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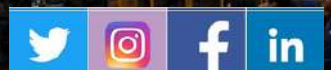
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CHINA'S MILITARY AVIATION BREAKTHROUGH'S AND INDIA'S FIGHTER DEVELOPMENT CHALLENGE: ACCELERATING THE LCA-AMCA TRAJECTORY

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China's Military Aviation Breakthrough's and India's Fighter Development Challenge: Accelerating the LCA-AMCA Trajectory



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"Airpower is not merely about possessing advanced aircraft; it is about the ability to design, test, certify, produce, and field them faster than potential adversaries."-

Authors

Abstract

In the last two decades, China has transformed from an importer to a producer of advanced combat aircraft. These include the J-10C multirole fighter, the J-16 strike aircraft, the Y-20 strategic airlift, the KJ-500 Airborne Early Warning and Control (AEW&C) platform, and the J-20 stealth fighter. This transformation is the result of a well-planned national strategy, reforms in defence production, military–civil fusion, efficient programme management, and high-fidelity test setups.

India has talent, a scientific mindset, and decades of aerospace experience, yet it still struggles to accelerate the development of combat aircraft. The LCA Tejas Mk1 took over 30 years to enter service, and its successor, the LCA Mk1A, is still to be inducted. Programs such as the LCA Mk2, TEDBF, and AMCA continue to face scheduling, production, and integration challenges. While India now possesses a solid foundation—test facilities, production lines, and aerospace design and development capability—what is missing are institutional mechanisms that turn technological capability into on-time delivery.

This paper argues that China beats India not primarily in technology but in execution and integration speed. Based upon open-source data, India typically takes 15–20 years from design to induction for defence aircraft, while China often achieves operational induction in about 7–10 years for major combat programmes. This paper examines the timelines of the Tejas Mk1 and Mk1A and the organisational and process factors that caused delays. It proposes measures to speed integration, flight testing, and certification for future programmes such as the LCA Mk2 and AMCA. The study outlines reforms that could significantly shorten aerospace development timelines within five years. Incremental change alone will not close the airpower gap; India requires reforms in the execution model alongside technology development reforms.

Key Words. Tejas, AMCA, Project Management, Flight Testing, Defence Industrial Base, Certification

Introduction

In modern warfare, speed of production and D&D of fighter aircraft are strategic advantages. The country that can upgrade aircraft and integrate systems-weapons faster gains a combat edge as it deploys capabilities faster than its rivals.¹ Airpower is no longer defined only by the superiority of aircraft but also by time to induct them into squadrons.

China has been able to induct four generations of combat aircraft from 2002 to 2022. India could induct only one Tejas Mk1 indigenous aircraft during the same period. India still depends on imported aircraft such as the Su-30 MKI, Rafale, and Mirage 2000.²

This gap is not due to lack of talent in India. India has built complex systems such as Agni missiles, Arihant submarines, and ISRO satellites, which are complex technologies. The problem in combat aircraft development is the time taken in moving from concept to produce prototypes. This requires rigorous flight testing and a series of certifications before induction into the Indian Air Force (IAF). In aerospace, technology is continuously changing and hence needs regular upgrades. China has perfected this cycle; India is still closing the gap.³

Meanwhile, the geopolitical situation is changing rapidly:

- China has deployed J-20 squadrons near Ladakh.⁴

- It regularly conducts mass sorties near Taiwan.
- It pushes rapid UAV–electronic warfare (EW)–fighter swarm integration.
- Pakistan is inducting the JF-17 Block III with AESA and has plans for JF-17 Block IV and Chinese J-10CE.⁵

India cannot wait 12–15 years per fighter program anymore. If LCA MK 2 and AMCA are inducted late or in small numbers, there is risk of air inferiority by the mid-2030s.⁶ The answer is not to complain about delays but to fix the execution ecosystem in the aerospace sector.

The next sections break down:

- How did China structurally design aerospace speed?
- What India should emulate immediately?
- Specific reforms to NFTC, ASTE, and HAL Flight Test Operations that can double flight test speed without compromising safety.⁷

Extensive literature exists on Chinese aerospace modernisation and India's indigenous fighter programmes. However, there is limited research that examines the organisational, testing, certification, and programme-management factors that explain differences in development timelines. This paper seeks to address that gap. It compares the execution process and ecosystems of both countries and suggests reforms that can speed up India's fighter aircraft development.

The study relies exclusively on open-source literature, official government publications, annual reports, publicly available policy documents, and peer-reviewed research. No classified, restricted, or proprietary information has been used.

China's Aerospace Acceleration Model: How They Build Fast

The People's Republic of China (PRC) became an aerospace power with long-term planning and foresight. Until the late 1990s, its defence aviation industry was dependent on technology transfer from the Soviet Union. The change in the aerospace sector, especially in defence, began after 1999, when Beijing made it a national

priority.⁸ Today, China has overtaken most global ecosystems by speeding up production time to field squadrons.

China's aviation progress is the result of well-planned industrial architecture, project management, test facilities, optimisation of certification, and accountability at all levels. Six pillars drive this acceleration model.

- It has one accountable aerospace conglomerate (AVIC) with strong program integration.
- It uses a block development approach, leading to spiral upgrades instead of attaining perfection in one go.
- It invests heavily in test infrastructure and flight evaluation capacity through the China Flight Test Establishment (CFTE).
- It delegates technical authority to program-level chief designers and test directors.
- It has integration-ready electronic warfare, sensors, and weapons.
- It fully integrates private and state industry under military–civil fusion. India's aerospace sector, led by HAL, ADA, DRDO, and the IAF, must evolve from a culture of development to a culture for rapid delivery & production.

