

India's Air Cargo Trajectory, Technology Deficit, and The Road to 2035

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Abstract

India's air cargo sector reached an all-time record of 25.53 Lakh Metric Tonnes in FY 2024-25, yet its decade-long compound annual growth rate (CAGR) has decelerated sharply—from 7.6% to 2.9% (domestic) and 6.3% to 2.6% (international)—attributable primarily to structural supply-side shocks rather than weak demand. This study draws on three editions of the DGCA Handbook on Civil Aviation Statistics (FY 2014-15, FY 2019-20, FY 2024-25 Provisional) to construct a ten-year longitudinal baseline, diagnose India's most critical structural vulnerabilities, and project three growth scenarios to 2035: conservative (6% CAGR, ~4,500 TMT), base (7.5% CAGR, ~5,300 TMT), and optimistic (9% CAGR, ~6,200 TMT). The study simultaneously benchmarks six advanced technology domains—automation and robotics, AI-based demand forecasting, IoT real-time tracking, blockchain documentation, paperless e-freight, and smart warehousing—deployed at world-leading cargo hubs (Hong Kong, Singapore, Dubai, Frankfurt) against India's current adoption status. A structured technology gap assessment and a phased, India-specific implementation roadmap are presented. Evidence demonstrates that India's 2035 ambitions require not merely infrastructure investment and demand growth but a fundamental upgrade in operational intelligence—the kind already standard at global benchmark hubs.

Keywords: Air cargo, India, DGCA, logistics, technology deficit, e-commerce, freight, supply chain, 2035 forecast, dedicated freighters, automation, blockchain

I. INTRODUCTION

Air cargo constitutes one of the most strategically significant components of global aviation, enabling just-in-time supply chains, pharmaceutical distribution, time-sensitive perishables, and high-value electronics to move rapidly across continents. In India, its importance has intensified over the past decade as globalisation deepened, domestic e-commerce volumes surged, and infrastructure expanded significantly across tier-1 and tier-2 airports. Bodies including the Airports Authority of India (AAI) and the International Air Transport Association (IATA) consistently emphasise that stronger, more technology-enabled cargo operations are essential for India to remain competitive in global trade. Despite recording an all-time cargo throughput high

dedicated freighter capacity, overwhelming foreign carrier dependency (83.3% of international cargo), fragmented digital infrastructure, and terminal automation far below global benchmarks. This study addresses two interconnected objectives. First, it evaluates India's air cargo growth trajectory from FY 2014-15 to FY 2024-25 and projects three CAGR-based scenarios to 2035. Second, it benchmarks six advanced cargo technologies deployed at world-leading hubs against India's current adoption status, and proposes a structured, phased implementation roadmap. Nath and Upadhyay (2021) applied AHP analysis to Indian cargo terminals, process efficiency are the primary performance. The underlying premise is that demand growth and technology neither alone is sufficient to achieve India's 2035 ambitions.

II. LITERATURE REVIEW

A structured review of academic literature, industry publications, and policy documents was conducted to establish the theoretical and empirical context for this study. Three dominant themes emerged across the reviewed corpus.

The first theme is technology's transformational potential for cargo operations. Sayooj (2021) demonstrated that AI reduces human error and enhances ULD optimisation and predictive maintenance in cargo handling, though practical implementation in Indian terminals remains negligible. Nath and Upadhyay (2021) applied AHP analysis to Indian cargo terminals, finding that infrastructure quality and process efficiency are the primary determinants of throughput performance. Both studies converge on the conclusion that technology adoption, not merely physical expansion, is the binding constraint.

The second theme is India's structural fragility rooted in infrastructure deficits and carrier dependency. Salem (2020) documented how dedicated freighters sustained aviation during COVID-19, highlighting India's vulnerability given its near-absent dedicated freighter fleet. Greeshma et al. (2022) confirmed that cold chain inadequacy and fragmented digital tracking remain core bottlenecks. Nath and Upadhyay (2021) applied AHP analysis to Indian cargo terminals, finding that infrastructure quality and process efficiency are the primary determinants of throughput performance. The third theme is demand-side transformation driven by e-commerce and

pharmaceutical exports. Kumar and Chidambara (2023) quantified the rapid growth of Q-commerce freight patterns in Indian cities, while Baxter (2022) projected that environmental pressures will increasingly favour air cargo operators who adopt SAF and fuel-efficient platforms.

