve self-sufficiency and operational superiority. One of the primary concerns is technological dependence on foreign suppliers for key components such as avionics, sensors, and propulsion systems. Efforts to bridge this gap through Indigenous programmes such as the Ghatak stealth UCAV and the Archer-armed UAV are ongoing, but delays and budgetary constraints have hindered progress. The growing threat posed by adversarial drones, mainly from Pakistan and China, has also necessitated the development of robust counter-drone technologies, including electronic warfare systems and directed energy weapons.

The 2020 Galwan Valley standoff with China underscored the urgent need for persistent aerial surveillance in high-altitude regions. This prompted the Indian military to explore AI-driven autonomy and swarm tactics for enhanced situational awareness. Looking ahead, India's drone strategy focuses on expanding its indigenous manufacturing base, fostering public-private partnerships, and investing in next-generation technologies such as autonomous drone swarms and high-altitude long-endurance (HALE) UAVs. With sustained government support, increased defence budgets, and collaboration with international partners, India could become a significant player in the evolving drone warfare landscape.

> India's journey with combat drones has evolved from reliance on imports to an ambitious push for indigenous development

MQ-9 SEA/SKY GUARDIAN: LATEST WEAPON IN INDIAN ARSENAL

Predator Series of Drones. The Predator series of drones, developed by General Atomics, revolutionised modern warfare with their long-endurance, remotely piloted capabilities. Beginning with the RQ-1/MQ-1 Predator, used primarily for intelligence, surveillance, and reconnaissance (ISR), the series evolved into the more advanced MQ-9 Reaper, featuring greater payload capacity and strike capabilities. Armed with Hellfire missiles and precision-guided bombs, these drones have played crucial roles in US military operations, particularly in counter-terrorism. Widely exported, Predator drones are now integral to modern air forces, enhancing strategic and tactical operations. Sea/Sky Guardians are variants of the MQ-9 drone.

MQ-9 SeaGuardian Usage by Indian Navy. In 2020, the Indian Navy began operating MQ-9B SeaGuardian drones under a lease agreement with the United States, marking a significant step toward modernising its maritime surveillance and reconnaissance capabilities. These drones are a variant of the MQ-9 Reaper, adapted for long-endurance maritime operations with enhanced sensors, radar, and payloads specifically designed for naval use.

Maritime Capability Enhancement. The MQ-9B's capabilities give the Indian Navy an edge in tracking enemy vessels operating near India's borders and the broader Indian Ocean. With a range of over 5,000 km and the ability to stay airborne for up to 35 hours, these drones can cover vast areas, from sensitive chokepoints like the Malacca Strait to critical regions of the Bay of Bengal and Arabian Sea. Their versatility in real-time intelligence gathering and precision strike capabilities allows the Navy to act quickly and decisively to defend Indian interests, including counter-piracy operations and protecting vital sea lanes. The SeaGuardian drones provide the Indian Navy with persistent surveillance, allowing real-time monitoring of maritime traffic, enemy vessels, and submarine activity, significantly enhancing maritime domain awareness.

Indian MQ-9 Sea/Sky Guardian Drone Acquisition Programme. In October 2024, India's Ministry of Defence finalised a contract with the US government to procure 31 MQ-9B drones from General Atomics, valued at approximately $4 billion. The deal comprises 15 SeaGuardian drones designated for the Indian Navy and 16 Sky Guardian drones allocated between the Indian Army and Air Force. The procurement was executed under the Foreign Military Sales (FMS) programme, facilitating a government-to-government transaction. The contract includes a performance-based logistics agreement with General Atomics Global India Pvt Ltd for depot-level maintenance, repair, and overhaul within India, ensuring sustained operational readiness.

Capability Enhancement. India's acquisition of the MQ-9 drones, made by General Atomics, marks a significant step in enhancing the country's defence capabilities. These drones will provide India with advanced intelligence, surveillance, and reconnaissance (ISR) capabilities, significantly boosting its ability to monitor vast, remote, and high-altitude border regions. The drones are equipped with cutting-edge sensors capable of carrying many munitions, making them highly versatile for strategic and tactical operations. As a force multiplier, these drones mark a significant leap in India's aerial warfare capabilities.

CONCLUSION

The rise of combat drones represents a paradigm shift in modern warfare, challenging the supremacy of traditional air power. While manned aircraft will continue to play a crucial role in future conflicts, the increasing integration of drones necessitates a revaluation of military doctrines, investment priorities, and force structures. The future of air warfare lies in a balanced approach that leverages the complementary strengths of both manned and unmanned systems. The induction of MQ-9B Sea/Sky Guardian will be a game-changer for India's defence forces, significantly enhancing maritime domain awareness, surveillance, and precision strike capabilities. It will bolster India's preparedness against emerging threats, provide a crucial edge in monitoring adversarial activities, and strengthen deterrence. As India modernises its military, the MQ-9B's integration signals a shift towards greater reliance on cutting-edge drone warfare technology. SP

INDIGENOUS UCAV 'CATS' WARRIOR

Once operational, the CATS Warrior is expected to mark a significant milestone in India's indigenous defence and aerospace capabilities

INDIA'S INDIGENOUS UNMANNED COMBAT AERIAL VEHICLE (UCAV) 'CATS Warrior' was first unveiled as a scale model mockup at Aero India 2021. The Warrior scale model was accompanied by a Tejas-Max cockpit which acted as a "mothership" for the CATS. The CATS Warrior, a key component of the broader Combat Air Teaming System (CATS) programme, is being developed by the Aircraft Research and Design Centre (ARDC) of Hindustan Aeronautics Limited (HAL), in collaboration with Bengaluru-based private startup NewSpace Research and Technologies (NRT), as part of a public-private partnership.

The CATS Warrior is a low-observable UCAV designed to function as a 'loyal wingman' that can accompany and support manned fighter jets during combat missions. It is engineered for autonomous operations, with capabilities for both land-based and aircraft carrier operations. At the Aero India 2025, HAL displayed a full-scale prototype of the CATS Warrior, signaling the project's advancement. Multiple design changes had been brought up in the prototype demonstrator as compared with the scale model showcased at Aero India 2021, most importantly the air intake. The new design shifted from angular surfaces which prioritised stealth. A report stated that, instead, the prototype now uses Radar Absorbent Material (RAM) coatings and laminations with over 99 per cent attenuation. These changes were made to enhance the performance while still being low observable. The changes could also increase payload and efficiency.

The ambitious CATS Warrior initiative is steadily progressing toward completion. The first test flight of the CATS Warrior is scheduled for 2026, with the prototype currently in its final stages of development.

