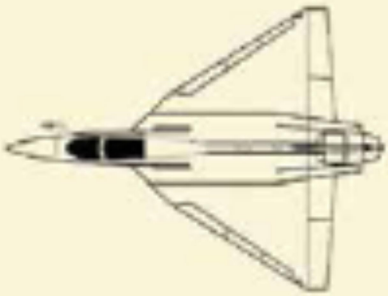

Unnikrishnan G Kartha Chair of Excellence: 2024-25

Research Report

Part - 1

Role and Service History of the MiG-23 and MiG-27

Prepared by:

Arjun Prakash Iyer and Shwetabh Singh

Part - 2

Training and Transformation

A Historical Study of Indian Air Force Training in the Southern Peninsula (1940s – Present)

Prepared by:

Atul Chandra

February 2026

CENTRE FOR AEROSPACE POWER AND STRATEGIC STUDIES

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February 17, 2026

Centre for Aerospace Power and Strategic Studies (CAPSS)
New Delhi

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1
Introduction

This report presents the findings of a year-long research project conducted by Mr Arjun Prakash Iyer and Mr Shwetabh Singh under the Unni Kartha Chair of Excellence in IAF History (2024-25) on the role and service history of the MiG-23 and MiG-27 in the Indian Air Force. It consolidates archival material, operational records, and veteran interviews into a unified historical and technical account of the aircraft's evolution, employment, and institutional legacy.

The MiG-23 and MiG-27, alongside the Jaguar, marked a decisive transition in the IAF from second- to third-generation combat aviation. The MiG-23MF, inducted in response to Pakistan's F-16 acquisition, introduced the Indian Air Force's (IAF) first all-weather Beyond Visual Range (BVR) interception capability and Infrared Search-and-Track (IRST) platform. The MiG-23BN and MiG-27ML established a new strike doctrine based on high-speed, low-level tactical air support and penetration of enemy airspace for the Offensive Counter Air (OCA) operations. Together, these platforms bridged the operational gap between legacy systems such as the Dassault Mystere IV-A, Hindustan Aeronautics Limited

(HAL) Marut, and Su-7BMK, and fourth-generation fighters such as the Mirage 2000, MiG-29, and Su-30MKI.

This study has two objectives:

- To produce the first consolidated, source-based history of the MiG-23/27 family in IAF service, covering four variants of the aircraft for nearly four decades (1981–2019).
- Evaluate the operational, logistical, and policy lessons derived from their induction, adaptation, and withdrawal. This report concludes the first phase of the project; thematic and analytical extensions are presented in six previously published research papers.

Why the 'Flogger' Family?

The significance of the MiG-23/27 lies in the doctrinal transformation it enabled. When the first MiG-23MF squadron was raised in 1982, the IAF acquired its first true area-defence interceptor, capable of rapid response to high-altitude and all-weather threats. Until the induction of the Mirage 2000 and MiG-29, MiG-23MF remained the only platform capable of countering advanced regional air threats. It was deployed in high-altitude operational environments, such as Operation *Meghdoot*.

The MiG-23BN and MiG-27ML filled in the critical gap for a highly manoeuvrable fighter aircraft to fulfil the IAF's Close Air Support (CAS) and tactical offensive capabilities. While not as advanced as their Western contemporaries, the MiG-23/MiG-27 proved to be capable platforms, as demonstrated by their high-

altitude operations, such as during Op *Safed Sagar*. The MiG-27UPG programme provided the Defence Research and Development Organisation (DRDO) and HAL with critical experience in avionics and systems integration, without the involvement of the Original Equipment Manufacturer (OEM), which continues to inform indigenous upgrade programmes. Collectively, the Flogger variants enabled transition the IAF from platform-centric operations to mission-oriented force packages capable of operating across theatres, day or night, under complex threat conditions.

Despite this impact, the MiG-23/27 family has received limited systematic documentation compared with other IAF platforms. Existing records remain fragmented across squadron publications and veteran recollections. This study addresses that gap by assembling and validating primary data to produce the first integrated account of the Flogger's role in shaping Indian air power.

Sources and Methodology

This research employs a hybrid methodology combining archival research, structured interviews, and comparative evaluation. Primary sources include Form 1500s (Operational Record Books) and squadron history excerpts/Coffee Table Books of 12 squadrons over 15 years (approximately 720 quarters), official squadron histories, and material from the IAF History Cell. Interviews with pilots and Technical Officers were conducted to capture experiential insights absent from formal documentation.

Secondary sources include published IAF histories, defence journals, memoirs, Russian design bureau publications, and relevant open-source literature available on the internet. Where possible, oral testimony was cross-validated with documentation. The study integrates technical, operational, and institutional perspectives, and each chapter draws upon this consolidated report. This has also been carried out through the publishing of six web articles for CAPSS.

Limitations in scope and coverage of the research must be acknowledged. Several Air Headquarters documents remain classified, including all Form 1500 records post-December 1995, and access to HAL archives is restricted. Accordingly, the analysis reflects only data that could be accessed in the limited period of 12 months provided.

2
Mikoyan Gurevich MiG-23MF

Introduction

Following the 1971 war, the IAF enjoyed qualitative and quantitative superiority over the PAF. This balance shifted with Pakistan's acquisition of the F-16 under the 'Peace Gate' I programme in 1981, driven by geopolitical developments in Afghanistan.[1] Although India had already selected the Mirage 2000 as a long-term solution, this unexpected change in the air power dynamics necessitated a stopgap interceptor capable of rapid induction. The MiG-23MF was the aircraft chosen to fulfil this role. In the Indian Air Force (IAF), the MiG-23MF emerged as an interim yet critical capability, addressing an immediate operational gap during a period of rapid regional geopolitical changes, by becoming a bridge between the 2nd generation MiG-21FL/M/MF/Bis and the 4th generation Mirage 2000 and MiG-29 fighters.

Induction and Early Operations

Two squadrons were to be raised with this new type. The first squadron to be raised was No. 223 Squadron, then known as the 'First Swing

Wing Interceptors'. Its core prospective pilots and technical officers were sent to the USSR for conversion training in October 1981. The squadron was raised at Adampur on May 10, 1982 and achieved full operational capability by September that year. By the end of 1982, it had reached its sanctioned strength of 16 MiG-23 MF aircraft and two MiG-23UB trainers. The squadron conducted its first armament training in December 1982, successfully firing the R-60 Infrared close-combat missile. Early operations revealed both the aircraft's strengths and its vulnerabilities, including an early loss due to a flameout following S-24 rocket firing. Despite this, the MiG-23MF was rapidly integrated into the IAF's air-defence posture.

A second group of pilots went to the USSR in late 1982-early 1983 to raise No. 224 Squadron, the 'Warlords'. Both squadrons initially operated from Adampur and formed the backbone of the IAF's interceptor capability in the western sector. The period was marked by intensive training, integration of the KTS-6 simulator, and the first operational deployments to high-altitude environments starting mid-1984.

High-Altitude Operations and Consolidation

During Operation *Meghdoot* in 1984, both squadrons were mobilised for Combat Air Patrols (CAPs) over the Siachen region. The initial deployments were carried out from Srinagar and Awantipora, until on May 24, 1984, when Wing Commander IJS Boparai (OC, 223 Sqn) and Squadron Leader DS Gurum (Flt Cdr, 223 Sqn) executed the first landing of the type at Leh. Subsequently, the MiG-23MF

became the first IAF interceptor to operate routinely from Leh, validating its performance envelope in extreme altitude and weather conditions. 224 Squadron soon followed suit, starting operations from Leh on September 5, 1984, with the first landing by Wing Commander AKM Raje (OC, 224 Sqn) and Squadron Leader OP Sharma (Flt Cdr, 224 Sqn).

Through the mid-1980s, the squadrons participated in multiple exercises, conducted BVR missile trials, and engaged in dissimilar air combat training with the newly inducted Mirage 2000. Despite accidents and leadership changes, both units achieved operational maturity and were recognised for their performance within Western Air Command.

Transition, Sustainment and Decline

In 1989, No. 223 Squadron began converting to the MiG-29B, technically marking the end of the MiG-23MF's frontline interceptor role. All remaining MiG-23MF airframes were consolidated within No. 224 Squadron, which assumed responsibility for sustaining the ageing fleet without a formal overhaul facility. Serviceability challenges increasingly emerged due to canopy degradation, radar failures, and engine-related issues.

Despite these constraints, the squadron continued operational deployments, including repeated missions over Siachen, and undertook extensive Dissimilar Air Combat Training (DACT) with other fighter squadrons. Indigenous efforts by 11 BRD, HAL, and third-party vendors partially mitigated spares shortages, though

radar capability steadily declined. By 1998, approximately 80 per cent of all airworthy airframes had their radars go offline due to lack of overhaul.

Thoise Operations and Operational Innovations

In the mid-1990s, No. 224 Squadron spearheaded efforts to operationalise Thoise as a fighter recovery and forward base to support operations in the region. Following extensive overshoot trials, the first successful MiG-23MF landings were conducted on October 28, 1995, significantly enhancing operational resilience in the Ladakh sector. Key individuals accomplishing this achievement were Wing Commander P Kinra (OC, 224 Sqn), Squadron Leader G Chand (Flt Cdr, 224 Sqn), Makkar (Duty Air Traffic Control Offr), Squadron Leader R Gandotra (Senior Tech Offr, 224 Sqn) and Flight Lieutenant R Talwar (Sqn Flight Safety Officer). The effort demonstrated squadron-level initiative and high-risk operational planning.

The squadron moved from Adampur to Halwara in April 1996, and eventually to Jamnagar in September 1997, from where it operated until its official winding down (numberplating) 10 years later.

Final Decade and Secondary Roles

From late 1997 onward, the MiG-23MF transitioned to secondary roles, including Banner Target Towing (BTT), as inoperable radars reduced their air defence capability. Modified aircraft supported

air-to-air gunnery and missile training during major exercises such as Vayu Shakti, compensating for the retirement of older target-towing platforms such as the Hawker Hunter and the English Electric Canberra.

From 1999-2003 [Kargil conflict (1999), aftermath of 9/11 attacks (2001) and Operation *Parakram* (2002)], the squadron remained fully mobilised, conducting round-the-clock Operational Readiness Platform (ORP) duties with secondary air-to-ground tasking. Under successive commanding officers, the unit introduced procedural innovations, including high-altitude weapons delivery techniques, night attack training, and the use of handheld Garmin/ Time Arc GPS for mission planning and debriefing. These measures significantly improved serviceability and operational effectiveness despite the platform's age.

The MiG-23MF, after 25 years of operational service, was finally retired from IAF service on March 31, 2007 marking the end of India's swing-wing interceptor era.

3
Mikoyan Gurevich MiG-23BN

Background and Induction

By the late 1970s, the IAF had concluded its Deep Penetration Strike Aircraft (DPSA) procurement programme with the selection of the SEPECAT Jaguar, marking a significant departure from earlier procurements for ground attack aircraft. The Jaguar was to replace the Canberra and the Hunter, such that it combined the range and weapon-carrying capability of the Canberra with the manoeuvrability and ruggedness of the Hunter. Despite the Jaguar's induction, the IAF faced an urgent requirement to replace the ageing fleet of CAS and Tactical Strike aircraft, the Mystères, Maruts, and Su-7BMKs with a modern, high-performance platform.

Following extensive evaluations in the USSR in 1979, the MiG-23BN was selected under the Tactical Air Support Aircraft (TASA) procurement programme. 95 airframes were procured to equip four squadrons: Nos. 10, 31, 220 and 221 (along with attritional spares), making the MiG-23BN the first Flogger variant to enter IAF service in 1981. No. 10 Squadron 'Daggers' became the first unit to convert to the MiG-23BN from the HAL Marut

on January 01, 1981. The aircraft was designated "*Vijay*" (Victory) in Indian service, but was also simultaneously known as the Type 24. The aircraft's induction marked the IAF's first operational use of a variable-geometry aircraft. The next units in line were No. 220 Squadron 'Desert Tigers' (August 23, 1981), No. 221 Squadron 'Valiants' (March 6, 1982), and No. 31 Squadron 'Lions' (April 22, 1983).

Operational Expansion and Early Capability Development

The early 1980s were characterised by rapid operational expansion and doctrinal experimentation with the type. MiG-23BN squadrons extensively participated in exercises focused on low-level Offensive Counter Air (OCA), Battle Air Interdiction (BAI) and CAS roles, with emphasis on operating in dense enemy Anti-Aircraft Defence environments. Night flying and high-altitude operations were progressively introduced, culminating in successful deployments to Leh during Op *Meghdoot*.

Simultaneously, the IAF undertook extensive indigenous modifications to overcome limitations in the baseline Soviet configuration. These included the integration of reconnaissance pods ('Red Baron', 'Green Baron', IRLS, SSH Cameras and Vinten Vicon 91 Long Range Oblique Photography pod), Identification Friend-Or-Foe (IFF) Mk. X compatible with IAF assets, and defensive aids such as AN/ALE-144 Countermeasures Dispensing System (CMDS) and various kinds of weapons that were not a part of the

aircraft's original loadout configuration (such as Carrier Bomb Light Stores (CBLS) and BL-755 Belouga cluster munition, and BAP-100 Runway Denial Weapon).