- **Centralised Aerospace Ownership – AVIC as the Execution Machine**

Unlike India's fragmented aerospace structure (HAL, ADA, DRDO labs, multiple vendors), China consolidated its aviation entities under a single holding giant, the Aviation Industry Corporation of China (AVIC).⁹ AVIC controls design, manufacturing, integration, avionics, radar, engine development, and flight testing under one system, eliminating friction and bureaucracy.

Key advantages of AVIC's monopoly model:

Single engineering standard across aircraft programs

- Common tools and digital design platforms
 - Rapid reuse of components (sensors, radar, cockpit systems)
 - Seamless flow from prototype to mass production
 - Fast decision-making led by chief designers who have real authority
- Under AVIC are two main fighter houses.
- 611 Institute (Chengdu Aircraft Corporation) – J-10, J-20, FC-31.¹⁰

➤ 601 Institute (Shenyang Aircraft Corporation) – J-11, J-15, J-16.¹¹

Both compete internally but reuse 70–80% common digital frameworks. The USA also follows an approach that leads to early integrations and delivery. India lacks such structured design competition. LCA Mk1/1A, LCA Mk2, TEDBF, and AMCA depend on a single design stream (ADA), slowing iteration. Table 1 below summarises these models.

Dimension	China Model	India Model	United States Model
Prime Industrial Structure	Centralised state conglomerate – Aviation Industry Corporation of China (AVIC) integrating design, production, avionics & testing	Split ecosystem – Aeronautical Development Agency (design) + Hindustan Aeronautics Limited (production) + DRDO labs	Industry prime (Lockheed/Boeing/Northrop Grumman) under DoD acquisition structure
Requirement Authority	Central Military Commission via Equipment Development Department	IAF via MoD (DAC/CCS approvals)	DoD via Service Acquisition Executive
System Design Authority	Empowered Chief Designer with end-to-end control	Distributed (ADA, HAL, DRDO labs, IAF, Flight Test Centres, CEMILAC)	Program Executive Officer (PEO) legally accountable

Mission Systems Ownership	Integrated within AVIC	Fragmented across labs and agencies	Integrated Product Teams (IPTs) under Program Manager
Accountability Model	Single chain of command	Committee-based approvals	Delegated authority with statutory responsibility
Customer Project Management Teams (PMTs) Role & Authority	People's Liberation Army Air Force (PLAAF) officers embedded within AVIC & China Flight Test Establishment; operational users co-located with designers; influence configuration decisions in real time	PMTs embedded at ADA/HAL/DRDO ; advisory role but limited delegated configuration, decision control, management or certification authority; approvals external	USAF customer represented within Program Office; operators embedded in IPTs and Combined Test Forces; authority structured through PEO/PM framework with defined decision rights

Table 1. Institutional Architecture & System Authority **Source:** Author's Creation from Open-Source Information

- **Military–Civil Fusion (MCF): China’s Force Multiplier**

China’s Military–Civil Fusion (MCF) policy pulls in private industry and academia into every aircraft development program. Instead of depending only on defence labs, China uses.¹²

➤ Civil aerospace universities (e.g., NPU, Beihang University)

- Private suppliers for composites, mission computers, and AI processors
- Dual-use R&D parks for avionics, sensors, and flight control

Result: Massive scaling of aerospace manpower and hardware production.¹³

Why this matters: India still has a defence vs private divide, whereas China treats aerospace as a national industrial mission.

- **The Equipment Development Department (EDD): Program Authority**

The Central Military Commission's Equipment Development Department (EDD) is China's equivalent of DRDO + HAL + MoD procurement authority combined.¹⁴ It defines requirements, funds projects, monitors delivery, and directly connects to flight test units.

EDD ensures:

- No endless file delays like Indian procurement bureaucracy
- Budget does not choke programs midway
- Test and production decisions are data-driven, not committee-driven
- Integration issues are solved by forcing stakeholders to work in one command chain

- **Co-located Test Infrastructure – CFTE: China's Tejas Accelerator**

At the heart of China's aerospace speed lies the China Flight Test Establishment (CFTE) in Yanliang.¹⁵ CFTE is effectively China's counterpart to the U.S. Air Force Test Centre (Edwards AFB)¹⁶ or EASA/FAA flight test organisations in terms of capability, though it serves both military and civil aircraft development under the AVIC ecosystem.¹⁷ The Yanliang Flight Test Zone is often referred to as China's "cradle of flight testing." It is a massive integrated test hub for:

- Flight envelope expansion
- Weapon integration
- Avionics and EW trials
- Radar calibration
- High-altitude testing

At CFTE, everything required for fast testing is co-located: real-time telemetry, mission data analysis labs, flight clearance boards, simulator suites, and instrumentation hangars. This allows for parallel testing; while one jet is flying, another is being ground tested, and test data is already being analysed in real time. A similar approach is taken by the USA too, although it has multiple private industries with matured processes and systems.

India's flight testing is divided between NFTC (Bengaluru), ASTE (Bengaluru), HAL FTO (various bases), and separate telemetry & certification bodies like CEMILAC. That structure slows clearance cycles. Unlike CFTE, NFTC does not maintain a permanently assigned prototype test cadre and test setup capabilities like CFTE. Table 2 below shows these aspects in a nutshell.