General characteristics of the CATS Warrior include the following: Capacity - 650 kg weapon load; Length - 9.1 metres; Wingspan - 7.6 metres; Height - 2.6 metres; Maximum Take Off Weight - 2,100 kg; Powerplant - 2 × HAL PTAE-W turbojet with 3.7 kN thrust each. Performance parameters of the CATS Warrior are: Maximum Speed: Mach 0.9; Cruise Speed - 790 km/h or Mach 0.6; Range - 700 km; Combat Range - 350 km; Service Ceiling - 9,000 metres. The armament package of CATS Warrior comprises: Four Hardpoints – two internal (155 kg each) and two external (170 kg each) with a capacity of 650 kg; Provisions to carry combinations of 2 x ASRAAM air to air missiles and bombs – 2 x DRDO Smart Anti-Airfield bombs and 24 x CATS ALFA-S. For avionics, the CATS Warrior will be equipped with an electro-optic/infrared payload, Active electronically scanned (AESA) radar, inertial navigation unit, and a jammer for intelligence, surveillance, and reconnaissance and combat operations, The prototype uses an indigenous Mission Computer from SLRDC.

The CATS Warrior will team up with the Indian Air Force (IAF) fighter jets like the LCA Tejas, Advanced Medium Combat Aircraft (AMCA), Su-30 MKI and Jaguar, which will act as motherships. A smaller naval version is also under consideration for the Indian Navy. The Defence Research and Development Organisation (DRDO) is conducting final-stage trials of the indigenous Kaveri engine in Russia, which is being considered for integration with the upcoming CATS Warrior platform.

The CATS Warrior is designed to carry out a range of combat roles. Operated remotely by a mothership aircraft (IAF jet fighters), the CATS Warrior has the capability to return to base after completing its mission. The CATS warrior is designed to perform a series of tactical roles, from reconnaissance and absorbing enemy fire to offensive strikes using internal and external weapon pylons. In high-risk missions, it can also be deployed as a kamikaze drone, intentionally crashing into high-value enemy targets to protect manned aircraft and maximise mission impact. According to a former IAF test pilot, the CATS Warrior will serve as a 'sensor amplifier' for the LCA Tejas fighter jet, flying out ahead of the manned aircraft and using its sensors to feed information back to the Tejas. He also says the CATS Warrior will fly back for another mission within the combat radius of 350 km and for a long-range mission with a combat radius of 800 km it will sacrifice itself crashing into the target. As an unmanned asset, it can be directed towards a target and sacrificed in case it cannot be flown back to its own territory. SP

INDIA'S INDIGENOUS UNMANNED COMBAT AERIAL VEHICLE (UCAV) 'CATS WARRIOR' IS DESIGNED TO CARRY OUT A RANGE OF COMBAT ROLES

PHOTOGRAPH: WIKIPEDIA

—By Lt General P.C. Katoch (Retd)

THE MOD IS ACTIVELY EXPLORING SHORT-TERM FOREIGN PROCUREMENT TO BRIDGE IAF'S CAPABILITY GAP. RUSSIA HAS PROPOSED ITS SU-57 JET.

IAF TO ADDRESS SQUADRON GAPS, INTERIM SOLUTION TO ACQUIRE FIFTH-GENERATION JETS

It is widely noted that the IAF needs to urgently plug a growing capability gap as the thrust comes amid thinning squadron strength. Could there be an interim solution to fill the void?

By MANISH KUMAR JHA

PHOTOGRAPH: UAC

THE INDIAN AIR FORCE (IAF) HAS FORMALLY RECOMMENDED acquiring two to three squadrons (roughly 40–60 aircraft) of fifth-generation stealth fighters.

It is widely noted that the IAF needs to urgently plug a growing capability gap as the thrust comes amid thinning squadron strength (projected to fall to 29 by October 2025, versus an authorised 42.5) and a rapidly advancing adversary in the region. This comes in the background of the final batch of ageing MiG-21s, which is set to retire by September, leading to an acute shortfall.

IAF SHORTAGES AND COMPETITOR ADVANCEMENTS HAVE SPURRED URGENT ENHANCEMENT IN AIRBORNE CAPABILITY. THE UNITED STATES HAS PITCHED ITS F-35 STEALTH FIGHTER.

To address such an anomaly, a high-level panel led by the Defence Secretary in looking into and evaluating various possibilities. For stopgap arrangements, certain reports point out the two stealth offerings – F-35 from the US, and Su-57 from Russia. F-35 is the only fifth-generation operational fighter that is widely used by the US and its allies. Russia's Su-57 is an advanced fighter jet with many features of fifth-generation elements.

The United States has pitched its F-35 stealth fighter, widely deployed by its allies across the globe. Russia, on the other hand, has proposed its Su-57 jet. Both aircraft are classified as fifth-generation platforms. However, the foreign route is already in discussion under the MRFA programme for 114 jets with a 'Make in India' component.

PROJECT STATUS & INSTITUTIONAL OVERSIGHT: SQUADRONS UNDER STRAIN

Approved by the Cabinet Committee on Security (CCS) in March 2024 with a ₹15,000+ crore budget, the Advanced Medium Combat Aircraft (AMCA) is India's flagbearer for indigenous fifth-generation capability.

A special committee chaired by Defence Secretary Rajesh Kumar Singh—including IAF Vice Chief, Defence Research and Development Organisation (DRDO), ADA, and Defence Production officials—has been convened to craft a production cum business model framing a fast-track path. The committee aims to shrink development timelines, boost private sector participation, and explore foreign engine collaboration.

> It is widely noted that the IAF needs to urgently plug a growing capability gap as the thrust comes amid thinning squadron strength (projected to fall to 29 by October 2025, versus an authorised 42.5) and a rapidly advancing adversary in the region

As of now, the time line looks like - Design work concluded in 2023. Five prototypes are planned, with rollout starting in late 2026 to early 2027. The first flight is expected by 2028–29, certification by 2032, and IAF induction by 2034–35.

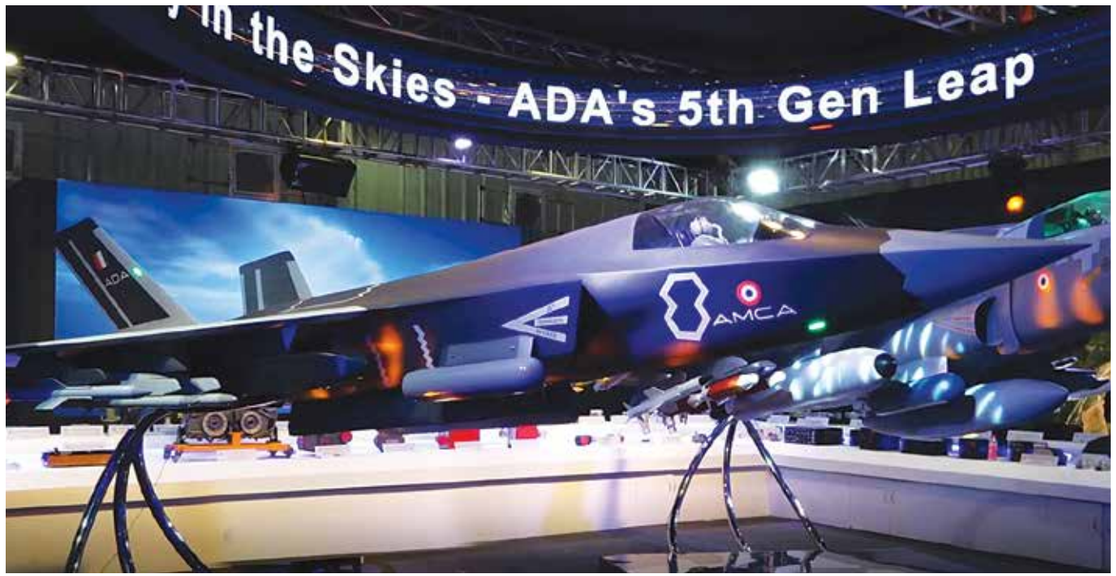
At the same time, MoD's AMCA execution model, cleared in May 2025, has shifted from a HAL-led SPV to a public-private partnership (PPP). The roadmap for AMCA will have Indian private entities-individually or in joint ventures, to lead development and production.