Persistent issues with the SVG-17/ASP-17 gunsight led squadrons to develop alternative delivery techniques, reflecting a recurring pattern of tactical adaptation to system limitations. Later, specialised training was provided to better learn and maintain this system, thereby mitigating the issue.

Operationalisation and Multi-Role Employment

By the mid-1980s, the MiG-23BN had matured into a versatile strike platform. Squadrons demonstrated high levels of operational readiness during no-notice inspections and large-scale exercises, validating the aircraft's ability to deliver heavy weapon loads under compressed timelines. Some squadrons experienced maintenance hurdles due to a shortage of testers; however, this did not cause significant issues in readiness levels. The platform's role expanded beyond traditional CAS to include maritime strike missions in coordination with the Indian Navy, with No. 220 Squadron pioneering sea-flying and naval strike procedures.

Despite increasing serviceability challenges associated with engine reliability and airframe fatigue, squadrons achieved notable milestones, including instances of 100 per cent serviceability through intensive maintenance efforts and indigenous spares development.

High-Intensity Operations and the Kargil Conflict

Despite the Jaguar being the premier ground attack platform of the IAF, it had a key issue with the engine thrust output that prevented it from conducting high altitude operations. This gap eventually was to be filled by the MiG-23BN.

In May 1984, when Op *Meghdoot* was underway, a request was made to No.221 Squadron to deploy the aircraft to Leh; however, there was no prior experience in that regard. Similar to the MiG-23MFs, the Vijay aircraft have only been operating from Awantipora and Srinagar until then. Furthermore, minor modifications had to be locally made to the aircraft's turbo-starter valve to enable high altitude take off/landings at airfields situated 3km or more ASL. Nonetheless, this was overcome through local reverse engineering of said valves. After several overshoot trials, on May 23, 1984, Squadron Leader AD Joshi (Flt Cdr, No.221 Sqn) successfully executed the first MiG-23BN landing at Leh.[2]

Apart from the landing itself, the squadron in principle became the high-altitude specialists amongst the MiG-23BN fleet, due to other significant contributions, such as the activation of Toshe Maidan and Kar Tso firing ranges, as well as conducting extensive valley flying in the region. Added to this were the experiences gained through Photo/Fighter Reconnaissance carried by the squadron throughout Op *Meghdoot* in the region, as well as certain missions well into Pakistan occupied Kashmir (PoK), specific details of which are still mostly classified. Sometime during this period, No.221

squadron also carried out overshoots over Thoise, but no landings were executed.

The MiG-23BN's most significant combat employment occurred during the 1999 Kargil conflict under Operation *Safed Sagar*. No.221 Squadron was the only MiG-23BN squadron to be mobilised for battle, and operated a detachment from Srinagar.

After the loss of a MiG-27, MiG-21M and Mi-17-1V respectively (see MiG-27 chapter for more context), tactics were revised, and squadrons transitioned from low-level attack profiles to GPS-assisted Medium Altitude Level Release (MALR) tactics and conducted night strike missions. MiG-23BNs equipped with GPS guidance systems acted as pathfinders for combined strike packages. Wartime serviceability surged between 90 to 95 per cent, with rapid turnaround times and no mission aborts attributed to technical failures.[3]

No. 221 Squadron alone flew 155 combat sorties, delivering approximately 130 tonnes of ordnance and accounting for nearly one-third of strike missions during the campaign. The Flogger aircraft family (MiG-23BNs and MiG-27MLs combined) delivered the highest cumulative weapon load during the operation, and multiple pilots were awarded gallantry honours.[4, 5]

Post-Kargil Operations and Phase-Out

Following the Kargil conflict, MiG-23BN squadrons remained active during Op Parakram. However, by the early 2000s, the platform had been superseded by the MiG-27ML, and progressive de-induction

began. No. 10 Squadron de-inducted first in 1993, converting to the MiG-27ML, followed by No. 31 Squadron in 2003 and No. 220 in 2005. No. 221 Squadron, the last operator, flew the final operational sortie on December 31, 2008, with the formal phase-out completed in March 2009 at Halwara. The MiG-23BN concluded nearly three decades of service, having played a decisive role in shaping the IAF's strike doctrine, indigenous modification practices, and high-altitude combat capability.

4
Mikoyan Gurevich MiG-27ML

Induction and Force Expansion

The decision to procure the MiG-27ML followed closely after the induction of the MiG-23BN, driven by the IAF's requirement for a more capable and sustainable dedicated strike platform. A contract signed in March 1982 covered 165 aircraft, with Hindustan Aeronautics Limited (HAL) manufacturing the majority domestically between 1984 and 1997. The MiG-27ML (Bahadur), along with its upgraded variant MiG-27UPG, would equip seven frontline squadrons and form a core element of the IAF's tactical strike capability for over three decades.

No. 222 Squadron 'Tigersharks' was the first to convert to the MiG-27ML in 1985, followed by Nos. 9, 18, 22, 2, 10, and 29 Squadrons through the late 1980s and 1990s. Conversion typically replaced legacy platforms such as the Su-7BMK, HAL Ajeet, and MiG-21 variants. Early service was marked by documentation gaps in the Form 1500s, equipment shortages, and reliability issues, particularly related to aeroengines, fuel systems, and gun firing, all

of which necessitated rapid procedural and technical adaptation at squadron and flight-line levels.

Capability Development and Weapons Integration

Throughout the late 1980s and early 1990s, the MiG-27ML underwent continuous capability expansion. The aircraft was integrated with a wide range of air-to-ground munitions, including conventional gravity bombs, rockets, cluster munitions, runway denial weapons (BAP-100), and later precision-guided systems. British CBLS pods enabled realistic weapons training, while reconnaissance capability was enhanced through integration of VICON-91 LOROP pods.

The MiG-27 also served as a testbed for guided weapons. Extensive trials of the Kh-29T (TV-guided) and Kh-29L (laser-guided) missiles were conducted with ASTE, marking the IAF's first successful firing of a laser-guided air-to-surface missile. Although operational use of the Kh-29 was constrained by target contrast and acquisition limitations, these trials laid the foundation for later precision strike doctrines. The pursuit of Kh-29 trials ceased in the late 1990s, as Western guided weapons were integrated on both the MiG-27ML and the MiG-27 UPG, which were found to have more room for standoff capability than the Soviet missile.

Indigenous innovation played a critical role in sustaining the fleet. Squadrons and maintenance units developed in-house testing equipment, modified weapon racks and pylons, addressed avionics incompatibilities, and mitigated recurring engine and fuel-system

issues. Despite persistent serviceability challenges, operational readiness was maintained through rigorous inspection regimes and local engineering solutions.

Operational Employment and Tactical Evolution

By the mid-1990s, MiG-27ML squadrons had matured into versatile multi-role strike units. In addition to conventional close air support and interdiction, selected squadrons undertook 'specialist' roles: No.2 Squadron 'Winged Arrows' became the first MiG-27ML Maritime Strike squadron in 1994-95, and in that same annual year, No.18 Squadron 'Flying Bullets' became the first dedicated night strike squadron. No.9 Squadron 'Wolfpack' was deemed to be the high-altitude specialists amongst the MiG-27 squadrons. The aircraft regularly participated in large-scale joint and international exercises, particularly in the late 2000s and 2010s, refining tactics for low-level penetration, night strike, electronic warfare environments, and multi-package operations alongside Mirage 2000s, MiG-29s, Jaguars, and allied air forces. No.18 Squadron ceased dedicated night flying operations in 2005, and overtook the Maritime Strike role when No.2 Squadron was number plated.[6] No. 22 Squadron carried out Banner Target Towing duties in the final years of operations, as seen during Ex Iron Fist 2016.[7]

Kargil Conflict (1999)

The MiG-27ML's most demanding combat employment occurred during the Kargil conflict under Operation *Safed Sagar*. No.9 Squadron

was among the first squadrons to be mobilised and conducted strikes against heavily defended targets in the theatre.[8] Initial operations using low-level dive attacks and rocket pods exposed the aircraft to MAN Portable Air Defence Systems (MANPADS) threats, resulting in two losses, a MiG-21M flown by Squadron Leader Ajay Ahuja and an Mi-17-1V of No.129 HU 'Nubra Warriors'. The Wolfpacks lost one MiG-27, flown by Flight Lieutenant Kambampati Nachiketa Rao, but that was due to an engine flameout caused by ingestion of gun exhaust gases. Flight Lieutenant Nachiketa was captured and held as Prisoner of War (POW), eventually being repatriated to India.[9, 10]

These events prompted a rapid tactical reassessment. MiG-27s transitioned to GPS-assisted Medium Altitude Level Release (MALR) profiles and later conducted night strike operations. Combined with MiG-23 BNs, the MiG-27 fleet delivered a decisive proportion of the IAF's strike effort, accounting for over half of the total ordnance delivered during the conflict. Wartime serviceability rose sharply to above 90 per cent, demonstrating the effectiveness of maintenance practices under combat conditions. The type and its crews received multiple gallantry awards for their performance.

Post-Kargil Service and Drawdown

Following the Kargil conflict, MiG-27ML squadrons remained operationally active during Operation Parakram (2001–02) and continued to participate in domestic and international exercises. Several units achieved high readiness and inspection ratings despite

increasing challenges related to engine availability and ageing airframes.

The mid-2000s marked the gradual drawdown of the fleet as upgraded MiG-27UPG and newer platforms assumed primary strike roles. This period also marked a sharp reduction in the serviceability rates and aeroengine availability; however, this was tackled through rigorous maintenance checks and high safety standards. The final MiG-27ML squadrons were phased out in 2016, with No.22 Squadron being the last to wind down in November that year.

Assessment

Over nearly three decades of service, the MiG-27ML evolved from a conventional strike aircraft into a highly adaptable multi-role platform. Its legacy lies not only in combat performance—particularly during the Kargil conflict—but also in the institutional lessons it imparted: indigenous sustainment under constraint, rapid tactical adaptation, cross-platform weapons integration, and the transition toward precision-guided warfare within the IAF. The platform's performance during Op *Safed Sagar* prompted the IAF to consider giving it another lease of life through the limited-scale MiG-27 Upgrade programme.

5
MiG-27 Upgrade

Introduction

By the end of the millennium, the Indian Air Force operated three aircraft dedicated to ground attack: the SEPECAT Jaguar for deep strike, and the MiG-23BN and MiG-27ML for tactical strike and close air support. The Jaguar was viewed as a modern platform at induction, particularly when compared to earlier Soviet-origin aircraft in IAF service, such as the Su-7BMK and MiG-21, which relied on mechanical controls and largely analogue navigation and attack systems.

Jaguar introduced integrated navigation and weapons-delivery avionics, most notably Navigation and Weapon Aiming Sub-System (NAVWASS) and the Laser Ranger and Marked Target Seeker (LRMTS), which enabled higher accuracy in air-to-surface operations. These capabilities influenced the evolution of IAF air-to-ground doctrine, especially in mission planning and attack execution. Issues with NAVWASS, however, led to the clearance of the DARIN programme, which was replaced NAVWASS with Sagem's inertial navigation system (INS) and the COMED (Combined Map &

Electronic Display) display, improving navigation accuracy and reducing pilot workload.

The Kargil conflict exposed limitations of Jaguars, as they were unable to reach targets in Kargil and Batalik, leaving precision strikes to Mirage 2000H aircraft, while MiG-23BN and MiG-27ML conducted conventional bombing. Post-conflict attention shifted to the MiG-27ML, whose Ikava gyro inertial system suffered from large drifting issues. Although night operations were possible, they remained inflexible and heavily pilot-dependent. The absence of a modern weapons-delivery computer and precision-guided munitions confined both the MiG-23BN and MiG-27ML to unguided weapons

Concurrently, the Su-30MKI upgrade programme drove avionics indigenisation under DARE. Air Chief Marshal S. Krishnaswamy directed the procurement of 45 additional upgrade kits for MiG-27MLs. Of 165 aircraft acquired between 1984 and 1997, 127 remained in service by 2003; 40 airframes with over 1000 hours remaining were selected. An Air Staff Requirement defined a non-OEM, cost-effective upgrade executed by Air HQ, Defence Avionics Research Establishment (DARE), and HAL under a tripartite MoU.[11, 12]

Avionics and Navigation Systems

The MiG-27ML's original Soviet-era avionics suite, including the PrNK-44L NavAttack System, Orbita 10-15-44L digital computer, RSBN-6S, PRMG, Klistron ILS, and Russian communication

systems, was augmented with an Inertial Navigation System (INS) integrated with GLONASS and INCOM radio sets. This foundational architecture was retained but fundamentally overhauled during the UPG programme. The Orbita-20-44L, a core component of the PrNK-44L, was replaced with the modular Core Avionics Computer (CAC), developed by DARE. The CAC, an open-architecture system, utilised contemporary processors and functional modules, leveraging the same hardware deployed in the Jaguar DARIN II and Su-30MKI. This design choice ensured compatibility with IAF-specific flight and maintenance protocols, while enabling scalability for future upgrades. More than one million lines of code were generated, rigorously tested, and validated to meet operational and safety standards. The CAC's modular design facilitated real-time data processing for navigation, weapon delivery, and sensor fusion, critical for the aircraft's dual CCIP (Constantly Computed Impact Point) and CCRP (Constantly Computed Release Point) attack modes.