Dimension	China Model	India Model	United States Model
Flight Test Infrastructure	Fully co-located under China Flight Test Establishment (CFTE), Yanliang	Split between National Flight Test Centre (NFTC), ASTE, HAL FTO	Combined Test Forces (CTFs) at Edwards/Eglin
Ground-Flight Integration	Iron Bird + Hardware-in-the-Loop (HIL) before first flight	Partial rig use: integration often continues post-first flight	Extensive SIL/HIL & digital twin integration
Telemetry & Data Reduction	Real-time, 24x7 co-located analysis	Distributed; multi-agency clearance cycle	Integrated operator + industry telemetry teams
Certification Model	Block-based compliance; iterative	Serial airworthiness gates	Delegated DER-style embedded authorities

Test Philosophy	Parallel campaigns across variants	Sequential	Parallel, milestone-driven
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Table 2. Testing & Certification Ecosystem **Source:** Author's Creation from Open-Source Information

- **Program Culture – Iteration Over Perfection**

China does not wait for a “perfect aircraft” before induction.¹⁸ It uses spiral development:

- J-10A → J-10B → J-10C upgrades radar, EW, and engine step by step.
- J-20A → J-20B engine and avionics upgrades post-induction.
- KJ-200 → KJ-500 AEW&C evolution.
- Y-20A → Y-20B engine and payload upgrade. Indian programs, in contrast, lose time aiming for final baseline perfection, causing delays and redesign loops.

- **Mission System Authority – The Secret Speed Weapon**

Every major Chinese program has a Chief Designer and Mission Systems Integrator with authority over avionics, datalinks, radar, EW, and weapons. They sit inside AVIC and CFTE during testing and can approve configuration decisions on the spot.

In India, system integration authority is split:

- ADA owns flight control and platform design
- HAL handles production
- DRDO labs handle avionics
- IAF gives operational feedback
- CEMILAC approves safety

ADA is responsible for D & D, but it is heavily dependent on D & D efforts of DRDO labs and HAL, who are not responsible to DG ADA. Their delays impact programmes at ADA. This distributed model slows avionics and weapon integration more than anything else.

Processes, Integration, and Engineering Speed: Inside China's Fighter Development Method

China's success in fighter development does not come only from centralised organisation. What matters more is its engineering execution model—how aircraft move from design to prototype to flight testing so fast. This section explains how China compresses product development timelines through process discipline and parallel integration.¹⁹

- **Concurrent Engineering – No Waiting Between Phases**

India follows a sequential V-model. Design phase → Review → Prototype development → Testing → Modify → Certify. China uses Concurrent Engineering (CE) instead.²⁰ Under CE:

- Design, systems integration, software, and structural testing run simultaneously.
- Multiple subcontractors work in parallel.
- Certification evidence begins during design and not after testing.
- Test jigs and HIL benches are set up before the first prototype flies

CE cuts 2–3 years from development time. AVIC uses Computer-Aided Technologies (CAX)/Product Lifecycle Management (PLM)/Computer-Aided Three-Dimensional Interactive Application (CATIA) digital platforms (similar to Dassault's CATIA V6 and Siemens Teamcenter) to keep all subsystem teams aligned.²¹

India has begun digital design flows on Tejas Mk2 and AMCA but has not yet adopted full concurrent certification. HAL and ADA still run serial testing, causing avionics finalisation, delays, and flight-testing loops.²²

- **Spiral Development – Block Upgrades, Not Delayed Perfection**

China learned from the F-16 and Gripen approach. They build aircraft as block 0, 1, 2, 3... instead of waiting 10 years for a complete version.²³

This spiral method:

- Introduces capability to squadrons early
- Keeps industry constantly upgrading

- Ensures combat learning feedback enters design every year
India's challenge: Tejas Mk1 waited decades for final FOC. Mk2 and AMCA must adopt block-based delivery, not "everything ready at once".²⁴

- **Full System Integration Before Prototype – China's Iron Bird Advantage**

China builds complete ground integration rigs (Iron Birds) that simulate hydraulics, flight systems, avionics, and weapons before first flight.²⁵ These rigs allow:

- Instant detection of interface failures
- Fast EW + Radar + Data Link cross-compatibility checks
- Software tuning before risking a real aircraft
- Weapon integration before the first prototype takes off.

India has mission integration rigs and iron birds (IB) but limited system rigs for full fusion testing. Further, they are on different projects, leading to bottle necks. As a result, weapon trials start late and slow down the flight test campaign.²⁶

- **Test-Centric Development – CFTE as the Speed Engine**

China reverses the traditional model—testing drives development, not the other way around. CFTE conducts a very high annual tempo of flight testing across multiple programmes.²⁷ Every aircraft variant (EW, AWACS, tanker) has dedicated test squadrons.

India, by contrast:

- NFTC undertakes only prototype flight testing but lacks full system authority to lead development
- HAL Flight Ops supports production testing but not aggressive envelope expansion
- ASTE focuses on operational acceptance, not rapid R&D testing
- Flight test scheduling is slow due to separate clearance chains

This is why weapon integration on Tejas took years, but JF-17 Block III integrated PL-15 months.²⁸

- **Rapid Weapon & Avionics Integration – The Chinese Way**

China pre-certifies weapons payloads like the PL-12, PL-15, and YJ-series missiles at the system level, as shown in Table 3 below. India treats each integration as a new project, thus doubling effort.