DELAYS IN TEJAS WEAPONISATION & PRODUCTION

A parliamentary panel in late 2024 highlighted that IAF needed 42 squadrons but had only 31 operational—citing delivery delays of 83 Tejas Mk1A jets from HAL, which had not been delivered on schedule. IAF Chief Air Marshal A.P. Singh has repeatedly criticised HAL over slow Tejas deliveries and urged urgency in weaponisation and integration, especially in light of China's military consolidation.

The upgraded Tejas Mk2, with 11

PHOTOGRAPH: USAF



THE ADVANCED MEDIUM COMBAT AIRCRAFT (AMCA) IS INDIA'S FLAG BEARER FOR INDIGENOUS FIFTH-GENERATION CAPABILITY

PHOTOGRAPH: PIB

weapon stations and a fully indigenous weapons loadout, is under development. The prototype's wings and fuselage are nearing completion, but the rollout timeline will see extension due to issues like engine delays, among others. Overall, the situation demands an urgency to fill the gaps while the indigenous fighters' development is underway.

DEFENCE SECRETARY COMMITTEE & CAPABILITY ROADMAP

In early 2025, the Empowered Committee for Capability Enhancement, chaired by the Defence Secretary, submitted recommendations to boost IAF's light combat aircraft production and integrate the private sector into defence aerospace roles.

The committee's recommendation was not only based on the IAF's perspective plan, but also the immediate threats and counter-attack strategy, which is all about operational readiness.

CHINA'S RAPID PLAAF (PLA AIR FORCE) ADVANCES

China has already deployed its Chengdu J-20 fifth-generation stealth fighters at airbases such as Hotan and Shigatze, directly facing India's border regions.

In December 2024, Chinese authorities unveiled what are believed to be two prototype sixth-generation stealth fighters from Chengdu and Shenyang—remarkable for their tailless design and AI-driven features. This startled global defence observers.

Inducted in 2017, the Chengdu J-20 now numbers around 200–300 operational jets, armed with PL-15 long-range missiles and positioned near the LAC. Using stealth, super cruise, and networked warfare, it provides China with significant air dominance.

PAKISTAN'S J-35 / FC-31 ACQUISITION PLANS

Pakistan has expressed intent to procure 30–40 Chinese Shenyang J-35A (export variant of FC- 31). Pilot training began in China around mid 2025, with initial deliveries expected by 2026—but these were later downplayed by Pakistan's defence minister as speculative media reporting.

Pakistan continues to operate J-10CE and JF-17 Block III fighters, many armed with PL-15E active radar guided missiles.

STRATEGIC IMPLICATIONS & OUTLOOK

India today is at a critical inflexion point! IAF shortages and competitor advancements have spurred urgent upgrade in airborne capability. The Defence Ministry is actively exploring short-term foreign procurement to bridge the gap, while simultaneously accelerating indigenous platforms like Tejas Mk2 and AMCA with the aid of new institutional reforms.

> Beyond mere procurement, India and the US are in the final stages of negotiating a co-production agreement for the next generation GE F414 engines, slated for the LCA Mk2

Yet challenges remain—from HAL's delivery delays to compressed timelines needed to match China's sixth-generation ambitions and Pakistan's acquisition of advanced Chinese fighters. Achieving technological self-reliance, bolstering squadron strength, and implementing strategic modernisation under strict deadlines will define the IAF's future posture—and India's regional deterrence calculus. SP

IAF MAINTENANCE CREW ON THE JOB AT A BASE REPAIR DEPOT

PHOTOGRAPH: IAF_MCC / X

INDIA'S DEFENCE MRO SECTOR — FLYING STRONG

From building joint ventures with global OEMs to developing indigenous component manufacturing, India is reclaiming its capability to maintain, upgrade, and extend the life of its defence assets on Indian soil, with Indian hands, and for Indian missions

By SWAATI KETKAR

AS INDIA CELEBRATES 78 YEARS OF INDEPENDENCE, A QUIET revolution is reshaping the nation's military aviation capability, not in the skies, but on the ground. With a vision rooted in Atmanirbharta (self-reliance), India's defence Maintenance, Repair and Overhaul (MRO) sector is undergoing unprecedented transformation, ensuring that our armed forces no longer have to look abroad to keep their aircraft flying.

India's has a huge defence aviation fleet approximately around 1,700 aircraft and is one of the largest in the world. A part of this fleet, legacy aircraft like MiG-21, IL-76, and Mi-17 are fast becoming obsolete. Taking care of this fleet is of critical importance in terms of safety and security. Eyeing this market, the Adani Aerospace & Defence forecasted India's defence MRO market to reach $3bn by 2031 – A $3bn worth of opportunity!

Here's where arises the need of self-reliance or atmanirbhata, as every nut tightened and every engine overhauled domestically strengthens India's ability to protect its skies without foreign dependencies or logistical bottlenecks.

(LEFT) THE UPCOMING C-130J MRO FACILITY IN BENGALURU IS A JOINT VENTURE BETWEEN TATA ADVANCED SYSTEMS AND LOCKHEED MARTIN;
(RIGHT) DASSAULT AVIATION HAS ANNOUNCED A SUBSIDIARY COMPANY IN INDIA DEDICATED EXCLUSIVELY FOR MRO OF ITS MILITARY ACTIVITIES.

INDIA'S COME A LONG WAY!

In the latest, Rolls-Royce is exploring the establishment of a dedicated MRO facility in India for its AE2100 engines. These engines power the Indian Air Force's (IAF) fleet of C-130J Super Hercules transport aircraft that is a critical asset for strategic airlift and rapid deployment operations.

This initiative is in line with the India–UK Comprehensive Economic and Trade Agreement (CETA) and the Vision 2035 Defence Industrial Roadmap, both of which seek to deepen bilateral cooperation in aerospace, technology, and innovation.

With this MRO, the AE2100 engine support in India would deliver reduced turnaround times, enhanced fleet availability, and improved mission readiness for the IAF. Beyond maintenance, there is potential for assembly and testing collaborations under India's Multi-Role Transport Aircraft (MTA) programme, creating further opportunities.

Rolls-Royce's plan also aligns with its broader strategy to double sourcing of complex aero-engine components from India within the next five years. This would build upon its existing partnerships with leading Indian defence and aerospace manufacturers, including Hindustan Aeronautics Limited, Force Motors, Tata Group, Godrej & Boyce, and Bharat Forge.

RELIANCE DEFENCE STEPS IN!