Cockpit Modernisation

The cockpit redesign was the most visually transformative aspect of the UPG. The Klyon PM TV Guidance set, characterised by its large, top-right-mounted CRT display, was replaced with a Multi-Function Display (MFD). The S-17VG-1 gunsight was superseded by a Heads-Up Display (HUD) paired with an Up-Front Control Panel (UFCP). While analogue instruments such as the Airspeed Indicator (ASI), Altimeter, and Vertical Speed Indicator (VSI) were

retained for redundancy, the HUD and MFD provided digital flight data, weapon status, and navigation information. The UFCP featured a proprietary "Get You Home" (GETU) button, a critical safety feature. When activated, the GETU function cross-referenced the aircraft's current GPS-aided INS position with a preloaded database of Indian airbases. The system filtered the 10 nearest bases capable of accommodating a MiG-27UPG, prioritised by distance, and automatically generated a recovery route to the selected airfield. This capability was enabled by integrating Jeppesen charts and airspace data into the INGPS system, ensuring geospatial accuracy for emergency landings.[13]

Weapons and Sensor Integration

The UPG programme expanded the MiG-27's offensive and defensive capabilities through the integration of advanced pods and guided munitions. The legacy MiG-27MLs were fitted with the *Klyon PM TV Guidance system* and the *Kayra Laser Designator* for the employment of Kh-29 missiles and the KAB-500 guided bombs. This system was replaced with the LRMTS and Litening Pod, which facilitated laser designation, while the CAC processed CCRP release points for Paveway II and DRDO Sudarshan Laser-Guided Bombs. This marked a departure from the MiG-27ML's reliance on CCIP bombing, which required precise trigger timing to account for forward throw ballistics.

The Vinten Vicon Tactical Photo Reconnaissance Pod was also retroactively integrated on the MiG-27ML, providing tactical

reconnaissance capability. These systems enabled the aircraft to transition from unguided to precision-guided weapon delivery. The UPG's dual-mode capability enhanced mission flexibility, particularly in contested environments where unguided munitions were vulnerable to countermeasures.

Countermeasures and Electronic Warfare

The AN/ALE-44 CMDS, an American-origin system, replaced rudimentary Soviet countermeasure dispensers. Two of these were fitted to each aircraft, and each CMDS unit carried 30 cartridges for flares and chaff, providing multi-spectral protection against radar- and infrared-guided threats. The system was locally manufactured by Bharat Dynamics Limited (BDL) and fitted across the MiG-21 Bison, MiG-27UPG, MiG-29, Mirage 2000, and Su-30MKI fleets. Complementing the CMDS, the EL/L-8222 SPJ pod emitted deceptive signals to confuse enemy radar, with the capability to jam multiple targets simultaneously. The SPJ's threat library was updatable, enabling real-time adaptation to evolving radar signatures.[14] DRDO-built Jammer pods (Trumper, Tusker, Tramp and Tempest) were also integrated on the type, adding further indigenisation in the area of Self Protection.

Radar Warning Receiver and Threat Library

The DRDO Tarang 1B Radar Warning Receiver (RWR), developed by DARE, replaced the SPO-141 RWR. The SPO-141's limited threat library, optimised for NATO aircraft, was inadequate for

Indian operational scenarios. The Tarang 1B addressed this by maintaining a dynamic database of regional threats, including Chinese and Pakistani radar systems. This customisation ensured the IAF could detect and classify adversaries with high fidelity, a critical requirement for high-intensity conflict.

Upgrade Process and Technical Challenges

The tripartite MoU (DARE, IAF, HAL) valued at INR 460 crores was signed on March 14, 2002, with a five-year timeline. The first two years focused on prototype development, including avionics integration, weapon testing, and the first flight. The remaining three years were allocated to upgrading 40 aircraft. Key challenges included:

1. OEM Exclusion: Unlike previous upgrades, Mikoyan/UAC and Western subsystem OEMs were not involved, necessitating domestic solutions for technical bottlenecks.
2. Architecture Mismatch: Russian and Western avionics used incompatible connectors and power requirements. DARE redesigned interfaces, including power distribution systems, to meet IAF standards.
3. Logistical Constraints: Weapon testing required distant ranges (e.g., Pokhran, Jamnagar), straining HAL and DARE's support infrastructure.

Organisational Structure

- Air HQ (New Delhi): Project governance and logistics.

- HAL Ozhar (Nashik): Avionics installation and aircraft modifications.
- DARE (Bengaluru) Software development, integration, and certification.

Prototype Development

The UPG programme was divided into six stages:

1. Stage I: (April-November 2002): Focused on system specifications and operational concept translation into software.
2. Stage II: CAC programming and integration rig testing at DARE. HAL Nashik stripped MiG-27MLs to redesign internal layouts. A Mission Planning System reduced pre-flight planning from 2-3 hours to 30 minutes.
3. Stage IIB: Navigation and attack databases were compiled using digitised Jeppesen charts and empirical data from Kolar's temporary weapons range. CBLS (Carrier Bomb Light Stores) tests generated drag coefficient and ballistics tables for the CAC.
4. Stage III: Subsystems were environment-tested in Nashik before installation.
5. Stage IV: CEMILAC and DGAQA certifications enabled prototype flight testing. The first flight, conducted by Group Captain Ashit Mehta on March 25, 2005, achieved IOC and FOC by 2007.
6. Stage V: Aircraft with ≥1000 flight hours were upgraded during scheduled overhauls to minimise downtime.

7. Stage VI: No. 10 Squadron (Daggers) and No. 29 Squadron (Scorpions) transitioned to UPG aircraft, based at Jodhpur.

Since the MiG-23UB was not upgraded, an APTT (Avionics Part Task Trainer) was developed by ADE (Aeronautical Development Agency), Bengaluru. The APTT is a Real-Time Part-Task Trainer used to train pilots on upgraded aircraft. It is designed to provide functional simulation of all the avionics subsystems of the upgraded aircraft, EW systems and weapon release systems. It provides training under normal flying (take off, landing and en route navigation) and under failure conditions. APTT was delivered to the IAF in the year 2012.[15]

AL-31 Engine Re-Engining Proposal

A proposed re-engining with AL-31 turbofans (excluding thrust vectoring) was abandoned due to OEM demands. Mikoyan required shipping the MiG-27UPG prototypes to Russia for integration, which would have exceeded budgetary and operational constraints. The AL-31F's higher thrust (122.5 kN vs. the R-29-300's 83.2 kN) would have extended operational ceilings and improved climb rates, but the programme's core objective precluded such a radical overhaul.

However, the Russians attempted to change the engine on the aircraft by themselves. The prototype, a Russian airframe with Bort No. "Blue 115" was repainted in the Indian tricolour and was modified at the Salyut plant. The first flight of this prototype was carried out on January 15, 2008, from Ramenskoe Air Base. However, the re-

engining was abandoned by the Russians soon thereafter, citing reasons of low Return on Investment and aircraft obsolescence.[16, 17]

Operational Impact and Legacy

The MiG-27UPG's success was validated by three consecutive IAF gunnery meet victories post-upgrade, underscoring its precision and reliability. However, persistent engine failures and ageing airframes led to the fleet's decommissioning on December 27, 2019, marking the end of the IAF's swing-wing era.

Institutional Contributions

- Industrial Capacity: The UPG programme accelerated indigenous production of avionics, adapters, and spares, directly informing later DRDO and HAL projects.
- Training Infrastructure: The APTT (Avionics Part Task Trainer), developed by ADE, provided real-time simulation for avionics, EW, and weapon systems, ensuring pilot readiness under normal and failure conditions.
- Operational Doctrine: The MiG-27UPG's adaptability to Himalayan altitudes and maritime roles influenced IAF training and mission planning, while its integration of Western systems laid the groundwork for the Su-30MKI and DARIN II programmes.

6
Conclusion and Legacy

The MiG-23 and MiG-27 aircraft played a pivotal role in transforming the Indian Air Force's (IAF) combat aviation capabilities over four decades. These "Flogger" aircraft bridged the technological gap between second and fourth-generation fighters, serving as both a technological experiment and an operational mainstay. From the initial swing-wing MiG-23MF interceptors to the indigenously upgraded MiG-27UPG strike aircraft, the fleet significantly influenced the IAF's doctrine, training, and industrial ecosystem.

Remarkably, these aircraft performed duties far beyond their original design specifications. They excelled in diverse roles, from high-altitude air defence to maritime strike with unguided weapons, consistently delivering when needed most. Despite being designed for flat-terrain warfare, the MiG-23BN and MiG-27ML proved highly adaptable to the challenging Himalayan altitudes. This adaptability, driven by necessity and ingenuity within the IAF, led to modifications ranging from engine rating adjustments to the ad hoc integration of GPS. Their robust nature also made them ideal

test beds for indigenous technology development. They facilitated cross-integration of Western equipment, ad hoc upgrades, and the development of local systems, paving the way for technologies used in later-generation fighters and upgrade programmes like DARIN II and Su 30MKI.

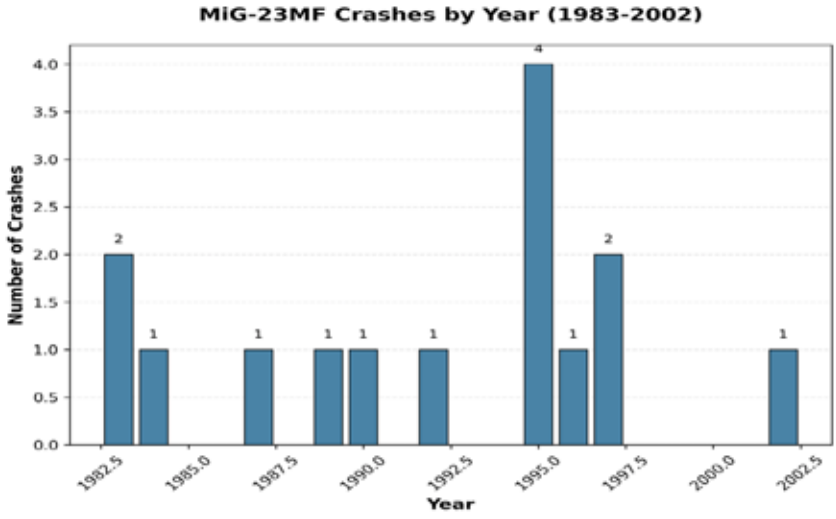
Equally important were the institutional lessons learned, both positive and challenging. Due to their Soviet origin and the demanding roles, they undertook, the MiG fleet presented significant maintenance challenges, including spares shortages and limited overhaul documentation. These issues, though familiar to the Air Force, became proving grounds for crews, managers, and designers. The MiG-27UPG programme, in particular, spurred the indigenous development of spares, adapters, and electronic subsystems. These initiatives directly informed later programmes by DRDO and HAL, strengthening India's aerospace industrial base. Furthermore, the fleet's extensive service generated invaluable operational data and experience, influencing the development of subsequent platforms such as, DARIN II and later Su-30MKI subsystems.