Aspect	China	India
Radar Integration	AESA radars tested on flying labs	Delayed due to late testbed availability
Missile Integration	Parallel certification	Certification after full flight envelope trials
EW Suite Testing	Uses IL-76 & Y-8 testbeds	Limited Indian flying labs
Data Links	Built into architecture	Retrofitted
Mission Computers	Unified across fleets	Multiple architectures
Software Upgrades	Every 6–9 months	Every 2–3 years

Table 3. Weapon and Avionics Upgrade by China **Source:** Author's Creation from Open-Source Information

- **Speed from Reuse – Fleet Commonality**

China treats aircraft like product families:

- J-11, J-15, and J-16 share 70% of systems.
- J-20 and FC-31 share stealth manufacturing techniques.
- Y-9 and KJ-500 use the same airframe

India:

- Tejas Mk1, Mk1A, and Mk2 do not reuse enough subsystem blocks.
- AMCA risks becoming a clean sheet again unless reuse is forced.

China's Speed Formula

Single authority with parallel integration and testing at scale leads to fast delivery, as shown in Table 4. India must replicate this formula selectively, without copying China's command system but by fixing our aerospace execution model.

Parameter	China	India	United States
Concept → First Flight	~4–5 years	8–12+ years	6–8 years
Concept → Squadron Induction	~5–7 years	15–20+ years (Mk1 baseline)	8–12 years
Core Strength	Central authority + test density	Engineering depth + skilled test cadre	Delegated authority + acquisition professionalism
Primary Constraint	Centralised opacity	Fragmented system ownership	Budget & complexity growth

Table 4. Programme Cycle Time & Strategic Output **Source:** Compiled by the author from CASI, China's Military Aviation Industry; IISS, The Military Balance 2025; RAND, Evolutionary Acquisition and Spiral Development in Defence Systems; HAL Annual Report 2024–25

Embedded Project Management Teams (PMT) in Advanced Fighter Aircraft Programmes — India, China, and the USA

- **Indian Air Force: PMT Roles in a Fragmented Ecosystem**

India's fighter development ecosystem is divided between DRDO/ADA (design), HAL (production), IAF test units (NFTC/ASTE), and airworthiness bodies (CEMILAC/DGAQA)—creating checks and balances but diffusing system authority.²⁹

PMTs stationed at ADA, DRDO labs, and HAL represent Air HQ inside this ecosystem. Their mandate is to embed operational requirements into development and production:

However, PMTs do not possess delegated authority to approve most configurations or changes. Approvals still flow serially via ADA to certifiers and finally to MoD through Air HQ. Frequent personnel rotation also undermines continuity and accountability.²⁹

This fragmentation is a core reason why weapon/avionics upgrades take years, unlike China's rapid spiral upgrades or the USAF's empowered IPT-led integration cycles.

- **China & USA: Co-located and Empowered Systems Authority**

China (PLAAF + AVIC + CFTE)

- Chief Designers own end-to-end configuration authority
- CFTE co-locates design, test, certification, and PLAAF operators.
- Decisions on integration/software fixes are made in the telemetry room—not via files→ Enables rapid parallel testing and Block 0/1/2 evolution.³⁰

United States Air Force Life Cycle Management Centre (AFLCMC)/Program Executive Officer (PEO)s/Rapid Capabilities Offices (RCO)

- PEOs and PMs are legally responsible for cost–schedule–performance³¹
- Integrated Product Teams (IPTs) unify airframe, avionics, propulsion, logistics & cyber
- Combined Test Forces at Edwards/Eglin embed operators + industry → PMs can approve many changes immediately within delegated authority³²

Both models give the user/operator binding authority inside the programme, unlike India, where user input is strong but structurally non-decisive.³³

- **Visual Comparison — Authority & Integration Models**

Table 5 brings out three different models followed by India, China, and the USA.

Attribute	India	China	USA
Technical authority	Split across labs	Chief Designer empowered	Chief Engineer empowered
Decision cycle	Serial gates	Real-time loops	Weekly boards
Operator involvement	Late	Embedded at CFTE	Embedded in IPTs

Table 5. Comparative structures of Programme Management and System Authority

Source. Author's Creation from Open-Source Information

- **Lessons and Strengthening PMTs**

India already has the aircraft, the engineers, and the test centres—what it needs now is for PMTs to hold enough authority in those rooms to turn insight into implementation at speed. Upgrade PMTs from coordinators to empowered system co-owners as brought out at Table 6.

Reform Priority	What Changes	Modelled on
Mission Systems Authority	A single empowered authority per programme; PMT represented inside leadership	PLAAF Chief Designer model; USAF PEOs
Embedded Decision Boards	J-NFTB + Integrated Test Teams at test & production campuses	CFTE and CTF enabled rapid approvals
Delegated Approvals (DER-style)	In-house clearance for minor avionics/software changes	USAF embedded certification authority

Long-tenure, career recognition	PMT as a command-equivalent path; specialization in systems/test	USAF acquisition corps
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Table 6. Strengthening PMTs **Source:** Author's Creation from Open-Source Information

- Comparative Snapshot: China vs India (LCA Mk1/Mk1A/Mk2/AMCA vs J-series)**

Table 7 shows who turns design into frontline capability faster and why. It focuses on organisation, process, testing, integration, and 2025 program status.