Table 1. Summary of Key Literature Reviewed

Author / Study	Methodology	Key Finding	Gap Identified
Sayooj (2021)	Conceptual & secondary	AI improves ULD optimisation, load planning, predictive maintenance	Shallow real-world implementation in India
Nath & Upadhyay (2021)	AHP & econometric	Infrastructure quality is primary throughput determinant	No real-time nationwide cargo data
Sikdar & Bhadra (2018)	Quantitative traffic analysis	Air cargo growth drives airport infrastructure demand	Regional cargo capacity overlooked
Salem (2020)	Secondary data analysis	Dedicated freighters sustained aviation during COVID-19	India's long-term cargo infrastructure understudied
Greeshma et al. (2022)	Literature review	E-commerce & pharma are primary demand drivers	Cold chain & digital tracking inadequate
Kumar & Chidambara (2023)	Urban case study, Delhi	Q-commerce significantly amplifies freight demand	Logistics planning for developing cities limited
Baxter (2022)	Qualitative airline reports	SAF and efficient aircraft reduce air cargo footprint	Large-scale green technology adoption unexamined

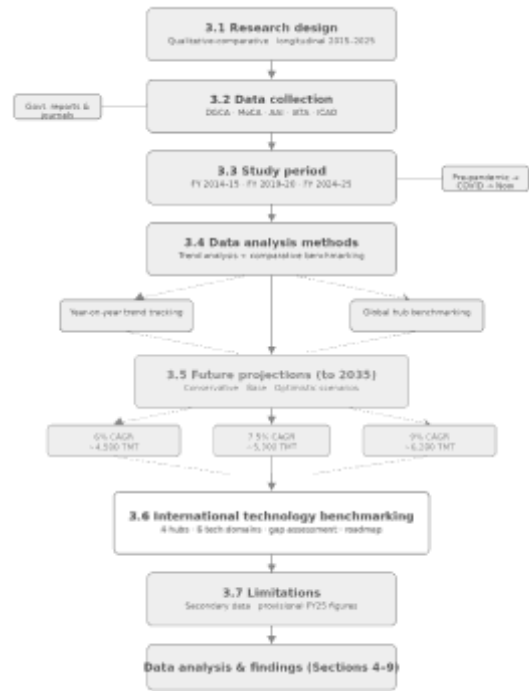
III. RESEARCH METHODOLOGY

This study adopts a qualitative-comparative research design integrating longitudinal trend analysis with systematic cross-sectional benchmarking. The framework spans ten fiscal years (FY 2014-15 to FY 2024-25), capturing structural evolution and cyclical disruptions. Three benchmark years—FY 2014-15 (pre-disruption baseline), FY 2019-20 (dual shock year: Jet Airways collapse and COVID-19 onset), and FY 2024-25 (post-recovery consolidation)—structure the comparative analysis. All data are drawn exclusively from secondary sources: three editions of the DGCA Handbook on Civil Aviation Statistics, supplemented by MoCA Annual Reports, AAI statistics, IATA/ICAO publications, and operational reports from Hong Kong HACTL, Singapore Changi Airport Group, Dubai Airports, and Lufthansa Cargo. This methodology is designed to be fully reproducible, with all data points traceable to named official publications.

Growth projections to 2035 are modelled under three scenarios. The Conservative scenario (6% CAGR) assumes moderate infrastructure growth, limited expansion of Indian carrier international capacity, and partial customs digitalisation by 2030,

yielding ~4,500 TMT. The Base scenario (7.5% CAGR) assumes successful execution of Air India and IndiGo freighter programmes, achievement of SWIFT 2.0 single-window customs at all 33 international airports by 2027, and cold chain reaching 30+ airports by 2030, yielding ~5,300 TMT. The Optimistic scenario (9% CAGR) assumes a dedicated national cargo airline, full AI-driven cargo hub management at the four major gateways, 95%+ e-AWB penetration, and India's emergence as a South Asia

Fig. 1 — Research Methodology Flowchart



transshipment hub, yielding ~6,200 TMT. Each scenario is explicitly linked to the technology implementation roadmap, making growth forecasting and technology benchmarking mutually reinforcing frameworks.