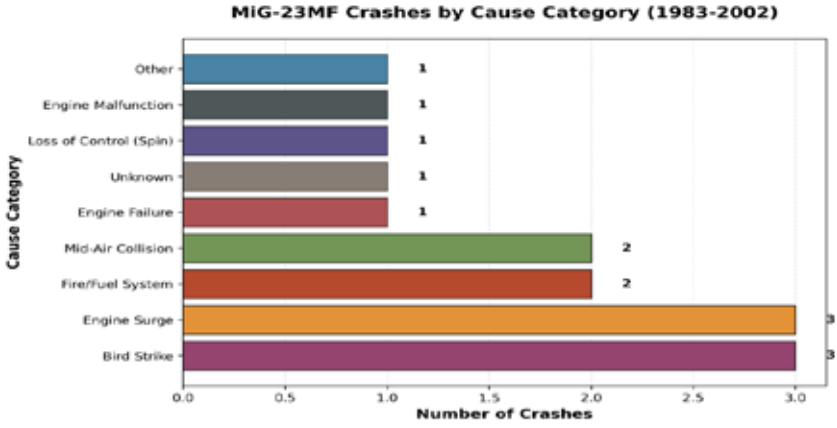
The decision to manufacture MiG-27MLs at HAL Ozhar, on a production line previously used for MiG-21s, provided valuable experience in assembling third-generation fighters, which paved the way for later production of fourth-generation aircraft like the Su-30MKI. The "Flogger" community, encompassing pilots, engineers, and ground crew, maintains a deep institutional nostalgia for the aircraft. The operational philosophy and lessons learned from years with the Floggers continue to influence high-level decision-making

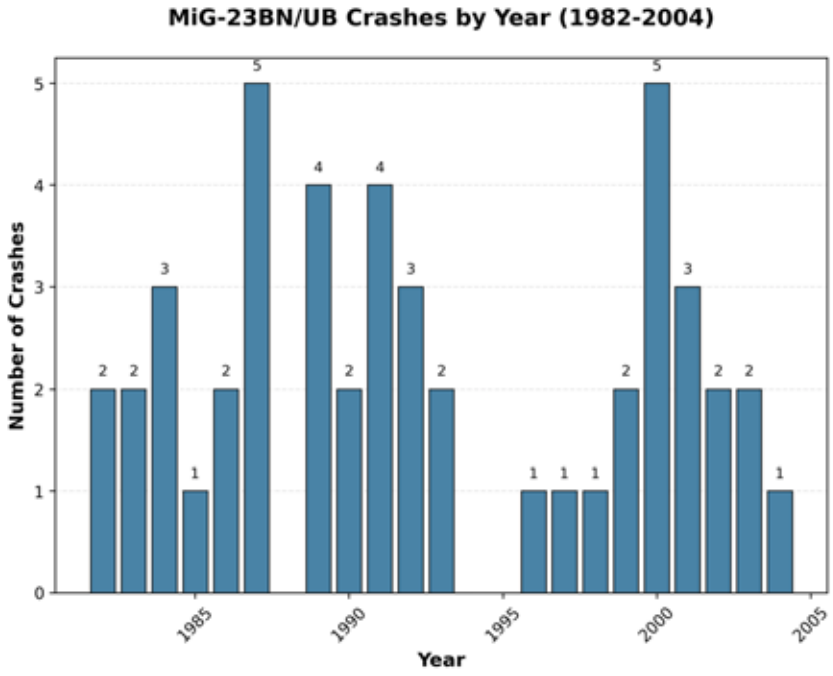
within the Indian Air Force, as evidenced by figures like ACM AP Singh, who commanded the No. 22 squadron equipped with MiG-27s as a Wing Commander.

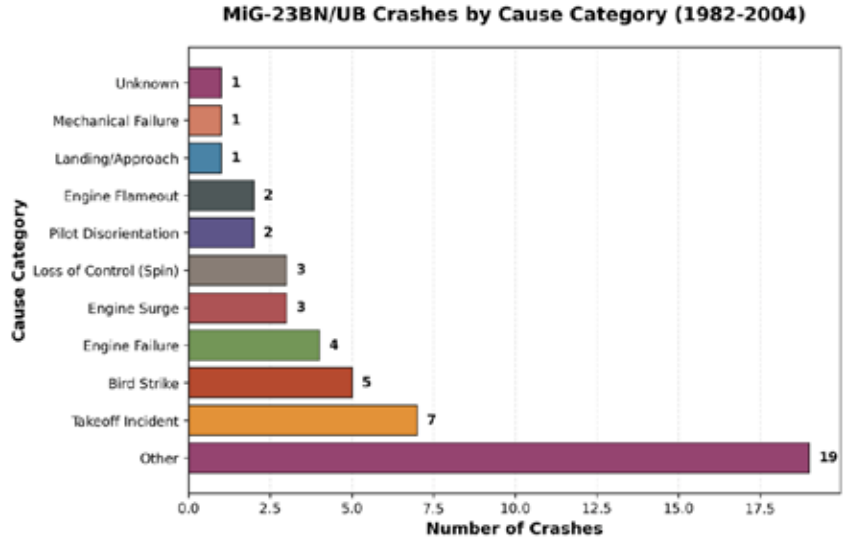
The Floggers of the Indian Air Force stand as a testament to the enduring legacy of a silent workhorse. These formidable aircraft, though lacking the overt flair often associated with more glamorous roles, consistently undertake the profoundly important task of striking deep into enemy territory. Their missions demand exceptional skill due to the nature of operations they take and their soviet origin design philosophy, yet they accomplish their objectives and, crucially, return home. This quiet dedication and unyielding effectiveness define their contribution, making them an indispensable component of the Indian Air Force's operational capabilities.

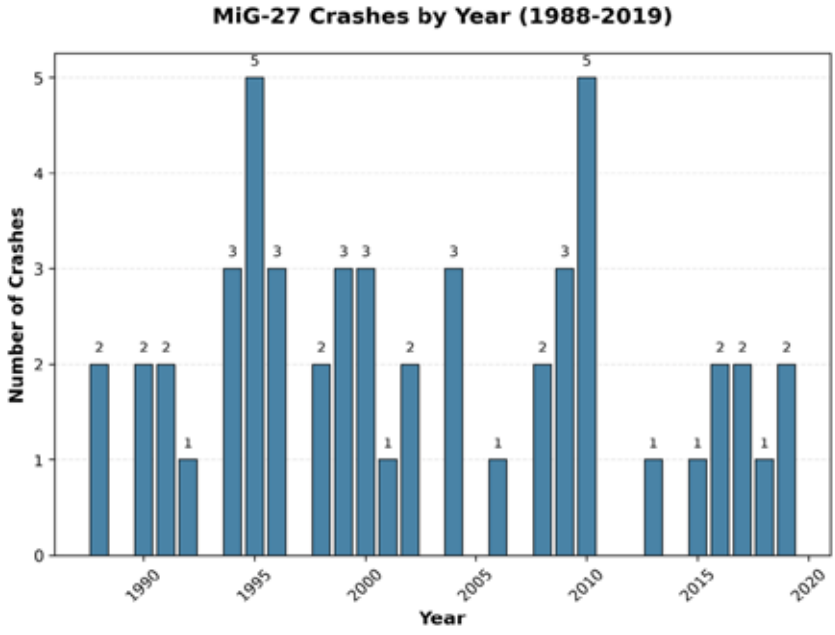
Appendix A
MiG-23 and MiG-27 Attrition Rates

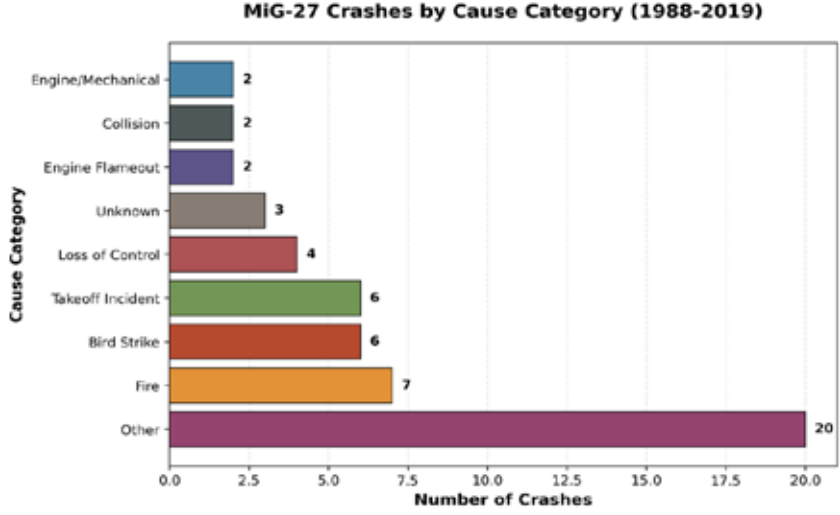





MiG-23BN/UB Crashes by Year (1982-2004)
Number of Crashes
Year
0
1
2
3
4
5
1985
1990
1995
2000
2005
2 2 3 1 2 5 4 2 4 3 2 1 1 1 2 5 3 2 2 1


MiG-23BN/UB Crashes by Cause Category (1982-2004)
Cause Category
Number of Crashes
Unknown 1
Mechanical Failure 1
Landing/Approach 1
Engine Flameout 2
Pilot Disorientation 2
Loss of Control (Spin) 3
Engine Surge 3
Engine Failure 4
Bird Strike 5
Takeoff Incident 7
Other 19
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5





Note: The information regarding accidents in this report is based on data from both Form 1500s of individual squadrons and *Bharat Rakshak*. Consequently, some data may not fully reflect the complete reality or may contain inaccuracies.

Appendix B
IAF Officers Trained in the USSR on MiG-23BN and MiG-23MF

Original converted pilots from the USSR for MiG-23MFs	
No. 223 Squadron	**No. 224 Squadron**
Wg Cdr Inder Jit Singh Boparai	Wing Commander Roy Andrew Massey
Squadron Leader Bhupinder Singh Marwa	Wg Cdr Ajit Kumar Manohar Raje (MCF only on KTS-6 Simulator)
Sqn Ldr Dasharathy Dayakar	Squadron Leader Om Prakash Sharma
Sqn Ldr James Thomas Palapuzha	Sqn Ldr Prakash Prahalad Dani
Sqn Ldr Koyippillil Balagangadhara Kurup (Technical Officer)	Sqn Ldr Dhanwant Singh Guram
Sqn Ldr Anil Rajeshwarrao Ambatkar (Tech Offr)	Sqn Ldr Kamal Chaudhry
Flt Lt Walter Raymond (Tech Offr)	Sqn Ldr Satish Kumar Gahlaut
Flight Lieutenant Phillip Frank Montes	Flight Lieutenant Anil Gupta
Flt Lt Makarand Dattatrya Palekar	Flt Lt Vijay Kumar Tondon
Flt Lt Devendra Nath Ganesh	Flt Lt Suneet Shripad Soman
Flt Lt Ashok Balakrishna Rahane	
Flt Lt Keshava Murthy Rama Sundara (Tech Offr)	

Table 4: MiG-23MF Converts from the USSR

Original converted pilots from the USSR for MiG-23BNs	
No. 10 Squadron	**No. 221 and 31 Squadrons**
Wg Cdr Rattan Lal Bamzai	Wg Cdr Hemant Vishnu Khatu
Sqn Ldr Maheshwar Das Khanna	Sqn Ldr Avinash Deodatta Joshi
Sqn Ldr Vinod Kumar Verma	Sqn Ldr Vinod Kumar Arora
Sqn Ldr Charanjit Singh Gill	Sqn Ldr Bhushan Nilkanth Gokhale
Sqn Ldr Pradeep Vasant Nail (later Air Chief Marshal)	Sqn Ldr Anil Thapar
Flt Lt Mukundan Sushil Kumar	Sqn Ldr Ranjit Singh Pannu
Flt Lt GS Gurcharan Singh Bhogal	Sqn Ldr Syed Mohammed Ghouse
Flt Lt Virender Nath Kalia	Sqn Ldr Melvinder Singh Grewal
Sqn Ldr Pirthi Pal Singh Kahlon AE(M)	Flt Lt Vijay Kumar Sharma
Sqn Ldr Dalip Kumar Khashnobish AE(M)	Flt Lt Nalluri Motilal
Flt Lt Ajit Kumar Raina AE(L)	Flt Lt Tapan Kumar Chatterjee
Flt Lt Anurag Bhawanishankar Pandit AE(L)	Flt Lt Devinder Singh
Flt Lt Pichaimuthu Antoni Savari Raj AE(L)	Flt Lt Pradeep Singh
Flt Lt Indu Bhaal Bhasin AE(M)	Flt Lt Subramanyam Sukumar
	Flt Lt Tarun Kumar Varma
	Sqn Ldr Sashanka Shekhar Roychoudhary AE(M)

Table 5: MiG-23BN Converts from the USSR

Appendix C
Op *Safed Sagar* MiG-23/MiG-27 Squadron Gallantry Awards

For their contributions towards Op *Safed Sagar,* the following awards were given to officers and men of No. 9 Squadron:

1. Sqn Ldr Bhatnagar - Vayusena Medal (Gallantry) [VM(G)]
2. Flt Lt Nachiketa - VM(G)
3. Flt Lt A Gupta - Mentioned-in-Despatches (M-in-D)
4. Flt Lt A Banerjee - M-in-D
5. Fg Offr M Yakoob - M-in-D
6. WO Jaswant Singh - M-in-D
7. Cpl Krishnendu Mitra - M-in-D[18]

The following officers and men from No. 221 squadron were awarded for their contributions towards operations:

1. Wg Cdr A Mehta - M-in-D
2. Sqn Ldr HP Singh - VM(G)
3. Sqn Ldr R Prem - M-in-D
4. Flt Lt A Dabral - M-in-D

5. Flt Lt R Walia - VM(G)
6. Fg Offr J Singh - M-in-D[19, 20, 21]

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Unnikrishnan G Kartha Chair of Excellence: 2024-25

Research Report

Part - 2

Training and Transformation

A Historical Study of Indian Air Force Training in the Southern Peninsula (1940s – Present)

Prepared by:
Atul Chandra

February, 2026

Centre for Aerospace Power and Strategic Studies (CAPSS)
New Delhi

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Executive Summary

This study examines the evolution of the Indian Air Force (IAF) training in the Southern Peninsula from the early 1940s to the present day. It traces the region's transformation from a Second World War wartime support area into the central pillar of the Service's training architecture. It analyses how geography, institutional decisions, and training philosophy combined to create a resilient and adaptive training ecosystem that remains capable of meeting changing operational and manpower requirements.