Dimension	China (AVIC + CMC/EDD)	India - LCA Mk1	India - LCA Mk1A	India - LCA Mk2	India - AMCA
Prime & Design Ecosystem	AVIC-led integrated ecosystem with Chengdu (611) and Shenyang (601) institutes using shared digital toolchains and unified standards.	ADA-led design with HAL production; legacy processes gradually improving.	ADA design with HAL production and expanded vendor participation.	ADA-led redesign with larger airframe and subsystem evolution.	ADA as design authority; industry-partner execution model under CCS-approved framework.
Requirement &	CMC/EDD centrally	IAF/Mod D	Similar approval	Similar structure:	CCS-cleared governance

Authority Structure	controls requirements, funding, integration and test coordination.	approvals through DAC/C CS with serial decision chains.	structure with incremental streamlining.	integration authority still distributed.	model with partner-selection process underway.
Test Infrastructure	CFTE (Yanliang) integrates telemetry, ground rigs and flight testing in one ecosystem enabling parallel campaigns.	NFTC, ASTE and HAL FTO operate separately; telemetry and certification remain distributed.	Expanded production testing with additional HAL Nashik line support.	Test rigs and integration infrastructure expanding; surge capacity still evolving.	Requires integrated national test campus for schedule compression and rapid block testing.
Development Philosophy	Spiral block development with rapid iterative upgrades and frequent software releases.	Long development cycle with focus on achieving full capability before	Incremental block improvement over Mk1 with avionics and weapon upgrades.	New platform emphasizing subsystem reuse and faster induction cycles.	Fifth-generation platform requiring block induction from inception.

		inductio n.			
Weapons & Sensor Integration	Extensive HIL labs, flying testbeds and pre-qualified weapon families with common interfaces across fleets.	Integrati on sequenti al and post- envelop e expansi on.	Astra, LGB and ELM-2052 integration trials continuing prior to full induction.	F414 engine integration and new avionics under parallel but schedule-sensitive testing.	Open architecture planned; integration ecosystem and industrial execution model still evolving.
Production Lines (2025)	Multiple AVIC facilities with surge production capability.	Two HAL Bengaluru producti on lines operatio nal.	Third HAL Nashik line operational ; first Nashik-built Mk1A completed flight trials.	Prototype fabrication and rollout activities underway with schedule slippages.	Industry Expression of Interest (EOI) completed; prototype development planned later in the decade.
2025 Programme Status	Multiple fighter variants in serial production with continuous block upgrades.	Operati onally inducted and in service.	Production ramp-up and pre-induction evaluation ongoing.	Pre-first-flight integration and fabrication phase.	Governance, industrial participation and execution architecture still being finalised.

Table 7. Comparative Snapshot: China vs India Fighter Development Models

Source: Compiled by the author from PIB AMCA release, HAL Annual Report 2024–

25, CASI reports on AVIC and CFTE, IISS Military Balance 2025, and USAF
AFLCMC publications

China compresses cycles by central authority (AVIC/EDD), co-located testing (CFTE), and block releases. India's speed is improving (third Tejas line at Nashik; Mk2 parts fabricated), but integration and test throughput remain the pacing items.

Where India Actually Loses Time (Root causes only, not to blame)

- **Fragmented ownership of “system authority.”** ADA (design), HAL (production), DRDO labs (avionics), IAF (user), CEMILAC/DGAQA (airworthiness) create serial, committee-heavy loops.⁹ In China, chief designers and mission-systems leads inside AVIC + CFTE can approve changes quickly.³⁴
- **Test Dispersion.** NFTC, ASTE, and HAL FTO are excellent but geographically and institutionally split; telemetry, rigs, and certification chains are not fully co-located, unlike CFTE.
- **Late integration mindset.** Weapon/sensor work often trails flight envelope expansion instead of running in parallel with robust HIL/iron-bird discipline.²⁵
- **Approval style.** Evidence acceptance is serialised; Designated Engineering Representative (DER)-style delegated signatories are limited inside the program's Integrated Project Teams (IPT).
- **Production surge limits.** Lines are scaling (Nashik); however, they yet to achieve full potential. Further engine deliveries and vendor maturation affect annual outputs.³⁵
- **Inadequate reuse.** Mk1→Mk1A→Mk2 should reuse avionics, hardware, stores management and software blocks more aggressively; AMCA must force reuse to avoid clean-sheet delays.
- **Long Lead Software Development Cycle.** Software for mission computers, smart displays, flight control systems, sensor fusions, and weapon integration has a long cycle time, as an open architecture and plug-and-play approach is lacking. Furthermore, generation of required document takes a long time, thus delaying development itself. This is because the focus is on final versions instead of a block development approach. Also, with the rise of artificial

intelligence, start embedding it for developing software, documentation, process acceleration, and reducing administration time.

- Lack of Multiple Suppliers or Partners.** Design cum production partners (DCPP) are limited to one or zero during D & D. Thus, leading to delay in realisation of production units. Further, certain critical components like application-specific IC (ASIC), engines, data links, and sensors which are bought out, are limited to specific foreign OEM. No plan is in place to change to another make and model at a later date due to the supply crunch without any hassles. An example is the GE 404 and GE 414 engines for LCA Mk1/1A/2 and AMCA. A similar issue is with ejection seats from Martin Baker and data links. The ideal is to develop aircraft with at least two different makes of critical components with similar specifications and as drop-in replacements. For example, along with GE engines from the USA, Safran engines from France, or even Russian engines can be integrated as part of D & D to have assured supply and certifications to conduct field modifications as they are being done in Chinese programmes as part of block up-upgrades. Figure 1 below brings out the present structure being followed.