IV. DATA ANALYSIS & INTERPRETATION

4.1 Decade-Level Cargo Overview

Table 2. Master Cargo Metrics — Three-Year Comparative Overview

Four structural phases emerge from the ten-year time series. Phase 1 (2014–19): sustained growth propelled by e-commerce expansion, pharmaceutical export surge, and passenger network enlargement — domestic cargo rose 28.5% and international 31.5%. Phase 2 (2019–21): the Jet Airways collapse (April 2019) removed substantial belly cargo capacity, followed immediately by COVID-19 in March 2020, producing a 35.4% total cargo contraction to 1,475,000 MT in FY 2020-21 — the steepest collapse in modern Indian aviation history. Phase 3 (2021–23): a notably swift recovery driven by pent-up demand, pharmaceutical momentum, and cargo-only charter operations restored volumes to near pre-COVID levels. Phase 4 (2023–25): consolidation and new records, with FY 2024-25 total cargo at 2,553,000 MT surpassing all prior benchmarks, and ATF consumption reaching 8,985,000 MT — 8.2% above the pre-COVID peak.

4.2 Carrier Dependency Analysis

Table 3. Indian vs. Foreign Carrier Share of International Air Cargo (%)

Year	Indian Carriers (%)	Foreign Carriers (%)	Event / Driver
2014-15	17.8	82.2	Stable baseline
2018-19	20.9	79.1	Pre-collapse peak (highest of decade)
2019-20	13.9	86.1	Jet Airways collapse — share fell 7 pp in 1 year
2020-21	12.0	88.0	COVID-19 decade low; foreign cargo-only ops continued
2024-25(P)	16.7	83.3	Recovery aided by Air India Tata-era expansion

Indian carriers carry fewer than one in six tonnes of India's own international air freight — a structural exposure to third-party operational decisions in Dubai, Doha, and Frankfurt. The Jet Airways exit caused Indian carrier share to decline from 20.9% to 13.9% in a single year, demonstrating severe concentration risk. The FY 2024-25 recovery to 16.7% — supported by Air India's widebody fleet expansion (Boeing 777/787/A350) and IndiGo's A321-211F freighter programme — is encouraging but fragile. Until Indian carriers capture 30%+ of international cargo, the sector's growth trajectory remains hostage to foreign carrier decisions.

4.3 Trade Geography Shifts (2014–2025)

Two significant decade-long geographic realignments are observable. On the export (outbound) side, Europe's share grew from ~14% (2014-15) to 33.3% (2024-25) — the most transformative shift in this dataset, driven by pharmaceutical generic exports, PLI-manufactured electronics, and engineering goods. The Africa & Middle East corridor, while declining from ~55% to 45.8%, remains the single largest destination. On the import (inbound) side, China and North Asia's share grew from ~6% to 20.1%, directly mapping to India's expanding electronics manufacturing base and its dependence on Chinese component supply chains. As PLI schemes mature and domestic component manufacturing deepens, this inbound flow could contract — a positive signal of supply chain indigenisation.

4.4 Structural Composition: Belly vs. Dedicated Freight

Metric	2014-15	2019-20	2024-25(P)
Domestic Cargo (Lakh MT)	5.92	7.29	7.89
International Cargo (Lakh MT)	13.68	15.54	17.64
Total Cargo (Lakh MT)	~19.60	~22.83	~25.53
Domestic CAGR (decade, %)	7.6	6.4	2.9
International CAGR (decade, %)	6.3	3.2	2.6
International Airports	24	28	33
Scheduled Fleet (aircraft)	~400	710	841
Indian Carrier Intl. Share (%)	17.8	13.9	16.7
ATF Consumption (000 MT)	5,723	7,999	8,985

Belly cargo (passenger aircraft holds) accounts for ~80.5% of domestic air freight in FY 2024-25, with dedicated freighters at only 19.5%. The temporary spike to 24.4% dedicated share in FY 2020-21 — when passenger belly capacity evaporated overnight — revealed a critical operational truth: Blue Dart's dedicated freighter network provided continuity when the broader system collapsed. With only two dedicated domestic operators (Blue Dart and QuikJet Cargo, ~8 aircraft combined) for a market of India's scale, any major disruption in passenger operations would again constrain cargo throughput severely. This is simultaneously the sector's most glaring structural vulnerability and its most attractive investment opportunity.