A major step in this direction came recently when Reliance Defence Ltd, a 100 per cent subsidiary of Reliance Infrastructure, inked a strategic pact with US-based Coastal Mechanics Inc. (CMI). Together, they will set up a state-of-the-art MRO and upgrade facility at MIHAN, Nagpur.

This centre is poised to service over 100 Jaguar and MiG-29 fighter aircraft, 20 Apache attack helicopters and L-70 air defence guns.

With this, Reliance aims to become one of India's top three defence exporters, directly targeting India's multi-MRO opportunity while bolstering export-readiness.

THE S-400 BREAKTHROUGH

In a landmark development, India is establishing an MRO facility for the S-400 air defence system in partnership with Russia's Almaz-Antey. This move comes on the heels of the S-400's pivotal performance in Operation Sindoor (May 2025), where it successfully defended multiple Indian cities against coordinated drone and missile attacks.

With three S-400 squadrons already in service and two more on the way, localising maintenance ensures that India retains full operational control over one of its most advanced and sensitive military assets, without delays, risks, or external dependencies.

LOCKHEED MARTIN-TATA: C-130J MRO

One of the most strategic Indo-US defence collaborations to date is the upcoming C-130J MRO facility in Bengaluru, a joint venture between Tata Advanced Systems and Lockheed Martin.

Backed by the Karnataka government, this facility will service India's fleet of 12 C-130J Super Hercules aircraft and potentially support other regional operators. It marks a giant leap forward in building a regional MRO hub, echoing India's 'Make in India', Maintain in India vision.

> One of the most strategic Indo-US defence collaborations to date is the upcoming C-130J MRO facility in Bengaluru, a joint venture between Tata Advanced Systems and Lockheed Martin

THE HAL INITIATIVE

HAL, the backbone of India's aerospace ambitions, continues to anchor Atmanirbharta through deep technology transfer and strategic partnerships.

- With Collins Aerospace, HAL is establishing an MRO unit in Lucknow to service key electrical systems of the LCA Tejas Mk1, directly boosting fleet availability.
- With SAAB, HAL will indigenise the LWS-310 Laser Warning Systems, ensuring mission-readiness for IAF fighters and adding another layer of electronic warfare capability to India's growing inventory.

Both initiatives reduce dependence on foreign OEMs and inject long-term sustainability into India's indigenous platforms.

PHOTOGRAPHS: LOCKHEED MARTIN, DASSAULT AVIATION

(LEFT-RIGHT) RTX'S COLLINS AEROSPACE SIGNS MRO AGREEMENT WITH HINDUSTAN AERONAUTICS LIMITED FOR LCA TEJAS FIGHTER JET (SHOWN HERE)

MARITIME MRO COMES HOME

For the first time, Boeing and AI Engineering Services Ltd (AIESL) have delivered in-country overhaul services for the Indian Navy's P-8I fleet, starting with the landing gear at INS Rajali. The collaboration signals India's increasing technical maturity in high-complexity MRO, extending not just across platforms, but across services.

SAFRAN'S EXPANDING FOOTPRINT

Safran Aircraft Engine Services India is building a dedicated MRO facility in Hyderabad for Rafale's M88 engines, to begin operations by end-2026. The site will also support LEAP engines and is expected to generate up to 900 jobs in future phases.

This yet again reflects the strategic embedding of foreign OEMs into India's aerospace fabric, through long-term industrial partnerships, rather than transactional deals.

WHAT IS BREWING BETWEEN EMBRAER AND MAHINDRA

If selected under the IAF's Medium Transport Aircraft (MTA) programme, Embraer's C-390 Millennium will be locally assembled, maintained, and potentially exported from India in partnership with Mahindra Defence.

The proposal covers MRO, training, R&D, and tech transfer — making India not just an operator, but a stakeholder in the C-390's global support chain. The deal, if awarded, could mark India's first indigenous MRO base for a tactical transport aircraft with global export potential.

DASSAULT'S MRO INDIA SUBSIDIARY AND THE MIRAGE-RAFALE ECOSYSTEM

With the IAF operating three squadrons of Mirage 2000 and Rafale jets, Dassault Aviation's new MRO entity in Noida, Dassault Aviation MRO India (DAMROI) will ensure long-term sustainment of these aircraft under Indian control.

Established under the Atmanirbhar Bharat policy, this facility strengthens India's position in the Rafale global supply chain while creating new pathways for technology integration and capability development.

For India's defence readiness, such initiatives are more than just infrastructure investment; they are building blocks for a robust, self-sustaining MRO industry capable of meeting the demands of both current and future defence platforms.

THE FIRST MILE OF SELF-RELIANT MRO

True MRO self-reliance begins with localised components:

- Godrej Aerospace has partnered with ADA to develop Flight Control Actuators for the AMCA, a critical subsystem for India's future 5th-gen fighter.
- Safran-BEL JV will localise HAMMER smart munition production, reducing import dependency for precision weapons.

> With the IAF operating multiple squadrons of Mirage 2000 and Rafale jets, Dassault Aviation's new MRO entity in Noida, Dassault Aviation MRO India (DAMROI) will ensure long-term sustainment of these aircraft under Indian control

These developments embed self-reliance at the source, enabling long-term support, rapid turnaround, and robust defence manufacturing.

ATMANIRBHARTA IN DEFENCE MRO IS NOT JUST ON PAPER, ITS OPERATIONAL

India's 78th Independence Day marks more than a celebration of sovereignty. It marks a moment when India's armed forces can now rely on domestic capability to maintain and sustain their strategic platforms, across air, land, and sea.

From Nagpur to Noida, Hyderabad to Bengaluru, India's defence MRO network is rising, rooted in vision, skill, and self-belief. Atmanirbharta is no longer a policy, it is now a proven capability and it is here to stay! SP

PHOTOGRAPHS: COLLINS AEROSPACE, IAF_MCC / X

INDIA'S AVIATION GROWTH DEMANDS A ROBUST PIPELINE OF EXPERIENCED PROFESSIONALS ACROSS ALL AVIATION ROLES TO ENSURE SAFETY AND EFFICIENCY

BALANCING INDIA'S AVIATION BOOM WITH EXPERIENCE

India's aviation boom reflects its economic ambition, but growth without seasoned expertise risks safety and efficiency

By SANJAY JULKA

INDIA'S AVIATION SECTOR IS SOARING, WITH ITS COMMERCIAL aircraft fleet poised to double in the next five years. This surge, alongside growing numbers of helicopters and business jets, promises better connectivity and economic growth. Yet, recent accidents—like the Air India crash, Kedarnath helicopter accidents, and trainer aircraft mishaps—cast a shadow over this optimism. As India's skies grow busier, the need for experienced professionals across all aviation roles becomes critical to ensure safety and efficiency.