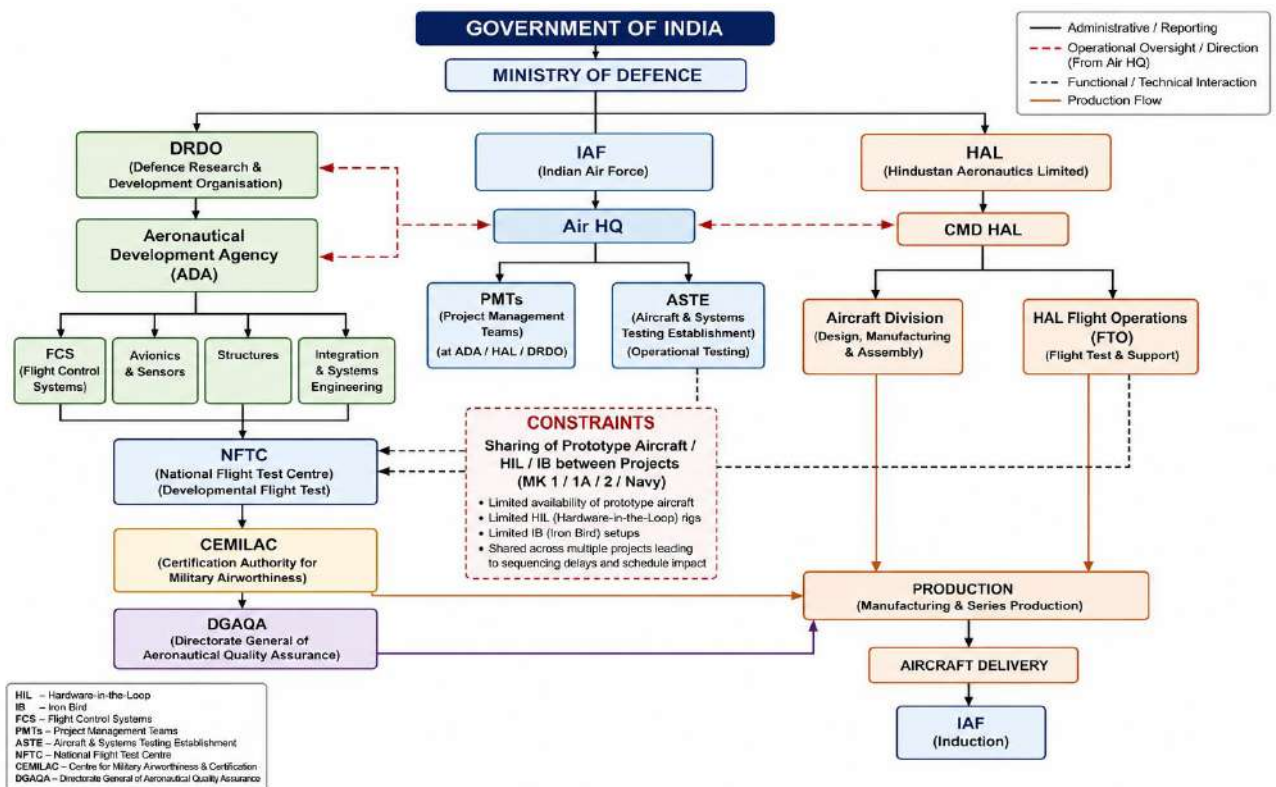


Figure 1. Present Organisation Structure

(Authors Creation from Open-Source Information)

How China Integrates Weapons, Sensors, Links Faster (and what to copy)

- **Design for integration from day one.** Reserve power/cooling/mounting and standardise stores management buses; maintain common mission computer families across fleets (J-10/11/16).³⁶
- **HIL + flying labs are routine.** China uses IL-76/Y-8 platforms and dedicated prototypes at CFTE to burn down risk before frontline jets are touched.³⁷
- **Block certification.** Missiles like PL-12/PL-15 and AESA radars are pre-qualified at the system level, reducing “new integration per jet” work.³⁸
- **Monthly integration rhythms.** Frequent software drops with defined regression suites keep schedules moving; issues are fixed in weeks, not seasons.³⁹

India's Programs in Context (late-2025)

- **Tejas Mk1A:** Third line at HAL Nashik; the first Nashik-built Mk1A flew in mid-October 2025. Formal induction waits on pre-induction weapon & radar trials (Astra, LGBs, ELM-2052). Capacity targets are ~30/yr with private partners, contingent on engine availability.⁴⁰
- **Tejas Mk2:** Fabrication milestones are public; leadership has reiterated rollout by end of 2025 and first flight in Q1 2026 (commentary notes risk of slippage; still the official target).
- **AMCA:** CCS-approved execution model with Expression of Interest (EOI) and Request for Proposal (RFP) to industry; multiple firms (L&T, BEL, BEML, TASL, Data Pattern, BEML, and VEM) engaged in the partner selection process.¹⁴ Timelines point to prototypes later in the decade; success hinges on the governance model and mission-systems authority.⁴¹

What India Must Change Now (12–36-month Action Framework)

- **Governance & Contracts**
 - **Appoint a National Mission Systems Authority (NMSA)** for Tejas Mk1A/Mk2 and AMCA, empowered to freeze open avionics standards, control ICDs, and approve rapid block deltas.
 - **One accountable prime for AMCA.** Use the EOI and RFP to select a consortium with integration-velocity incentives and liquidated damages for slippages; the prime owns design, integration, and delivery, not just build-to-print.
 - **Outcome-based funding.** Tie targets to integration milestones (e.g., “BVR + EW Block” flight-tested) rather than calendar quarters.