During the Second World War, airfields and training facilities in Southern India were established primarily to support Allied air operations and aircrew preparation. These early foundations, supported by a favourable climate and available airspace, created the necessary conditions for sustained training activity. In the post-Independence period, the IAF consolidated and expanded this infrastructure, progressively locating key training establishments in the region to support officers, airmen, and advanced flying training.

The study examines the establishment and evolution of major institutions, including the Air Force Academy (AFA) at Dundigal, the Airmen Training School at Belagavi, and training units at the Air Force Station (AFS) Yelahanka. Together, these establishments illustrate how training in the Southern Peninsula evolved from platform-centric instruction to a structured, system-

wide approach grounded in discipline, safety, and leadership development.

Since the early 2000s training reforms have reflected broader changes in air power, including increased platform complexity, advances in avionics, and the integration of simulation technologies. The induction of modern trainer aircraft and the adoption of blended training models have improved training efficiency and risk management while preserving the central role of in-person, actual flying. Field visits to training establishments confirmed that institutional culture, continuity of practice, and instructor judgement remain central to training effectiveness.

The study concludes that the enduring importance of the Southern Peninsula lies not merely in geography or infrastructure, but in institutional culture and adaptive practices. Over more than eight decades, training establishments in the region have demonstrated the ability to adapt to change while maintaining coherence and effectiveness, sustaining the IAF's operational readiness and future force development.

1. Introduction

Training has been a foundational element in the development of the IAF since its earliest years. As the Service expanded in size, complexity, and operational reach, the requirement for reliable, scalable, and adaptable training systems became increasingly critical. Within this context, the Southern Peninsula emerged as a consistent and enduring hub for air force training across multiple branches and disciplines.

This study focuses on the historical evolution of training establishments in Southern India from the early 1940s to the present. It examines how wartime imperatives, post-Independence consolidation, indigenous capability development, and modernisation efforts shaped the region's training ecosystem. Rather than presenting a catalogue of individual institutions, the study seeks to identify broader patterns of continuity and adaptation across decades.

The Southern Peninsula's importance to air force training has often been attributed primarily to favourable weather and geography. While these factors are significant, they do not fully explain the sustained concentration of training establishments in the region. This study argues that institutional choices, training philosophy, and accumulated organisational experience have been equally decisive in shaping the region's role.

By combining historical research with contemporary field observations, the study aims to contribute understanding of how training systems evolve over time and underpin long-term air power development. The findings are intended to be relevant to military professionals, researchers, and informed civilian audiences interested in the institutional dimensions of air force capability.

2. Methodology

This study employs a qualitative research methodology combining historical analysis, documentary review, and field-based observations.

The historical component draws on published works, institutional histories, archival materials, and official records to trace the evolution of air force training in the Southern Peninsula from the early 1940s to the present day.

Primary qualitative inputs were obtained through field visits to selected IAF training establishments in Southern India. These visits to AFA Dundigal, AFS Yelahanka, and ATS Belagavi enabled direct observation of training infrastructure, instructional environments, and institutional practices. Structured and semi-structured interactions were conducted with instructors, staff officers, and training personnel across flying and airmen training establishments. In accordance with institutional norms, these interactions are reflected through anonymised and non-attributed insights focusing on organisational practices rather than individual perspectives.

The research also incorporated audiovisual documentation recorded during the field visits. This material was intended to supplement the written analysis by capturing contemporary training environments and practices. While the video documentation is undergoing post-production at the time of submission, it has informed the contextual understanding presented in the study.

The synthesis of historical research and field-based observations allows for an assessment of continuity and adaptation within the training ecosystem of the Southern Peninsula. The methodology emphasises institutional patterns, training philosophy, and structural evolution rather than isolated case studies, aligning with the analytical objectives of the Centre for Air Power and Strategic Studies.

This study is based on archival review, site visits to selected IAF training establishments, and structured interviews conducted with instructional and administrative staff.

3. Foundations of Air Force Training in the Southern Peninsula (1940s–1960s)

The foundations of air force training in the Southern Peninsula were laid during the Second World War, when the strategic requirements of Allied air operations in the Indian Ocean Region (IOR) necessitated the rapid expansion of air infrastructure across the subcontinent. Southern India, geographically distant from the primary theatres of combat yet well positioned to support logistics, maintenance, and training, emerged as a suitable region for establishing airfields and support facilities.[1]

During this period, the emphasis was on creating functional infrastructure capable of supporting flying training, aircraft maintenance, and ground instruction under wartime conditions. Airfields such as the ones located at Yelahanka near Bangalore and Sambra in Belagavi were developed primarily to meet operational and training needs rather than as permanent institutional establishments. Yelahanka's history as an IAF air base has its origins in WWII. One of the first units located at the then Royal Air Force (RAF) Station Yelahanka was the RAF's No. 225 Group Communication Flight, which moved to Yelahanka on January 10, 1944.[2] Several other RAF Squadrons were based in Yelahanka, operating types such as the Bristol Blenheim, De Havilland Mosquito, Hawker Hurricane,

Republic P-47 Thunderbolt, and Spitfire Mk VIIIs.[3] The airfield and camp at Sambra, Belagavi, were initially set up by the RAF in 1942.

Training during this phase was pragmatic and task-oriented, shaped by the urgency of wartime demands and the requirement to generate aircrew and ground personnel at scale. While these wartime installations were not originally conceived as long-term training institutions, their location and accumulated operational experience proved significant in the post-war context. The relatively stable weather patterns of Southern India, combined with open terrain and available airspace, enabled flying and ground training to be conducted with fewer seasonal disruptions compared to other regions. These advantages, initially incidental, would later become central to institutional decision-making.

On May 01, 1946, No. 225 Group Communication Flight relocated to Hindustan Aircraft Limited (HAL) Airfield in Bangalore, and was rechristened as No. 2 (Indian) Group Communication Flight in June 1946. Following the transfer of this flight, which was its last flying element, the airfield at Yelahanka later fell into disuse.

From India's Independence, the IAF's requirements for basic trainer aircraft also played a key role in the growth of aeronautical manufacturing in Southern India. India's first aircraft factory was formally registered by Seth Walchand Hirachand as Hindustan Aircraft Limited under the Mysore Companies Act on December 23, 1940. The foundation stone for HAL's Bangalore factory was laid on January 12, 1941. The first HAL assembled aircraft, a Harlow trainer,

flew within eight months of the company's registration. The first local orders for aircraft production in India were awarded to HAL for assembly under license of 20 Harlow PC-5 trainers, 48 Curtiss 75A-SP Hawk fighters and 74 Vultee V-12-D attack bombers, to aid the WW II effort.

Note: Hindustan Aeronautics Limited (HAL) was formed on October 1, 1964, as the amalgamation of two companies, i.e. Hindustan Aircraft Limited and Aeronautics India Limited (created for license-production of MiG-21 aircraft under license).

Following Independence in 1947, the IAF inherited a diverse mix of infrastructure, personnel, and training practices from the RAF. The immediate challenge was two-fold: to transition from a colonial force structure to a national service, and to expand training capacity to meet the requirements of a growing air force tasked with defending a newly independent state. Training assumed heightened importance as the Service sought to develop indigenous capability while maintaining operational readiness.[4]

The No. 2 (Indian) Group Communication Flight's nomenclature was changed to No. 2 (Training) Group Flight on August 15, 1947. As on the day of India's independence, No.2 (Indian) Group RAF was located at Bangalore, with Air Commodore CD Adams as Air Officer Commanding (AOC) responsible for Ground Training.[5]

HAL's first license-produced aircraft after Independence was a trainer aircraft, the Percival P.40 Prentice. The Prentice was developed to meet the Royal Air Force's (RAF) requirement for a basic trainer aircraft to replace the Tiger Moth. A total of 375 units of this type

were delivered to the RAF, with Argentina, India, and Lebanon being its other customers. To meet the IAF's urgent need for a basic trainer aircraft, HAL produced sixty-five P.40 Prentice under license, and the first Indian assembled Prentice made its maiden flight with HAL's Chief Test Pilot (CTP) Captain Jimmy Munshi at the controls on April 30, 1948.

Over the course of 1947-48, discussions were held on the type of aircraft to be designed in India for the first time, and the IAF requirement for a basic trainer aircraft was accepted. The Government of India sanctioned the development of such an aircraft on October 11, 1948. The original plans called for three indigenous trainer aircraft types to be developed: the Hindustan Trainer 2 (HT-2) primary trainer, HT-10 advanced trainer, and HT-11 intermediate trainer. The latter two never progressed beyond the mock-up stage. The full-scale mock-up of the HT-2 was ready by August 1949, less than a year from programme sanction. The first HT-2 prototype (VT-DFW) made its maiden flight on August 05, 1951, and the second prototype (VT-DCG) took to the air for the first time on February 19, 1952. The HT-2 received its Type Certificate on January 03, 1953, and was formally inducted into the IAF on January 10, 1955.

Changes were underfoot at the IAF, too. The IAF reorganised Air HQ in 1948, and No. 2 (Training) Group was renamed as Training Command on July 22, 1949. The buildings of HQ No. 2 (Training) Group RIAF at Bangalore High Grounds were occupied by HQ Training Command. Air Commodore RHD Singh was

the first Air-Officer-Commanding (AOC) and Group Captain R Atmaram was the first Senior Air Staff Officer (SASO) of Training Command. In 1950, No. 2 (Training) Group Flight at HAL airfield was renamed Transport Communication and Coordination Flight (TCCF).

Located near Yelahanka, was the settlement of Jalahalli, where the IAF's Technical Training College (TTC) was established in 1949. The IAF's direct-entry officers of the Technical Branch were trained in the UK prior to the establishment of TTC. Group Captain MJ Kriplani took over as the first Indian Commandant of the TTC in July 1956. The TTC was renamed as Air Force Technical College (AFTC) in 1957.

In April 1948, the Flying Instructor's School (FIS) was formed at Ambala with Flight Lieutenant LRD Blunt as its first Commanding Officer. In its initial few years, 5-6 pilots were trained per course on Tiger Moth and Harvard aircraft. The duration of each course at the time was 12 weeks. In 1954, the IAF decided to relocate the FIS to Tambaram near Chennai. The decision was taken to relocate the school due to continued tensions with Pakistan. Following the establishment of the FIS at Tambaram in 1954. The origin of Tambaram airfield dates to 1942, when it was used as a Royal Naval Air Station during World War II. It featured two cross-runways. After its relocation in 1954, the FIS was equipped with the indigenously built HT-2 aircraft.

In 1955, the HT-2 was inducted into the Flight Instructors School at Tambaram and No. 2 Air Force Academy, Begumpet,

with pupils logging 40 hours on the aircraft before proceeding to the Harvard. The HT-2 was used to train cadets of No. 68 Pilot Instruction Course in 1955, and by the time of the 72nd Course, the indigenous trainer had replaced the Prentice entirely. HAL ceased production of the HT-2 in 1958 after manufacturing approximately 166 aircraft, out of which 150 were delivered to the air force.

It is with this context that the Southern Peninsula began to assume greater institutional significance. Unlike northern and eastern regions, which faced competing operational priorities and strategic sensitivities, Southern India offered relative freedom for sustained training activity. The availability of land for expansion, combined with predictable flying conditions and manageable airspace, allowed the IAF to consider establishing permanent training institutions rather than relying on dispersed or temporary facilities. Coupled with the location of HAL for the manufacture of military trainer aircraft, it set the stage for further consolidation of the IAF's training infrastructure in the Southern peninsula.

The relocation of training establishments from congested urban centres to more suitable locations in Southern India began with the movement of ground training elements to Sambra in the early 1960s, reflecting both practical constraints and evolving institutional priorities. As Bengaluru and other urban centres expanded, space limitations and civil–military considerations increasingly affected training activity. Sambra, by contrast, offered the physical capacity to accommodate large numbers of trainees, infrastructure expansion, and live training activity.[6] When No. 1 Ground Training School

(GTS) was relocated from Jalahalli to Sambra in 1962, the assets of the camp were transferred to the IAF's No. 1 Ground Training School (GTS).

During the 1950s and early 1960s, training curricula across the IAF underwent a process of revision and standardisation. This is evident in the growth of AFS Yelahanka. The inherited British training models were reviewed and adapted to suit national requirements, climatic conditions, and emerging operational doctrine. While technical proficiency remained a core objective, increasing emphasis was placed on discipline, physical conditioning, and service ethos. Training establishments were expected not only to impart skills but also to shape the character and professional identity of personnel.

All flying establishments of the IAF were transferred to Training Command on September 15, 1954, making it responsible for the entire training in the IAF. HQ Training Command moved from High Grounds, Bangalore, to Hebbal on May 31, 1958.

AOC, Training Command was sanctioned by the President of India on April 08, 1960, and redesignated the post as Air Officer Commanding-in-Chief (AOC-in-C). The permanent establishment of HQ Training Command at Hebbal was finally completed in 1968. In the meantime, TCCF returned to Yelahanka on June 4, 1964, where it was established as a lodger unit of the Transport Training Wing (TTW).