PHOTOGRAPH: AIRBUS

EXAMPLES OF ACCIDENTS: WHEN RAPID EXPANSION OUTPACED EXPERIENCE

History shows that unchecked aviation growth can lead to safety risks. Here are three global examples where rapid expansion exposed gaps in experience:

- **United States (1970s Airline Boom):** After airline deregulation, the US saw a surge in air traffic that overwhelmed pilots, Air Traffic Controllers (ATCs), and regulators. Airlines cut corners on pilot training, and ATC systems struggled to keep up. The 1978 PSA Flight 182 crash, a mid-air collision, underscored the dangers of prioritising growth over expertise.
- **China (Early 2000s Aviation Expansion):** China's aviation boom in the early 2000s led to a rush in pilot licensing to meet demand. Inadequate training and skill gaps contributed to accidents, like the 2010 Henan Airlines crash, revealing how rapid growth can compromise safety when experience is sidelined.
- **India (2000s Low-Cost Carrier Boom):** The rise of low-cost carriers in India during the early 2000s triggered a pilot shortage, prompting airlines to hire foreign crews unfamiliar with local challenges like monsoon weather or high-altitude airports. The 2010 Mangalore Air India Express crash highlighted the catastrophic risks of insufficient cockpit experience.

Role	2030 Need	Current Pool	Key Risks
Air Traffic Controllers	6500	~3,800	High fatigue, operational delays
DGCA Safety Inspectors	1200	<600	Delayed audits, incomplete oversight
Continuing Airworthiness	2000	~1,100	CAMO burnout, safety lapses
Quality & Safety Managers	3000	~1400	Gaps in SMS deployment, and training

Sources: include ICAO Global Aviation Safety Plan, DGCA public reports, and industry staffing standards

The Crucial Role of Experience Across Entire Spectrum of Aviation

Safety doesn't rest solely on pilots and technicians. Accountable Managers, Quality Managers, Continuous Airworthiness Managers (CAMs), Safety Officers, and airport personnel all play vital roles. Their expertise ensures smooth operations, from daily decision-making to crisis response. Without experienced management and leadership across these roles, India's aviation boom risks faltering.

INDIAN SKIES: EXPERIENCE IN THE MAKING

India's aviation growth demands a robust pipeline of skilled professionals to match its ambitious trajectory.

Pilot and Technician Shortages

The Directorate General of Civil Aviation (DGCA) projects a need for 10,000 pilots and 15,000 technicians by 2030 to support the expanding fleet forcing us to source pilots from abroad. However, reliance on foreign pilots and fast-tracked training risks gaps in expertise. Historically, airlines enforced strict criteria for upgrading copilots to captains, but rapid growth may tempt operators to lower these standards, affecting both cockpit and maintenance expertise.

Operational Complexity

India's unique aviation challenges—monsoon weather, high-altitude airports, and short runways—require seasoned judgment. The Kedarnath helicopter crashes exposed the limits of technology in extreme conditions, emphasising that experience is vital for safe operations.

Strain on Air Traffic Control and Infrastructure

The UDAN scheme, launched in 2016, doubled India's operational airports, but this growth has strained air traffic control systems. A 2024 Mumbai incident, where two aircraft occupied the same runway, highlighted the risks of overburdened ATCs with limited experienced staff. As passenger numbers climb, these gaps could become critical choke points.

Regulatory Gaps

The DGCA, with fewer than 1,500 staff, oversees 1,200 commercial aircraft, hundreds of helicopters, and business jet operations, struggles with resource constraint. A 2022 International Civil Aviation Organization (ICAO) audit flagged delays in accident investigations and inconsistent maintenance standards. Rapid fleet growth only widens these regulatory cracks.

INDIA MUST STRATEGICALLY MANAGE ITS AVIATION EXPERTISE GROWTH BY USING SEASONED PROFESSIONALS AS MENTORS AND FACULTY

PHOTOGRAPH: CAE

EXPERIENCE MANAGEMENT IN INDIAN AVIATION: STRATEGIC RECOMMENDATIONS

To sustain growth while prioritising safety, India must strategically manage its aviation expertise.

Recognise and Mobilise Existing Talent

Wasted time on duplicating approvals or retraining slows progress. India should streamline qualifications across agencies like the FAA, EASA, and Defence sectors to retain talent.

- **Standardise Protocols:** Align training, licensing, and certification for consistency.

THE RISE OF LOW-COST CARRIERS AND THE UDAN SCHEME IS TRIGGERING A PILOT SHORTAGE IN INDIA

- **Bridge Gaps:** Offer accelerated orientation programmes to address inter-agency differences.
- **Global Collaboration:** Partner with each other to mutually recognise licenses and certifications.
- **Consolidate Infrastructure:** Unify training academies and regulatory processes to free senior talent for critical tasks like safety oversight and mentoring.

Global Standard Aviation University for Training Regulators and Managers

India lacks a flagship aviation university comparable to Embry-Riddle (USA) or Cranfield (UK). While the Rajiv Gandhi National Aviation University (RGNAU) exists, its scale and scope remains limited. A flagship institution could address fragmented expertise by:

- Integrating existing training centers into a national framework.
- Using seasoned professionals as mentors and faculty.
- Offering specialised degrees in airworthiness, ATC, safety, regulatory policy, and DGCA post-holder roles.
- Serving as a policy think tank, like Singapore's CAAS Academy.

Dedicated Owner-Operator Model for Business Aviation

India's 120+ Non-Scheduled Operator Permits (NSOPs) manage nearly 400 aircraft with stretched technical staff, leading to inconsistent safety oversight. A US-style "Separate Owner-Operator" Part 135 model could:

- Consolidate compliance and technical teams for better accountability.
- Enable cost-effective maintenance and training.

***Note:** While NSOP consolidation is vital for safety and scalability, implementation of the "Separate Owner-Operator" model has been hindered by India's differential import duty regime. Aircraft imported for exclusive private or corporate use face higher duties than those for commercial operations, discouraging fleet integration. This anomaly not only inflates costs but also limits the formation of technically robust, accountable entities. By shifting the tax burden from import to usage, India can level the playing field, enabling consolidation, and strengthening safety oversight.*

Structured Mentorship Programmes

Institutionalising mentorship for safety officers, DGCA post-holders, and inspectors ensures knowledge transfer. Incentives for senior professionals to guide emerging talent would embed expertise within airlines, MROs, and regulators.

Form an Indian Aviation Commission (IAC)

A unified body, modeled on Malaysia's MAVCOM, could streamline coordination among DGCA, AAI, MoCA, and defence stakeholders. An IAC would:

- Eliminate bureaucratic silos.
- Accelerate approvals.
- Align manpower and infrastructure with industry growth.

> As India's skies grow busier, the need for experienced professionals across all aviation roles becomes critical to ensure safety and efficiency

CONCLUSION

India's aviation boom reflects its economic ambition, but growth without seasoned expertise risks safety and efficiency. By learning from global missteps, India can prioritise experience management—standardising training, unifying oversight, and fostering mentorship. With these steps, India's skies can become a model of ambition balanced with wisdom, setting a global standard for aviation excellence. SP

PHOTOGRAPH: FLYSPICEJET / X

FREEDOM IN THE SKIES

Simran Singh Tiwana, CEO of Star Air on how the airline is bringing Independence to everyday Indians

AS WE CELEBRATE ANOTHER INDEPENDENCE DAY, I FIND myself reflecting not just on our nation's incredible journey, but on the meaning of freedom in today's India. At Star Air, we see freedom in a very real and everyday way. It's in the face of the first-time flyer boarding a flight from Nanded to Bengaluru. It's in the joy of a family that can now reach their hometown without a 30-hour train ride. It's in the confidence of a young professional who can explore opportunities in cities once out of reach.