- **Certification & Airworthiness**
 - Create an N-MAA (National Military Airworthiness Authority) that delegates DER-like signatories into program IPTs at ADA/HAL/NFTC/ASTE—so evidence can be accepted inside the team.
 - Shift to block compliance: pre-approve reusable evidence libraries (EMI/EMC, environmental, software assurance) across Mk1A→Mk2→AMCA.

- **Test Infrastructure & Process**
 - Co-locate Software-in-the-Loop (SIL) /HIL/iron-bird rigs, telemetry rooms, and certification desks with flight lines in a National Test Campus (Bengaluru and one additional test range) to CFTE-like density.
 - Fund two flying avionics testbeds (e.g., Do-228/C-295/A320 class) dedicated to radar/EW/datalink + weapon seeker trials.
 - Continuous Integration labs: monthly flight-worthy builds, automated regression on rigs; force “software drop every 60–90 days.”

- **Supply Chain & Production**
 - Lock a yearly engine delivery S-curve with buffers for F404/F414; grow licensed pack assembly and MRO capacity.

- Elevate private Tier-1s (Tata, L&T, Data Patterns, BEL, BHEL, Bharat Forge, etc) to own major AMCA structures/avionics Line Replaceable Unit (LRU) lines from day one.
- **Speeding Up Flight Testing — NFTC, ASTE, HAL Flight Ops (Focused Reforms)**

Problem in one line: India's flight testing is excellent but serial and dispersed. We need parallelism, delegation, and co-location—without compromising safety.

Structural Fixes

- **Joint National Flight Test Board (J-NFTB):** A standing daily board co-chaired by NFTC (ADA) and ASTE (IAF), with HAL Flight Ops, CEMILAC, and DGAQA liaison embedded. It issues daily test priorities and clearances instead of weekly cycles.
- **Integrated Test Teams (ITTs) by platform:** Mk1A ITT (handover + weapons), Mk2 ITT (envelope + integration), AMCA ITT (Block-0), and so on. Each ITT has a chief test pilot and a chief engineer with delegated sign-off limits.
- **Co-located telemetry & analysis cells:** 24×7 rooms adjacent to the flight line; data reduction starts while the jet taxis in (mirroring CFTE practice).
- **Unified instrumentation pool:** Common data acquisition systems (DAS), recorders, and quick-install kits across prototypes to avoid hangar-time swaps.

Procedural Acceleration

- **Risk-based test planning:** Tier tests (A: safety-critical; B: mission-critical; C: enhancements). A-items retain rigorous gates; B/C run in parallel with rapid approvals.
- **Block test points:** Approve clusters of test points per block (e.g., “BVR + EW Baseline”), no single-point clearances.
- **Pre-flight digital rehearsals are mandatory:** SIL/HIL/iron-bird runs the exact card the evening before.

- **T+24/48 hr decisions:** Telemetry review and signoffs within two days using automated data reduction.
- **Two surrogate/flying labs:** Dedicate one Dornier/C-295 and one Su-30/Jaguar as avionics & stores testbeds for early de-risking.

People & Capacity

- Increase throughput at NFTC (prototype focus) and ASTE (ops realism) via a joint syllabus; expand experimental test pilot / FTE pipelines with short-term exchanges to Empire Test Pilots' School (ETPS)/ United States Naval Test Pilot School (USNTPS).
- Establish Flight Test Acceleration Cells (FTACs) staffed by Flight Test Engineers (FTE), maintenance & system engineers, and software certification leads to drive daily closure. Till the setup of permanent manpower, pool resources from IAF with engineers qualified in PG on associated subjects such as aerospace, aerodynamics, instrumentation, etc., for data analysis, report generations, and data crunching to assist and hasten debriefs and schedules of testing.
- Set up PMTs from IAF with well-defined responsibilities, authority, training, and mandates to take on-site decisions.

Expected impact: These changes shift us from serial to parallel testing, realistically doubling mission-system test velocity and shaving 6–12 months from Mk1A induction cycles, 9–18 months from Mk2, and multiple years from AMCA's Block-0/1—without lowering safety standards. Figure 2 below gives the proposed organisational structure.