This period also marked the gradual institutionalisation of training philosophy. Air Force Station Yelahanka was established on

August 01, 1963, following the 1962 Sino-Indian conflict, when it was realised the IAF needed to expand its transport aircraft fleet. This also gave rise to the Fixed Wing Training Faculty (FWTF), which has produced all the transport pilots serving the IAF today. Rather than viewing training as a preparatory phase preceding operational employment, the IAF increasingly recognised training as a continuous and integral component of force development.

The establishment of a dedicated training command and training schools reflected this evolving perspective. Southern India, with its growing concentration of training infrastructure, became central to this institutional shift. The FWTF had its roots in a conversion and training Squadron formed at Agra in 1948. It was then relocated to Begumpet in 1957, where it was renamed as the Transport Training Wing (TTW). In 1963, due to the necessity of expanding transport training in the IAF, the unit was divided into No.1 TTW at Begumpet and No. 2 TTW at Yelahanka. No. 2 TTW was established at Yelahanka, and the then deserted airfield was recommissioned in August 1963 under the command of Group Captain PL Dhawan. The Dakota was inducted at Yelahanka in 1963 for transport pilot training as part of No. 2 TTW, and the Wing's first batch of pilots was commissioned into service on December 31, 1963. The 2nd batch was commissioned on April 18, 1964. The Initial conversion courses were conducted on Dakota Mk III and Mk IV aircraft.

Importantly, the foundations laid during this phase were not solely physical or organisational. A culture of instruction, mentorship, and institutional memory began to take root within training

establishments. Instructors trained under earlier systems carried forward practices and values while adapting to new requirements. This continuity of practice, combined with incremental adaptation, would become a defining characteristic of training institutions in the Southern Peninsula.

By the mid-1960s, the Southern Peninsula had moved beyond its wartime role as a support region to become an integral part of the IAF's training architecture. The long-cherished vision of a dedicated Air Force Academy catering to all pre-commissioning training of Flying and Ground Duty branches took shape on October 11, 1967, when the foundation stone was laid by then President of India, Dr Zakir Husain. The infrastructure, institutional experience, and training culture developed during this period provided the basis for subsequent expansion and consolidation. These foundations enabled the IAF to respond to growing operational demands over the following decades while maintaining a coherent, scalable training system.

4. Institutional Consolidation and Expansion (1970s–1990s)

The period from the early 1970s through the 1990s represented a phase of consolidation and structured expansion in the IAF's training architecture. By this stage, the Service had moved beyond the foundational challenges of the post-Independence years and was focused on developing a training system capable of sustaining a growing and increasingly complex force. The Southern Peninsula

played a central role in this process, emerging as the institutional heart of the officers and airmens ground and flying training.

The Headquarters Training Command Communications Flight (HQ TCCF) was established at AFS Yelahanka in 1975, with HS-748 'Avro' aircraft to undertake communication duties of dignitaries of all three Services. The first HS-748 was inducted at AFS Yelahanka on July 10, 1974, and the full complement of aircraft was received by March 1975. The course was then renamed Transport Conversion Course (TCC). The Avros replaced the Dakotas, which performed yeoman duties in their role till January 1975. The Dakotas were also used to impart training to air force cadets from Iraq, Zambia, Nigeria, Bangladesh, and Nepal from 1972 to 1974. The HS-748 remains operational with HQ TCCF to this day.

A defining milestone of this phase was the establishment of the Air Force Academy (AFA) at Dundigal in January 1971. The IAF had nurtured the dream of such an academy since 1953, with the aim to bring together, at one place, the training of all fresh entrants into the flying and ground duty branches of the Air Force except for the technical branch. The plan was to develop the institution gradually, with the pilots flying school moving in first, then the navigation and signal school and finally the ground duties training school. Construction of the Air Force Academy was delayed for several years due to the difficulty in acquiring a proper site. Eventually, about 6,700 acres of land located approximately 43 km north-west of the twin cities of Hyderabad and Secunderabad was acquired from the

government of Andhra Pradesh. The location was considered ideal, as satellite bases for advanced training were available at Hakimpet and Bidar, and the weather was conducive to flying training for a majority of the year.

The 107 Pilot Course (PC) was the first to be trained at AFA, following its inception in 1971, and the first instructional sorties commenced using Harvard trainer aircraft on January 18, 1971. Conceived as a dedicated pre-commissioning academy, the Air Force Academy marked a significant institutional shift. Officer training, previously conducted across multiple locations and establishments, was now centralised within a unified framework. This centralisation enabled greater coherence in military training, leadership development, and professional education for cadets in both the flying and ground-duty branches.[7] The first course to be commissioned at AFA was the 113 PC on February 15, 1975.

The Ground Duty Officers' Course (GDOC) was shifted from the Air Force Administrative College, Coimbatore, to AFA on January 21, 1975, with Wing Commander M.V. Naniwadekar as the first Director of Studies. The first GDOC course to be offered by AFA was 56 GDOC in June 1975.

The Academy's location in Southern India was not incidental. Dundigal offers favourable weather and environmental conditions, which are highly conducive to flying training. The airfield experiences clear skies and mild winds most of the year, ensuring high sortie rates. Visibility and cloud conditions allow consistent morning and evening flying slots. The Local Flying Area ensures a safe, distraction-free

training environment, that supports both flight and ground training activities. There was also sufficient land for the development of training infrastructure. These factors have allowed the Academy to function as a comprehensive training establishment rather than a limited instructional facility. Over time, Dundigal became the focal point for shaping the ethos, discipline, and leadership culture of newly commissioned officers.

Flying training at AFA evolved steadily during this period. Initial training relied on WWII-era aircraft, consistent with training practices of the era. As aircraft technology and operational requirements advanced, the training syllabus was progressively restructured to include intermediate and jet training stages. As the operational life of the T-6G/Harvard IIB ended, HAL introduced the HJT-16 Kiran aircraft, which became the IAF's primary intermediate-stage trainer by 1975. This ensured continuity between ab-initio flying training and subsequent operational conversion units. The emphasis throughout remained on developing sound airmanship, procedural discipline, and prompt, and correct decision-making under pressure.

Parallel to officer training, the Southern Peninsula also assumed growing importance in the training of airmen. The expansion of the IAF during the 1970s and 1980s required a steady flow of technically competent and disciplined airmen across a wide range of trades. Ground training establishments underwent periodic reorganisation to align training outcomes with evolving force requirements. This process reflected a broader institutional recognition that airmen training was as critical to operational effectiveness as flying training.

In 1980, No. 1 Ground Training School (GTS) at Belgaum was renamed the Administrative Training Institute (ATI). It symbolised a broadening of training objectives beyond the basic training curriculum. Training curricula increasingly incorporated technical proficiency, administrative competence, and service ethos.

This period also witnessed increased emphasis on indigenous capability within training systems. The induction of new indigenously developed trainer aircraft reflected a deliberate effort to align training platforms with national industrial capacity. Aircraft types such as the HT-2 and HJT-16 Kiran served as a bridge between basic and advanced flying training, enabling a structured progression for trainee pilots.

The development of a new basic trainer aircraft was sanctioned by the Government in 1976 at a cost of INR 5.53 crores. The requirement for the new aircraft, which would be developed by HAL, was for a total of 161 trainer aircraft, and work was proceeding in earnest by 1977. The design of the Hindustan Piston Trainer 32 (HPT-32) proceeded swiftly. The first HPT-32 prototype (X 2157) made its maiden flight in Bangalore on January 06, 1977, piloted by HAL CTP Wing Commander Inder Chopra. The second HPT-32 prototype made its maiden flight in March 1979 and incorporated several modifications. The third and final prototype made its maiden flight in July 1981 and was representative of the final production version, being significantly lighter than the first two prototypes. Unlike the HT-2, the HPT-32 was a nose-wheel aircraft with side-by-side seating for two persons under a rearward-sliding, jettisonable, framed canopy. The HPT-32

also included a provision for a seat behind the instructor and trainee, along with space for some luggage.

The IAF placed an initial production order for the HPT-32 in 1981, ordering 40 aircraft with an additional requirement for 100-150. At the time, the cost of each aircraft was estimated at INR 19.25 lakh. The HPT-32 was inducted into the IAF in March 1984 and used for Stage 1 flight training. HAL completed the delivery of 40 HPT-32s by March 1987.

The IAF placed three additional orders for the HPT-32 in August 1988, January 1990 and March 1992 for 40, 30 and 24 additional aircraft, respectively. In total, the IAF placed orders for 134 HPT-32s. The HPT-32 took over the basic training role (Phase I) in the IAF in its entirety from 1988 onwards, following the retirement of the HT-2. The HT-2s, which served for over three decades at FIS Tambaram, were also retired in 1988, when they were replaced by the HPT-32, which joined the existing fleet of Kiran Intermediate Jet Trainers (IJT) at Tambaram.

Major changes were also afoot at AFS Yelahanka, with the Antonov An-32 transport aircraft and Mil Mi-8 medium helicopters inducted into service in 1986 and 1982, respectively. AFS Yelahanka has been home to No. 112 Helicopter Unit (112 HU), the 'Thoroughbreds', since July 1982. 112 HU was re-equipped with Mi-8 'Pratap' helicopters that same year, and the first Pratap Pilot Conversion Course (to convert pilots from Chetak helicopters) to Mi-8s was undertaken in July 1984. The training pattern was later modified and renamed the Helicopter Conversion Course (HCC),

which was the precursor to today's Stage III (H) pilot training. 112 HU commenced the ab-initio Flt Eng Course for twin-engine Russian helicopters in August 1984 and the Flight Gunners Course in July 1988. A new training aircraft inducted at the station in 1997 was the Dornier Do-228, built under license by HAL at Kanpur. The Dornier Do-228 (built under license by HAL) was inducted at AFS Yelahanka in 1996.

The15 TETTRA School, established on August 12, 1991, as No. 8 Technical Type Conversion Unit at AFS Palam, moved to AFS Yelahanka in January 1997. It was renamed the Dornier TETTRA School in August 1997 and later rechristened as 15 TETTRA School on March 17, 2006.

Beyond platforms and infrastructure, the 1970s–1990s were marked by important social and institutional transitions within the IAF. The commissioning of women officers into ground duty branches in the early 1990s, followed by their induction into the flying branch, required training establishments to adapt their infrastructure, accommodation, administrative procedures, and instructional approaches. The first batch of Short Service Commission (Women) Officers in Ground Duty branches, comprising 12 cadets, was commissioned on June 21, 1993, at AFA. The first Short Service Commission (Women) Pilot Course commenced with 12 cadets at AFA in January 1994. Training institutions in Southern India were at the forefront of this transition, demonstrating organisational flexibility while maintaining training standards and discipline.

Operational experience during this period also validated the effectiveness of the training system. Conflicts and operations undertaken by the IAF underscored the importance of producing well-trained personnel capable of operating in demanding environments. Training establishments in the Southern Peninsula contributed directly to this operational readiness by sustaining throughput and maintaining instructional continuity despite fluctuating demands. During Exercise Brasstacks in 1986, AFS Yelahanka was placed on operational alert with its An-32 and HS-748s flying 152 sorties totalling 263 hours. 1,608 personnel and 13,345 kg of load were airlifted by these aircraft. During Op *Pawan*, the station supported detachments belonging to No. 7 Squadron, PTS and 12 Squadron. The station also maintained a detachment at AFS Tambaram for relief operations.

By the end of the 1990s, the Southern Peninsula had become firmly embedded as the backbone of the IAF's training ecosystem. Its institutions supported officer commissioning, flying training, and airmen preparation at scale, underpinned by accumulated institutional experience and a culture of instruction. This consolidation provided the foundation upon which subsequent modernisation and reform efforts would build in the decades that followed.

5. Modernisation, Training Reform, and the Emergence of a Blended Training Model (2000s–Present)

By the turn of the twenty-first century, the IAF's training system was operating in an environment shaped by rapid technological change,

increasing platform complexity, and heightened emphasis on flight safety and efficiency. Advances in avionics, aircraft systems, and mission profiles placed greater cognitive and procedural demands on aircrew and ground personnel alike. These developments required training establishments to reassess traditional models that relied predominantly on live activity supported by classroom instruction. In the Southern Peninsula, this reassessment led to a gradual but deliberate process of modernisation rather than abrupt structural change.

A defining feature of this period was the systematic integration of simulation into training curricula across flying and ground streams. Earlier approaches had employed simulators primarily for familiarisation, with limited instructional scope. By the early 2000s, simulation had come to be regarded as an essential component of training design. Improvements in computing power, visual fidelity, and systems modelling enabled simulators to support procedural learning, emergency handling, and crew coordination in ways that were not feasible through actual physical training alone.

At the AFA, these changes were most evident in the evolution of ab-initio flying training, which saw a generational leap from the HPT-32 to the PC-7 MK-II. According to a Comptroller and Auditor General of India (CAG) report released in 2019, the HPT-32 aircraft was besieged with difficulties related to reliability and safety, including engine failure, poor glide characteristics and the absence of an ejection seat. Following numerous accidents, the entire HPT-32 fleet was grounded in July 2009. The decision followed the

crash of an HPT-32 aircraft in July 2009, which was caused by an engine failure. A High-Power Study Team (HPST) was constituted by Air HQ and HAL's Transport Aircraft Division in July 2009 to undertake an in-depth analysis of the maintainability and reliability of HPT-32 aircraft and its engine. The HPST was tasked to undertake a technical investigation to find out the cause of engine failures and suggest remedial measures

However, in August 2009, the IAF decided to discontinue flying the HPT-32 fleet till the finalisation of the HPST report. The HPST report released in December 2009 stated that the HPT-32 aircraft, which was designed and developed in the early 1980s, did not meet present-day standards (at the time). The technical investigation carried out by HAL was inconclusive in its findings.