For us, this day is more than just a celebration, it's a reminder of why we exist.

When we started Star Air, the vision was clear: to Connect Real India. Not just the big metros, but the towns and cities that are full of life, talent, and ambition, places that had been waiting far too long for air connectivity.

Over the years, I've had the privilege of witnessing something special. I've seen how a simple flight can change someone's world.

- A mother visiting her children after years.
- A student attending a job interview that was once too far.
- A small business owner accessing new markets.

That, to me, is what independence looks like in 2025.

- Freedom of movement,
- Freedom of choice, and
- Freedom of opportunity.

> "Let's remind ourselves that freedom is in the choices we make today for a better tomorrow"

This mission, to Connect Real India, is deeply personal to all of us at Star Air. Every new station launch, every route we open under the UDAN scheme, every passenger we welcome onboard, it's all part of a larger effort to make flying accessible to more Indians, not just a few. Because true progress, like true freedom, must be inclusive.

As an Indian airline born under the skies of a free India, we take this responsibility seriously. And we take pride in the fact that our fleet, our team, and our routes are all focused on building a stronger, more connected nation.

I want to take this moment to thank our passengers who trust us with their journeys, our incredible team who make it all happen, and our partners and the Government of India for supporting our vision.

This Independence Day, as we see the tricolor flying high, let's remind ourselves that freedom is in the choices we make today for a better tomorrow.

From all of us at Star Air, we wish you a very Happy Independence Day.

Jai Hind. SP

PHOTOGRAPHS: OFFICIALSTARAIR / X, STAR AIR

PILOTS LOOKING FOR LIFESTYLE THAT INCLUDES FLYING TO EXOTIC DESTINATIONS AND LUXURY STAYS WITH MORE CUSTOMER-FACING RESPONSIBILITIES PREFER GOING THE PRIVATE AVIATION ROUTE

AIRLINE VS CHARTER FLYING IN INDIA AND SOUTH ASIA: A PILOT'S PERSPECTIVE

The decision between flying for a commercial airline or a charter/private operator isn't simply about the aircraft or salary—it's a lifestyle choice that affects everything from job security and schedule predictability to long-term growth and work culture.

By SARTHAK BARANWAL

PHOTOGRAPH: TEXTRON AVIATION

AS INDIA'S AVIATION SECTOR CONTINUES TO SURGE, PILOTS today face more diverse career options than ever before. The decision between flying for a commercial airline or a charter/private operator isn't simply about the aircraft or salary—it's a lifestyle choice that affects everything from job security and schedule predictability to long-term growth and work culture. In the Indian and broader South Asian context, both career paths come with unique advantages and challenges. Let's explore each in depth.

THE OPERATING LANDSCAPE

India is home to several major carriers including IndiGo, Air India, Vistara, Akasa Air, and regional players like Alliance Air. These airlines operate under scheduled service rules (Part 121 equivalent), and offer structured career ladders. On the other hand, the charter/private jet space—governed under DGCA's Part 135 and Part 91 rules—includes luxury charter companies like JetSetGo, Club One Air, Taj Air, and a growing number of corporate and individual jet owners, especially in cities like Delhi, Mumbai, and Hyderabad. Additionally, regional demand in countries like Sri Lanka, Nepal, and the UAE creates a broader operating zone for Indian pilots, particularly in private and business aviation.

JOB ROLE DIFFERENCES

The roles of airline and charter pilots differ significantly. Airline pilots typically operate between major airports, flying fixed routes with the support of a professional dispatch team. Their duties are routine and highly procedural, focused on efficiency, punctuality, and compliance. Charter pilots, however, manage end-to-end operations—from flight planning and customs coordination to passenger interactions and even loading luggage. They often fly into smaller, less-equipped airports across India's vast interior or to remote destinations like Bhutan or the Maldives. This hands-on role requires a blend of flying skill and concierge-level service.

PROS AND CONS OF AIRLINE FLYING IN INDIA

Airline flying in India offers structured growth, job security, and a well-defined path from First Officer to Captain. With new aircraft orders and expanding fleets, particularly from Air India and IndiGo, demand for pilots is set to increase. Airline pilots enjoy consistent training standards, union protection (in some cases), and travel perks such as ID tickets and ZED fare agreements. However, the seniority system can be a double-edged sword—junior pilots may face years of undesirable rosters, high reserve duty, and commuting challenges. Furthermore, the repetitive nature of domestic short-haul flying and growing air traffic congestion at major Indian airports can make daily operations stressful.

PROS AND CONS OF CHARTER/PRIVATE FLYING IN INDIA

Charter and private flying provide a more dynamic work environment. Pilots enjoy faster career progression, including earlier opportunities to captain high-performance jets like the Citation XLS, Phenom 300, or Gulfstream G650. The missions are varied—ranging from high-profile celebrity flights to air ambulance and religious pilgrimages—and often involve luxury accommodations and international destinations. However, this comes at the cost of predictability. On-call schedules, short-notice departures, and the lack of regulatory consistency across operators can result in fatigue and job instability. Pilots flying for private jet owners may lose their jobs if the aircraft is sold or operations are suspended.

INFRASTRUCTURE, TRAINING, AND PAY

Indian airline pilots generally receive higher pay at senior levels, particularly in international roles. Domestic airline captains earn between ₹6–8 lakh per month, with structured per diem and benefits. Charter pilots earn slightly less on average—₹3–6 lakh per month for captains—though this varies widely depending on the aircraft and employer. Training quality in airlines is typically superior, supported by in-house simulator programmes and regulatory oversight. Charter training, while improving, can be inconsistent and depends heavily on the company's safety culture and financial investment. Additionally, charter pilots often face operational challenges like flying into uncontrolled airstrips with minimal ground support.

AS COMMERCIAL AVIATION GROWS IN INDIA, AIRLINE FLYING IN INDIA OFFERS STRUCTURED GROWTH, JOB SECURITY, AND A WELL-DEFINED PATH FOR PILOTS

PHOTOGRAPH: INDIGO6E / X

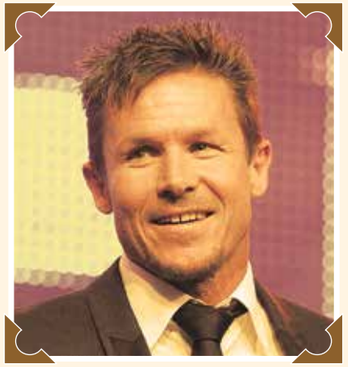
> With new aircraft orders and expanding fleets, particularly from Air India and IndiGo, demand for pilots is set to increase

LIFESTYLE CONSIDERATIONS

Lifestyle is perhaps the biggest differentiator. Airline pilots benefit from a more predictable roster (especially at senior levels), longer layovers, and scheduled days off. They're also more likely to be based in metropolitan hubs, which can aid work-life balance. Charter pilots, while enjoying more exotic destinations and luxury stays, deal with irregular hours, extended duty days, and more customer-facing responsibilities. This lifestyle suits pilots who thrive in unpredictable, high-pressure environments and are comfortable blending aviation with hospitality and discretion.