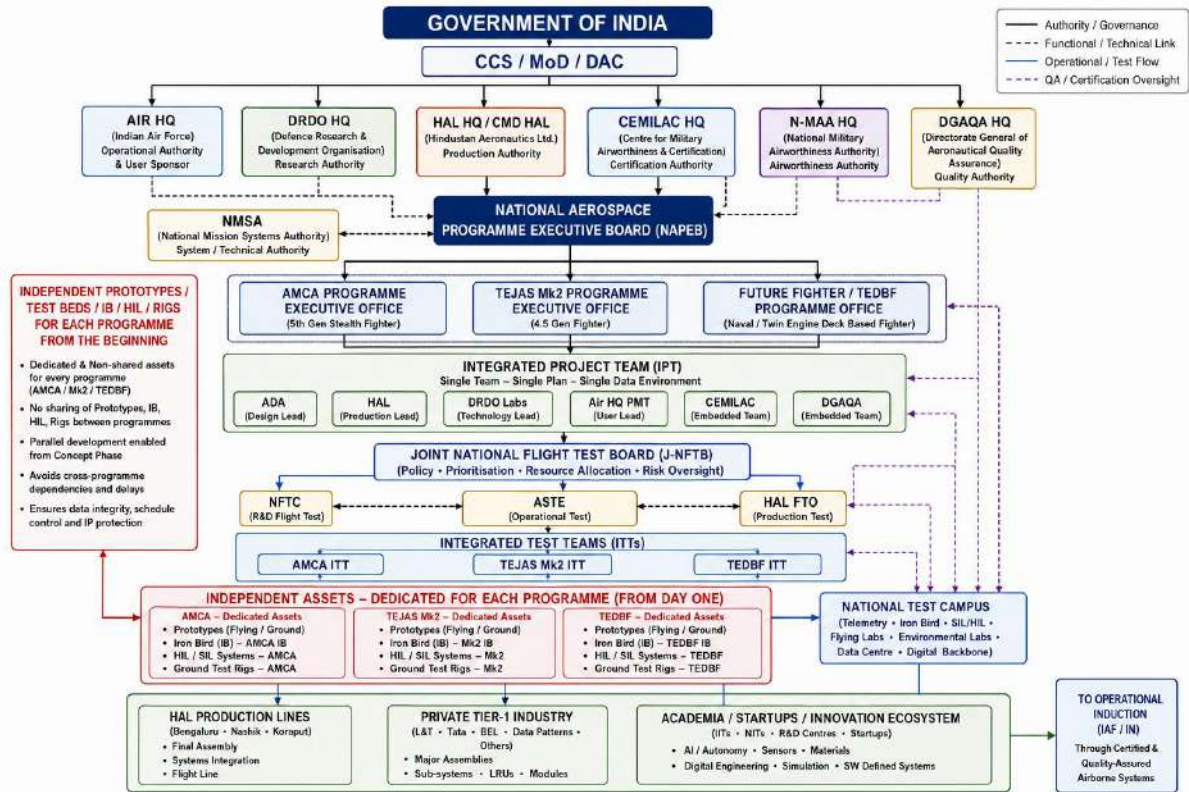


Figure 2. Proposed Organisation Structure
(Authors Creation from Open-Source Information)

Policy Recommendations.

The following proposals should be considered for implementation at the earliest.

- Name the NMSA within 90 days; publish open avionics standards (partitioning, ICDs, data buses, and cybersecurity) and lock them for Mk2/AMCA.
- Set up the J-NFTB and three ITTs within 120 days, with co-located telemetry rooms at Bengaluru and a western test range.
- Contract for two flying labs within 6 months; convert one HAL Do-228/C-295 and one frontline twin into system testbeds.
- Adopt block induction: Mk1A (B0 airworthiness; B1 radar, WVR; B2 BVR+EW), Mk2 (B0 envelope; B1 weapons), and AMCA (B0 stealth and flight control).
- Make industry a co-owner: Award AMCA prime integrator with incentives for block releases; enforce LDs for misses.

- Like CAC and SAC under AVIC, develop one more design powerhouse along with ADA for internal competition. They should have authority over PSU/DRDO labs developing components for fighter aircraft programmes.
- Publish an annual Airpower Velocity Report (MoD) tracking milestones (tests flown, software drops, integrations closed) to keep pressure on cycle time. Table 8 gives prioritisation.

Category	Priority Level	Why
Authority Delegation	Critical	Root cause of delay
Test Co-location	Critical	Direct multiplier on speed
Block Induction	Critical	Cultural shift required immediately
Project Management	High	Direct multiplier on speed
Supply Chain Resilience	High	Production stability
Structural Competition	Long-term	Strategic endurance

Table 8. Prioritisation Map **Source:** Author's assessment based on comparative analysis presented in this paper and supporting literature

Conclusion

China's rise as an aerospace power was not achieved through access to technology or larger financial resources. Its success is driven by the ability to convert ideas into capability at speed. It has integrated structures, programme leadership, extensive test infrastructure, spiral development, and collaboration between industry, academia, and defence. Through these, China has created an ecosystem that delivers combat capability at speed.

India's challenge is different. The country has a mature scientific base, experienced aerospace institutions, a growing industrial ecosystem, and a highly capable user in the Indian Air Force. The successful development and induction of the Tejas Mk1 — despite many obstacles — shows India can design and build advanced combat aircraft. The problem therefore lies not in technological competence but in execution speed, programme integration, and decision-making efficiency.

As India approaches the induction of the Tejas Mk1A, the development of the Tejas Mk2, and the stealth AMCA, time has become a strategic constraint. Delays in development, testing, sequential certification, and production raise costs and create capability gaps at a moment when the regional security environment is intensifying. China's rapid combat aircraft build-up and Pakistan Air Force modernisation emphasise the need to hasten aerospace programmes in India.

Lessons from China are to strengthen programme ownership, empower integrated project teams, and speed up certification and flight testing for India. Adopt block-based capability development and build systems that can integrate alternate technologies (engines and sensors) under supply constraints. Expand test infrastructure, bolster supply-chain resilience, and increase private industry participation in development and production.

The goal is not to copy Chinese or U.S. models, which arise from different political and industrial systems, but to adopt practices that boost efficiency, accountability, and delivery within India's own framework. The reforms proposed here can shorten development timelines, deepen indigenous capability, and reinforce India's long-term airpower.

The coming decade will decide whether India remains reliant on imported combat systems or becomes a global aerospace power. Success will depend not only on what India designs but also on how quickly it turns those designs into operational capabilities. In future battlespace, advantage will go to the nation that can operationalise technology first.

Declaration

I declare that this manuscript is being submitted exclusively to CENJOWS for publication consideration, is original, and has not been published or submitted elsewhere. I further certify that it contains no classified, restricted, or sensitive information and is based entirely on open-source material suitable for publication in the public domain.

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