As per a CAG report released in 2013, the report observed that engine cut-off issues had resulted in 189 incidents/accidents on HPT-32 aircraft. Originally slated for retirement in 2014, the HPT-32 fleet was grounded in 2009 resulting in HAL's HJT-16 Kiran Intermediate Jet Trainer (IJT) being used for Stage I training from 2010 to 2013. In June 2012, the IAF opted not to return its HPT-32 fleet back into service, which at the time numbered approximately 116 aircraft.

The Swiss Pilatus PC-7 MK-II was inducted in 2013 at AFA Dundigal and Flying Instructor School (FIS) Tambaram. Its induction marked a significant transition in training philosophy and capability. The aircraft's modern avionics, reliability, and forgiving handling characteristics enabled a restructuring of the training

syllabus. As of 2025, the fleet has flown over 240,000 hours. The PC-7 MK-II has a design life of 10,000 hours and 30,000 landings per aircraft.

Trainees could be introduced earlier to instrument flying, systems management, and standard operating procedures, reducing the cognitive gap when transitioning to more advanced platforms later in their careers. The IAF has two Fixed Base Full mission Simulators, three Cockpit Procedure Trainers and one Avionics Part Task Trainer for its PC-7 MK-II fleet. Training now follows a blended model combining theory, simulation, and actual flying. The PC-7 MK-II introduced simulator flying in Stage I and II, enabling pre-flight training in cockpit procedures and emergencies. Fixed-base and procedural simulators were employed to familiarise trainees with cockpit layouts, checks, and emergency procedures before exposure to live flying.

The Pilatus fleet also features a Mission Debriefing System, that enables detailed recording of training flights for subsequent playback on-screen. Instructors emphasised that simulators were intended to enhance, rather than replace, airborne training. Simulators replicate real aircraft handling closely, giving cadets a realistic control understanding before flying. They improve check proficiency, confidence, and navigation under varying simulated weather and terrain conditions. Thus, allowing trainees to practise procedures repeatedly in a controlled environment, simulators reduced avoidable errors during early sorties and enabled flying hours to be used more effectively for developing judgement, situational awareness, and

aircraft handling skills.[8] This approach bridged the gap between theory and flight, reduced in-flight errors and increased trainee confidence, making each sortie safer and more productive.

Training reforms during this period extended beyond flying training to encompass airmen and ground duty officers training curricula. No. 1 Ground Training School (GTS) at Belgaum was renamed Airmen Training School (ATS) on December 15, 2001. ATS is purely dedicated to joint basic phase training for all ab-initio trainees of the IAF. The ATI was shifted to Air Force Station Tambaram in November 2001. Its location in Southern India provided the space and infrastructure necessary to conduct training at scale while maintaining uniform standards.[9]

ATS was numbered as 405 Air Force Station, Belagavi, with effect from October 20, 2004, but continued to be known as ATS (405 AF Station) Belgaum. ATI was again shifted from Air Force Station Tambaram to Belgaum in December 2005 and became fully functional with effect from December 23, 2005. The training models have evolved to reflect changes in manpower policies and operational requirements. Modular training structures were introduced to align instructional content more closely with specific trade requirements, while retaining common foundational elements such as physical conditioning, drill, service ethos, and safety awareness. This approach sought to balance efficiency with standardisation, ensuring that airmen across trades shared a common institutional foundation.

The *Agnipath* scheme was launched by the Union Government in 2022. The first batch of *Agniveervayu* started their training at Airmen

Training School, Belagavi, on December 30, 2022. Subsequently, the first batch of *Agniveervayu* (Women) was also inducted into the IAF and commenced training from June 28, 2023, along with *Agniveervayu* (Men). The revised manpower model required training establishments to accommodate compressed timelines and revised training outcomes without compromising standards. Rather than abandoning existing frameworks, training institutions adapted established curricula and methodologies to meet new requirements.

ATS Belagavi conducts training through institutions such as the Basic Training Institute, Non-Technical Training Institute, and the Air Force School of Physical Fitness. The Basic Training Institute (BTI) imparts *Agniveervayu* trainee training (AGVTC) for 22 weeks (Phase I & II), while the Non-Technical Training Institute (NTTI) imparts trade-phase training to ab-initio, in-service trainees and international students in Administration Assistant and Education Instructor trades. The NTTI also conducts basic and trade-phase training for *Agniveervayu* (non-combatant) for 24 weeks. The Air Force School of Physical Fitness (AFSPF) imparts training to GTIs in modular patterns, advanced refresher courses for in-service GTIs, ad-hoc training for GTIs (Sports), swimming skill training for IAF tradesmen, and GTI trade training for international students. Emphasis was placed on focused instructions, continuous assessments, and close supervision to ensure that trainees achieved defined competencies within shorter training cycles.

While the earlier All-Through Training (ATT) in the IAF focused more on knowledge than skill. In 2004, a new concept, Just-in-Time

Training (JITT), was introduced through the Encapsulated Pattern of Training (EPT). This training philosophy emphasised need-based training—training air warriors on what is needed, when it is needed. Training content was redesigned considering employability in the field. From April 2006 onwards, following the restructuring and merger of trades, ab-initio and in-service trade training were refined and implemented under the Modular Pattern of Training (MPT). The career progression of an airman is now linked to the training imparted. In the erstwhile EPT and MPT, owing to the limited duration of JBPT, physical and discipline standards were not always at the desired level. As a result, this led to a review of basic training and the evolution of the Integrated Pattern of Training (IPT). Following deliberations at Air HQ, HQ Training Command, and other Commands, the new policy took shape and became effective for all airmen inducted from January 2014.

For the instructors who were enrolled under the All-Through Training Pattern at ATS Belagavi, the training duration had been longer and more exhaustive. Since then, multiple changes have been introduced, with the latest being the *Agniveervayu* Training Course, which commenced on 30 December 2022. Key changes include: Reduction of training duration from 64 weeks to 22 weeks of basic training, followed by 8 weeks of stream (trade-specific) training, as *Agniveervayu* serve an initial tenure of four years, 14 teaching classes per day, including two self-learning sessions, introduced to acclimatise trainees to the rigours of military life prior to posting to field units, introduction of surge and disruptive training to break

familiarity with fixed schedules and prepare trainees for extended and unscheduled activities. Other changes included the inclusion of 'Survival Day' to familiarise trainees with dry rations and plausible field conditions during adversity.

Digital tools increasingly supported these reforms. At ATS Belagavi, this included the introduction of simulators such as Fire Fighting Simulator, Common User Vehicle Simulator (Driving), Integrated Weapons Simulator, weapons handling tools, and hand-held modules (tablets). The computer-based training modules, electronic training aids, and simulator-driven instructional training were employed to reinforce technical understanding and procedural accuracy. Instructors noted that while contemporary trainees often demonstrated familiarity with digital interfaces, training continued to emphasise discipline, attention to detail, and adherence to standard operating procedures. Technology was consistently viewed as an enabler of efficiency rather than a substitute for instructional rigour.[10]

At Air Force Station Yelahanka, modernisation manifested through both platform upgrades and training methodology improvements, using simulators and digital programs. As a hub for transport and helicopter training, Yelahanka incorporated newer aircraft variants with upgraded avionics and systems. 112 HU inducted newer Mi-17 medium lift helicopters in February 2016 and retired its venerable Mi-8 helicopters from service in December 2017 at AFS Yelahanka. The Mi-8s were instrumental in training IAF's twin-engine helicopter pilots for more than four decades, but

by the time of their retirement, they were at the end of their life and demanded a high amount of maintenance.

Today, the training in FWTF is conducted in two stages—Stage II (T) and Stage III (T). The induction of the latest Glass Cockpit variant of the Do-228 at Yelahanka commenced in Oct 2023. In November 2023, a new Do-228 Level D Full Motion Full Mission Simulator built for HAL by the Slovakian firm Virtual Reality Media (VRM) was inducted into service at the station. The new Level D FFMS is configured with a glass cockpit. Stage II (T) training is conducted as an integrated module that comprises the Full Motion Full Mission Simulator and the KD series aircraft. Stage III (T) training is conducted on the HM series of Do-228 aircraft. The introduction of full-mission simulators enabled aircrew to practise complex scenarios, crew coordination, and emergency responses in controlled environments. These capabilities were particularly valuable for multi-crew aircraft, where effective communication and procedural discipline are critical to safety and mission success.[11]

The integration of simulation at Yelahanka was accompanied by changes in instructional approach. Scenario-based training allowed trainees to experience decision-making under simulated operational conditions, including degraded systems and adverse weather. Structured debriefs following simulator sessions were described as integral to the learning process, reinforcing lessons and encouraging reflective practices. This approach reflected a broader shift towards outcome-oriented training rather than reliance on flying hours alone.

At AFA, it was observed that today's cadets are tech-savvy and adaptive. They prefer immersive learning through simulators, tablets, and Augmented Reality (AR)/ Virtual Reality (VR) tools. Many have better hand–eye coordination due to gaming exposure, though some rely too heavily on instruments. The instructors focus on building mental resilience, composure, and stress inoculation through progressive exposure and mentorship.

However, instructors were clear that such familiarity does not substitute for sound airmanship. As a result, training continues to place strong emphasis on handling fundamentals, visual flying, situational awareness, and strict adherence to standard operating procedures. Technology was repeatedly described as a means of improving training efficiency rather than a determinant of training quality.

Across training establishments in the Southern Peninsula, modernisation during this period was characterised by balance rather than replacement. Live activity remained central to skill development and confidence-building, but it was now supported by structured preparation, simulation, and post-activity analysis. Training reforms were guided by institutional priorities of safety, effectiveness, and adaptability rather than by technology adoption alone.

AFA is now preparing for the arrival of its newest Basic Trainer Aircraft (BTA), the indigenously designed and developed HTT-40. The induction of the HTT-40 BTA will be a much-needed boost to the IAF, which has a longstanding requirement for 181 such aircraft. This need was partially met through the induction of 75 Swiss Pilatus

PC-7 Mk II BTAs, introduced into service between February 2013 and November 2015. The HTT-40 will operate alongside the PC-7 Mk-II in the Stage I basic flying training role.

The HTT-40 will be used for basic flight training, aerobatics, instrument flying, close formation flight training, navigation and night flying. HAL also has plans for a future weaponised variant intended for weapons training, Counterinsurgency (COIN) and limited strike missions. This variant will have four pylons for carrying weapons and other stores, and could also be fitted with a Head Up Display (HUD). The tandem-seat turboprop basic trainer is also a fully aerobatic aircraft. The IAF has played a pioneering role in the use of simulators for training, and HAL will deliver several synthetic training aids for the HTT-40, including a Fixed Base Full mission Simulator (FBFMS), Cockpit Procedure Trainer (CPT) and Avionics Part Task Trainer (APTT). It is expected that 30 per cent of the training on the HTT-40 will be met through synthetic training. The IAF had earlier acquired two FBFMS, three CPTs and one APTT for its PC-7 MKII fleet.

The IAF originally issued its Preliminary Staff Qualitative Requirement (PSQR) for the HTT-40 in 2009. The Acceptance of Necessity (AoN) for a new indigenously designed and developed BTA was accorded by the Defence Acquisition Council (DAC) in February 2010. At the time, HAL was to have completed the maiden flight of the HTT-40 by February 2013, obtained certification by 2015, and begun deliveries by 2017. HAL began design and development work on the HTT-40 from August 2013, when it

decided to proceed with the programme using internal funding. Company funds worth INR 177 crore were sanctioned by HAL to undertake the Preliminary Design Phase (PDP) and Detailed Design Phase (DDP) activities of the HTT-40 at the Aircraft Research & Design Centre (AERDC) in Bengaluru.

The first HTT-40 prototype (PT-1) made its maiden flight in Bengaluru on May 31, 2016, and the trainer's first public flight took place in Bengaluru on June 17, 2016, in the presence of then Defence Minister, the late Dr Manohar Parrikar. During his visit, he made the first official announcement that additional HTT-40s would be procured and that further import of basic trainer aircraft would be capped. At the time, he had stated that the total number of BTAs required would increase from 181 to 210. The second HTT-40 prototype (PT-2) took to the air in June 2022. Certification from the Centre for Military Airworthiness and Certification (CEMILAC) was obtained in February 2025.

The delays in the HTT-40 programme can be attributed to several reasons, including the excessive weight of the prototype aircraft, obsolescence of the Engine Electronic Controller (EEC) on the Honeywell TPE331-12B turboprop engine powering the aircraft, and COVID-19. HAL had issued a Request for Proposal (RFP) for a turboprop engine for the HTT-40 in June 2012 and selected the TPE331-12B turboprop engine in June 2015.