CHOOSING THE RIGHT PATH

Ultimately, the right choice depends on your personal and professional goals. If you prioritise structured growth, union support, long-haul dreams, and a clear retirement plan, airline flying is the way to go. If, however, you value flexibility, autonomy, luxury travel, and a faster route to command, the charter/private jet route offers an exciting alternative—though one with more risk and variability. In India, where both sectors are growing rapidly but unevenly, making the right career move requires careful consideration of not just salary, but the broader work culture and lifestyle you want to build. SP



FELIX BAUMGARTNER (1969 - 2025)

Felix Baumgartner jumped out of the capsule at 38,969.4 m. His exit was perfect, but after passing through the sound barrier, and still hurtling towards earth at Mach 1.25, he went into a flat spin.

THE AVIATION WORLD WAS STUNNED ON JULY 17, 2025, BY news of the tragic passing of Felix Baumgartner, in Italy. The shock was intensified because he died not while executing one of his trademark daredevil feats, like breaking the world record for the highest skydive, but while engaged in something much more mundane – motorised paragliding.

Felix Baumgartner was born in Salzburg, Austria, on April 20, 1969. As a child, he was inspired by watching astronauts on television. He had two goals – to become a skydiver and to fly a helicopter – and he ultimately achieved both aims. At the age of 16, he completed his first skydive. He joined the Austrian military, and over the years, perfected his parachuting skills, learning to land safely even on tiny target zones.

Felix was an inveterate adventurer, always in search of new and more exciting feats. Even as he pursued extreme parachuting, he took to BASE jumping. BASE is an acronym for four types of fixed objects to jump from: buildings, antennas (radio towers), spans (bridges), and earth (cliffs). He gained global fame by jumping off landmarks, often on live TV. In 1999, he set a world record by leaping off the world's then highest building – the Petronas Towers in Kuala Lumpur. Not long afterwards, the taller Taipei 101 was constructed in Taiwan so, in 2007, he jumped off that skyscraper. Also in 1999, his lowest jump – and another world record – was just 29 m, from one of the hands of the Christ the Redeemer statue in Rio de Janeiro. Not for nothing did they call Baumgartner, "The craziest base jumper in the world." In 2003, he also became the first person to literally fly across the English Channel. Donning a pair of specially-constructed carbon fibre wings, he exited a plane above Dover, England and landed 35 km away near Calais, France, 14 minutes later. Side-by-side, Felix pursued his other dream – helicopter flying. One of very few aerobatic helicopter pilots in the world, he was part of the "The Flying Bulls" – an Austrian group of aviation enthusiasts.

Baumgartner next set out to break Joseph Kittinger's 1960 world record for the highest ever skydive. "Fearless Felix," as he was often called, went about planning and preparing for this, his most challenging feat yet, with great deliberation. Kittinger had jumped from a balloon gondola at a height of 31.3 km, and two people had already lost their lives while trying to break his record. Felix pursued his project step by step, jumping first from 21.8 km, then from 29.6 km. Each time he learned something new, especially how to arrange his body in a delta position in the dive, head down.

Before attempting the record-breaking jump, there were many years of expensive research, development and testing, supported by industry experts, to perfect the equipment. Throughout, he was offered advice and encouragement by Kittinger, now in his 80s. One of the most critical pieces of equipment was Felix's pressure suit. If that failed, he would almost certainly perish. However, he found his suit so heavy and restrictive that he experienced a severe claustrophobic reaction whenever he wore it. Consequently, he took a year's break to undergo hypnotherapy and prepare himself mentally to overcome his phobia.

Baumgartner's "space jump" finally took place over the New Mexico desert on October 14, 2012. As his huge 55-storey-high helium balloon climbed slowly into the clear sky, millions of people worldwide followed the ascent through live video feeds. Felix jumped out of the capsule at 38,969.4 m. His exit was perfect, but after passing through the sound barrier, and still hurtling towards earth at Mach 1.25, he went into a flat spin. Thankfully, he was able to use his great experience of more than 2,500 dives to thrust out both his hands and stabilise himself before opening his parachute and descending safely back to earth. Subsequent analysis revealed that he attained a max speed of 1,357.6 km/h. He had aimed to be the first person to break the sound barrier, unaided by a vehicle, and he achieved his goal. The descent took just ten minutes, with around half that time spent in freefall.

At a media conference after his amazing jump, Felix Baumgartner said, "When I was standing there on top of the world, you become so humble. You don't think about breaking records anymore, you don't think about gaining scientific data – the only thing that you want is to come back alive." Strangely enough, for one so accomplished in extreme feats, a paragliding mishap ended his life. An official investigation has been ordered. Although local media in Italy had initially speculated that the 56-year-old aviator had lost consciousness while in flight, and consequently lost control of his paraglider, the official autopsy ruled out a heart attack as the cause of death.

— JOSEPH NORONHA

MILITARY

DRDO CONDUCTS SUCCESSFUL FLIGHT-TRIALS OF PRECISION GUIDED MISSILE-V3

In a major boost to India's defence capabilities, Defence Research & Development Organisation (DRDO) has successfully carried out flight-trials of Unmanned Aerial Vehicle Launched Precision Guided Missile (ULPGM)-V3. The missile is an enhanced version of the ULPGM-V2 missile developed and delivered by DRDO earlier.

The ULPGM-V3 is equipped with a high definition dual-channel seeker that can strike a wide variety of targets. It can be fired in plain and high-altitude areas. It has day-and-night capability and two-way data link to support post-launch target/aim-point update. The missile is equipped with three modular warhead options: Anti-armour to destroy modern age armoured vehicles equipped with Rolled Homogeneous Armour (RHA) with Explosive Reactive Armour (ERA); Penetration-cum-Blast warhead with Anti Bunker application and Pre-fragmentation warhead with a high lethality zone.

X-37B SPACEPLANE SET FOR EIGHTH MISSION

The Boeing built X-37B Orbital Test Vehicle (OTV) is preparing to launch its eighth mission (OTV-8) from Florida's Space Coast, with liftoff scheduled no earlier than August 21. This milestone comes less than six months after the successful completion of OTV-7. OTV-8 will fly with a service module, expanding capacity for experiments and opening new opportunities for mission partners, which include the Air Force Research Laboratory and the Defense Innovation Unit. The mission will host demonstrations of high-bandwidth inter-satellite laser communications technologies, as well as the highest performing quantum inertial sensor ever tested in space. The US Space Force will leverage insights from this mission to inform future space architectures.

ALAY PARIKH TO LEAD BUSINESS DEVELOPMENT FOR BOEING DEFENSE AND SERVICES IN INDIA

BOEING HAS APPOINTED Alay Parikh as Director of business development for its defence and services business in India, reinforcing the company's commitment to strengthening operations and accelerating growth in the region.

ALAY PARIKH

Parikh brings nearly two decades of experience at Boeing, where he has held key leadership roles across the company's global defence and supply chain operations. He previously led the BGS Programme Team for sustainment efforts in Singapore, overseeing support for the Apache, Chinook, and F-15 platforms. Earlier, he served as Strategy & New Business Manager within BDS Supply Chain, focusing on Asia and emerging markets, and driving strategic supplier engagement and offset programmes. Parikh also contributed to global supply chain architecture initiatives and has extensive experience with the CH-47 and AH-64 platforms. SP

CIVIL AVIATION

CATHAY PACIFIC ORDERS 14 MORE BOEING 777-9

Boeing and Cathay Pacific announced the Hong Kong-based carrier is ordering 14 more 777-9 passenger jets, bringing its order book to 35 of the world's largest twin-engine airplane.

Designed to reduce fuel use and emissions on average by 20 per cent and noise by 40 per cent compared to the airplanes it replaces, the 777-9 will enable Cathay Pacific to efficiently meet growing air travel demand across key global markets. The addition of the latest model, the 777-9, will further reduce the airline's operating costs as it modernises its fleet and expands passenger and cargo operations on long- and ultra long-haul routes.

FLYGABON RECEIVES FIRST ATR 42-600

Afrijet Business Service, operating as FLYGABON, the leading airline in Central Africa, has taken delivery of its first brand-new ATR 42-600, becoming the operator of the youngest ATR fleet on the continent. This aircraft enables Afrijet Business Service to complete the transition to an all-ATR -600 fleet, replacing its previous-generation ATR 42-500. In parallel, the airline has also confirmed its purchase of a second ATR 42-600, scheduled for delivery in 2026. Both aircraft will join FLYGABON's fleet, which includes five ATR 72-600s. With a growing network of 17 regular destinations, Afrijet Business Service/FLYGABON is reinforcing its role as a key player in domestic and regional connectivity.

AIRLINK AND AZORRA FINALISE LEASE OF 10 NEW EMBRAER E195-E2S

Airlink and Azorra have finalised a lease agreement that will see the Johannesburg-headquartered airline acquire 10 new Embraer E195-E2 twin-engine passenger aircraft, with the first delivery scheduled for later this year. This follows the previously announced selection of the E195-E2s by Airlink, South Africa's leading full-service airline.

Azorra, the Fort Lauderdale-based lease, finance and asset management firm will supply the newly-built aircraft which will augment Airlink's current 68-strong fleet. Deliveries of the 10 E195-E2s from Embraer's facilities in Brazil, will begin later this year and be completed in 2027. Airlink has operated Embraer aircraft since 2001.

DIPLOMACY MUST 'TRUMP' TARIFFS

The ongoing tariff tit-for-tat between India and the United States is fast becoming more than a trade dispute and now threatening to spill over into high-stakes sectors like aerospace and defence

By ROHIT GOEL

IT WAS RECENTLY REPORTED THAT SUBSEQUENT TO UNITED States imposition of 50 per cent tariffs, India has put a hold on a $3.6 billion deal to procure six additional Boeing P-8I aircraft, used for maritime patrol. As trade tensions escalate between New Delhi and Washington, the ripple effects may soon reach India's entire aviation industry, and if left unchecked, this escalation could deal a significant blow to India's aviation ecosystem, disrupt procurement cycles, and chill the otherwise growing strategic partnership between the two democracies.

While the current list of tariffs has largely spared aerospace goods, analysts warn that the inclusion of aircraft parts, avionics, and dual-use technologies in future rounds of duties cannot be ruled out — especially if talks between the two trade ministries continue to stall.

IMPACT ON CIVIL AVIATION

India's civil aviation sector is undergoing a historic expansion. Major carriers like IndiGo, Air India, and Akasa Air are on aggressive fleet expansion paths, with hundreds of aircraft on order — many from American manufacturers like Boeing.

If tariff barriers are raised on aircraft components, engines, navigation systems, or MRO tools, the cost structure for Indian airlines could be severely impacted. Operating margins, already squeezed by high fuel costs and airport charges, would come under further pressure. For budget carriers, even a 5–7 per cent increase in component costs can have cascading effects on ticket pricing, route viability, and profitability.

Furthermore, the trade tensions may cause delays in customs clearance of imported parts, leading to longer aircraft groundings. This is particularly risky in a market like India's where aircraft utilisation is among the highest globally, and spare inventory levels are lean by design. In short, the very reliability of day-to-day operations could be compromised if these trade issues bleed into the aviation supply chain.

FALLOUT IN MILITARY AVIATION

The implications grow even more profound in military aviation. India has increasingly turned to the United States for advanced aerial platforms, components, and joint development initiatives. Any trade friction that touches upon aerospace parts, software updates, or logistical support packages could impede mission readiness. India's contract structures often involve offset clauses and performance-based logistics agreements which are highly sensitive to parts delivery timelines and technical documentation exchanges. A tariff barrier or customs dispute may slow down these interactions. Moreover, several ongoing procurement negotiations could become entangled in a politically charged atmosphere if trade tensions worsen. The larger risk is that mutual confidence in the reliability of supply lines could erode, pushing India to diversify more aggressively toward European/Russian or indigenous platforms even where the US offers technological superiority.

STRATEGIC PARTNERSHIPS AT RISK

As per recent reports, American President Donald Trump's visible attempts to bully India have begun casting doubts on QUAD. Commentators have begun prospects of Prime Minister Narendra Modi cancelling the 2025 QUAD Leaders' Summit which is to be hosted by India. The ongoing trade friction undermines the very spirit of the India-US strategic partnership, which has been carefully built over decades through mutual alignment on democracy, maritime security, counter-terrorism, and Indo-Pacific stability.

American OEMs have been increasingly integrating Indian firms into their global supply chains, with manufacturing facilities, engineering centres, and digital tech hubs established in India. Any deterioration in trade relations may compel US aerospace firms to reassess future investments or local production plans, slowing India's goal of becoming a global aviation hub. Also, protectionist sentiment in the US could trigger domestic calls to restrict technology transfers or tighten export licences, even for dual-use systems.

PROTECTING A HIGH-ALTITUDE PARTNERSHIP

India has made significant strides in defence indigenisation but the capital and technology intensive road to self-reliance in aerospace and defence is long and arduous. Till the time India does become 'Atmanirbhar' in these critical sectors, it needs to play the balancing game with its foreign partners. The risk of short-term trade disputes undermining long-terms trust between the two nations is real, just when the geopolitical stakes are at their highest.

Trade spats are common, but when they begin to impact national security and critical infrastructure, the stakes escalate dramatically. It is imperative for India and the United States to insulate aviation — particularly military aviation and high-tech collaboration — from the spillover effects of tariff politics. Diplomatic backchannels must prioritise exemptions or special carveouts for aerospace and defence trade, recognising the long-term strategic value of these sectors. Exemptions for aerospace components, proactive diplomatic engagement, and a bilateral technology dialogue mechanism offer the path forward. SP

PHOTOGRAPH: BOEING

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