The Defence Acquisition Council (DAC), led by Defence Minister Rajnath Singh, approved the procurement of 106 HTT-40 aircraft on August 11, 2020. Initially 70 aircraft are to be procured,

with a balance of 36 aircraft to be procured after the trainer is operationalised by the IAF.

HAL was awarded the contract for 70 HTT-40s in October 2022, worth approximately INR 6,828 Crore. The HTT-40 will be manufactured at two production lines established by Hindustan Aeronautics at its Aircraft Division, Bengaluru and Aircraft Manufacturing Division, Nasik, with the bulk of production to be undertaken at the latter facility. HAL has stated plans to attain a peak production rate of 20 HTT-40s per annum.

The second HTT-40 production line at HAL's Nashik facility was formally inaugurated by Defence Minister Rajnath Singh on October 17, 2025. The assembly complex houses structural assembly shops for the manufacture of HTT-40 fuselages, wings and control surfaces.

In the present day, training in Southern India reflects a mature blended model that combines tradition with innovation. The ability of training establishments to absorb new platforms, revised manpower policies, and evolving instructional tools without losing coherence underscores the resilience of the training ecosystem. This modernisation phase has reinforced, rather than diminished, the Southern Peninsula's central role in the IAF's training architecture.

6. Contemporary Training Ecosystem: Insights from Field Visits and Interactions

Field visits to training establishments in the Southern Peninsula provided an opportunity to examine how historical training

philosophies are applied in contemporary practice. Interactions with instructors, staff officers, and training personnel across officer, airmen, and advanced flying training institutions revealed a high degree of continuity in approach, even as platforms, syllabi, and organisational frameworks have evolved. These interactions reinforced the view that training effectiveness in the region is sustained not only by infrastructure and geography, but by institutional culture and accumulated experience.

Over the years, the IAF has built a robust, integrated training pattern. Earlier, training was aircraft-based with limited simulator exposure. Emergencies and checks were memorised, not practised.

Today, simulators enable cadets to rehearse complete sorties, including emergencies—minimising in-flight errors and improving sortie efficiency. At AFA, training personnel consistently emphasised that modernisation has not altered the Academy's fundamental purpose: the development of military officers capable of leadership under diverse operational conditions. While aircraft types, simulators, and instructional tools have changed over time, the sequencing of training continues to prioritise discipline, accountability, and decision-making. Officers involved in training highlighted that the Academy's role extends beyond skill acquisition to the shaping of professional identity, service ethos, and command responsibility.[12]

Simulator integration at AFA was viewed as a significant enabler of instructional effectiveness. Instructors explained that procedural and fixed-base simulators allow trainees to arrive at the aircraft with

a higher baseline of systems understanding and cockpit orientation. This enables airborne instruction to focus more effectively on judgment, threat perception, and workload management. Importantly, simulators were not perceived as reducing the importance of live flying; instead, they were seen as enhancing its instructional value by reducing avoidable errors during initial training sorties.

The IAF has one of the largest requirements in the Indo-Pacific region for trained pilots, navigators and weapon systems officers. Over two decades ago, the air force planned to train 220 pilots annually during 2001-05; however, according to information provided by the Ministry of Defence (MoD) to the Parliamentary Standing Committee, there was a shortfall ranging from 15 to 31 per cent. A decade later, in February 2015, the IAF assessed that it had a shortage of 486 pilots. At that time, the air force had proposed to increase the number of trainees from 260 to 350 pilots every year by 2017.

A 2024 Report of the Comptroller and Auditor General of India on Training of Pilots in IAF presented in Parliament in December 2024 stated that "between the period 2016 to 2021, against the planned initial intake of 222 trainees annually, the initial annual intake ranged between 158 and 204 trainees. Also, the annual intake after wastage ranged between 124 and 167. As a result, the shortage of pilots rose from 486 to 596, which was expected to be filled up between January 2021 and January 2030," the CAG report informed. The IAF has a pressing need to fulfill its requirement for 181 basic trainers, but this has been impacted by delays in deliveries of the

HTT-40. The IAF's Stage I requirement will only be fully met when induction of all 108 HTT-40s is complete, joining the present fleet of 74 PC-7 MK-IIs.

At the Airmen Training School, Belagavi, interactions highlighted the scale and complexity of contemporary airmen training. Instructors described an institutional environment responsible for transforming large numbers of civilian entrants into disciplined airmen capable of functioning within a military and technical framework. Despite changes in training models and manpower policies, the core objective of instilling discipline, service ethos, and safety consciousness remained unchanged.

Training staff at Belagavi discussed the implementation of modular training structures designed to deliver trade-specific competencies while retaining common foundational elements. Physical conditioning, drill, weapon training, and safety awareness continued to form the bedrock of instruction irrespective of trade specialisation. Instructors noted that modularisation allowed training to be more focused and efficient but required close oversight to ensure uniform standards across different cohorts.[13]

The transition to *Agniveervayu* training was described as a process of institutional adaptation rather than fundamental re-invention. Instructors acknowledged the challenges associated with compressed training timelines, particularly in balancing technical instructions with military training. These challenges were addressed through focused lesson planning, continuous assessment, and structured supervision. Digital tools, simulators, and scheduled revision periods

were employed to reinforce learning, especially in technical and procedural subjects.

Importantly, instructors emphasised that safety standards and disciplinary expectations were not diluted as a result of the training reforms. On the contrary, the requirement to achieve defined outcomes within limited timeframes reinforced the importance of precision, standardisation, and instructional discipline. This emphasis was reflected in training schedules, evaluation methodologies, and instructor oversight.

At Air Force Station Yelahanka, interactions reflected the distinct challenges and opportunities associated with conducting training at an operational air base. Instructors and staff officers highlighted the dual responsibility of delivering training while supporting active transport and helicopter operations. This operational environment was viewed as beneficial for trainees, exposing them early to mission planning, crew coordination, and real-world operational tempo.

Flying and engineering personnel at Yelahanka discussed the role of simulators in enhancing crew coordination and emergency preparedness. Full-mission simulators allowed crews to practise high-risk scenarios that could not be safely replicated during live flying. These sessions were particularly valuable for developing communication, procedural discipline, and decision-making under pressure. Structured debriefs following simulator sessions were described as integral and hugely beneficial to the learning process.

Engineering officers noted that the co-existence of legacy and modern platforms at Yelahanka fostered a culture of adaptability and

problem-solving. Trainees were exposed to different maintenance philosophies, technical challenges, and operational contexts. This exposure was considered valuable in preparing personnel for long-term service across diverse platforms and operating environments.

Across all three establishments, several common themes emerged. Southern India's climatic conditions and airspace availability continue to support high training output with minimal disruption. While these factors are often cited as geographical advantages, interactions suggested that their true value lies in enabling predictable training schedules and sustained instructional continuity.

Instructors across branches expressed confidence in blended training models. Live activity remains central to skill development, but it is now supported by structured preparation, simulation, and post-activity analysis. This approach was consistently described as enhancing training effectiveness without reducing training rigour.

Finally, interactions underscored the importance of institutional memory. Many instructors had themselves trained at the same establishments earlier in their careers, creating continuity of practice across generations. This continuity, combined with measured adaptation to new platforms and policies, underpins the effectiveness of the Southern Peninsula's contemporary training ecosystem.

The field visits thus reinforced the central argument of this study: that training in the Southern Peninsula is sustained not merely by geography or infrastructure, but by institutional culture, instructional continuity, and adaptive practices. These qualities have enabled training establishments to absorb technological changes and

organisational reforms while maintaining the standards required to support the IAF's operational readiness.

7. Video Documentation: Scope, Status, and Intended Contribution

As part of the research methodology, video documentation was undertaken during field visits to training establishments in the Southern Peninsula. The recordings were designed to complement the written study by capturing visual and experiential aspects of contemporary training environments. These included interactions with training personnel, views of training infrastructure, aircraft, simulators, and institutional spaces relevant to officers, airmen, and advanced flying training.

The video content was structured around themes aligned with the objectives of the research. These themes included training philosophy, institutional evolution, the integration of technology into training, and the continuity of instructional practices across generations. Care was taken to ensure that discussions remained non-sensitive and focused on training processes rather than operational details or classified procedures.

At the time of submission of this report, the video material is being processed for post-production and editing. Once completed, it is intended to be submitted as supplementary material for reference and archival value. The videos are not essential to understanding the arguments presented in this study, which are fully developed through historical research and field-based observations. Instead, they are

intended to provide additional context and visual reinforcement for the institutional practices discussed.

The inclusion of video documentation reflects a broader recognition of the value of multimedia material in capturing aspects of training culture that are not easily conveyed through text alone. Used judiciously, such material can support future research, internal reference, and outreach without substituting for formal analysis.

8. Assessment

The examination of IAF training institutions in the Southern Peninsula over more than eight decades reveals a pattern of continuity shaped by adaptation rather than abrupt transformation. From its origins as a wartime support region to its present role as the centre of gravity for training activities, Southern India has consistently supported the Service's requirement to generate trained personnel across all branches.

Geography has undoubtedly played an enabling role. Predictable weather conditions, open terrain, and manageable airspace have facilitated sustained training activity with minimal disruption. However, the enduring importance of the Southern Peninsula cannot be attributed to geography alone. Institutional decisions to locate training academies, schools, and operational training units in the region created a concentration of expertise, infrastructure, and instructional culture that has reinforced itself over time.

Training establishments in the region have demonstrated the ability to adapt to change without eroding core training principles.

Platform induction, syllabus revision, and organisational reform have been undertaken incrementally, allowing training systems to adapt while maintaining coherence. The integration of simulators and digital tools has enhanced safety, efficiency, and standardisation, but live activity remains central to skill development and confidence-building.

Field visits conducted as part of this study indicate that institutional memory plays a significant role in sustaining training effectiveness. Instructors who trained at the same establishments earlier in their careers carry forward practices, standards, and expectations while adapting to contemporary requirements. This continuity of practice has enabled training institutions to evolve without losing instructional rigour.

The Southern Peninsula's training ecosystem reflects a mature, resilient system. Its effectiveness derives not from any single factor, but from the interaction of geography, infrastructure, institutional culture, and adaptive practices. Together, these elements continue to support the IAF's long-term operational readiness requirements.

9. Conclusion

Training in the Southern Peninsula has been a defining feature of the IAF's development since the early 1940s. What began as a wartime necessity evolved into a structured and enduring training architecture that continues to underpin the Service's operational capability.

Across successive phases—wartime expansion, post-Independence consolidation, institutional maturation, and contemporary

modernisation—training establishments in Southern India have demonstrated a continuity of purpose. While aircraft, technologies, and training models have changed, the emphasis on discipline, competence, safety, and leadership development has remained constant.

The field visits undertaken as part of this study reaffirm that training effectiveness in the Southern Peninsula is sustained not merely by physical infrastructure or climatic advantages, but by institutional culture and adaptive practices. The ability to integrate new platforms, revised manpower policies, and evolving instructional tools while maintaining training standards underscores the region's enduring relevance.

By documenting the historical evolution and present-day functioning of training establishments in the Southern Peninsula, this study contributes to a broader understanding of how training systems shape air power over time. The experience of Southern India illustrates that effective training ecosystems are built through long-term institutional commitment, continuity of practice, and measured adaptation—qualities that will remain essential as the IAF prepares to meet future challenges.

Notes

1. CAPSS research visit to Air Force Station Yelahanka, October 2025.
2. Anchit Gupta, "The Flying Wheelchair—Communication Flights in India," *IAF History,* November 26, 2024, https://iafhistory.in/2024/11/26/the-flying-wheelchair-communication-flights-in-india/. Accessed on October 20, 2025.
3. CAPSS research visit to AFS Yelahanka, October 2025.
4. Atul Chandra, "Foundational Institution: AFS Yelahanka has a Distinguished Legacy of Service to the Nation that is the Envy of other IAF Stations,"

CAPSS, January 09, 2026, https://capssindia.org/foundational-institution-afs-yelahanka-has-a-distinguished-legacy-of-service-to-the-nation-that-is-the-envy-of-other-iaf-stations/. Accessed on February 10, 2026.
5. Indian Air Force, "Our Command," https://indianairforce.nic.in/commands. Accessed on October 15, 2025.
6. CAPSS research visit to Airmen Training School, Belagavi, October 2025.
7. CAPSS research visit to Air Force Academy, Dundigal, October 2025.
8. Author conducted interviews with instructional and administrative staff, Dundigal, October 2025.
9. Author conducted interviews with instructional and administrative staff at Airmen Training School, Belagavi, October 2025.
10. CAPSS research visits to simulator and training facilities at Air Force Station Yelahanka, Air Force Academy Dundigal, and Airmen Training School Belagavi.
11. CAPSS research visits to Do-228 simulator and training facilities at Air Force Station Yelahanka, October 2025.
12. Author conducted interviews with instructional and administrative staff, Dundigal, October 2025.
13. CAPSS research visit to simulator and training facilities at ATS Belagavi, October 2025.