V. INDIA'S TECHNOLOGY DEFICIT: AN ANALYTICAL ASSESSMENT

Despite recovering to record cargo volumes, India's air cargo sector operates with a technology profile that sits several capability tiers below global benchmarks. This is not a marginal efficiency gap — it is a systemic deficiency that directly constrains throughput, increases dwell time, reduces cargo attractiveness for high-value shipments, and undermines India's competitiveness as a preferred air freight gateway. Four dimensions of this deficit are analytically significant.

5.1 Terminal Automation Deficit

At Hong Kong's HACTL Super Terminal 1 — the world's busiest cargo facility — fully automated storage and retrieval systems (ASRS) process over 4 million tonnes annually, handling 3,000 tonnes per day with minimal manual intervention. At Frankfurt Cargo City, robotic palletising arms and automated ULD (Unit Load Device) storage reduce handling time and damage rates by measurable margins. By contrast, India's largest cargo terminals at Delhi IGIA and Mumbai CSIA rely predominantly on manual labour for sorting, stacking, and ULD loading. Manual operations create three cascading problems: a throughput ceiling that cannot be raised simply by adding floor space, elevated mislabelling and misrouting rates leading to customs holds, and inconsistent 24/7 performance that deters high-value route commitments. The automation gap directly caps India's effective cargo handling capacity below its physical terminal footprint.

5.2 Digital Integration Fragmentation

Singapore Changi's CALISTA cargo community platform connects all stakeholders — airlines, ground handlers, customs, and freight forwarders — on a single real-time IoT-enabled data layer, enabling proactive bottleneck identification and dynamic shipment rerouting. A shipment moving through Delhi's IGIA,

by contrast, typically interacts with four to five separate, non-communicating IT systems. E-AWB penetration, while improved from <20% (2014-15) to ~75-80% (2024-25), still trails global leaders (Singapore, Netherlands: 95%+). More critically, non-airway-bill documents — phytosanitary certificates, drug controller approvals, FSSAI clearances — continue to flow in physical form for agricultural and pharmaceutical exports, creating situations where an electronic airway bill exists but a customs officer still awaits paper documentation. This negates the speed benefit of e-AWB adoption entirely.

5.3 Cold Chain Infrastructure Gap

India's pharmaceutical export sector — which now accounts for ~33.3% of outbound international freight to Europe — is critically dependent on temperature-controlled handling infrastructure that remains inadequate at all but the top three or four gateways. Cold chain facilities expanded from 2 airports (2014-15) to 12+ (2024-25), yet for a pharmaceutical export sector valued at over USD 27 billion, serving European regulators who require unbroken cold chain documentation from origin to destination, coverage at 12 airports is far from sufficient. Shipments that cannot demonstrate continuous cold chain integrity risk rejection at European customs — damaging India's pharmaceutical export reputation at scale. This cold chain gap also directly prevents the development of an agricultural perishables export corridor that India's geographic position and agri-production base would otherwise make highly competitive.

5.4 Customs Dwell Time and Process Inefficiency

Average customs dwell time for air cargo at Indian airports remains 48+ hours for many commodity types — compared to under 12 hours at Singapore Changi and Dubai World Central, where blockchain-based advance digital document submission enables pre-clearance before the aircraft lands. India's ICEGATE 2.0 platform has improved customs digitalisation, but the ecosystem remains fragmented: airlines, ground handlers, customs, DGCA, and freight forwarders do not share a common verified data standard.

Table 4. India's Technology Deficit vs. Global Best Practice

Technology Domain	Global Best Practice	India Current Status	Quantified Gap
Terminal Automation	Full ASRS + AGVs; 3,000 TPD automated (HKIA)	Manual-dominant; semi-auto conveyors at DEL/BOM only	~70% capability gap vs. HKIA
AI Demand Forecasting	14-day forward demand models; real-time yield mgmt (SIA, Emirates)	Early-stage pilots; capacity allocation largely reactive	No operational AI platform at any Indian carrier
IoT Real-Time Tracking	Continuous sensor data; community platform linking all stakeholders (Changi CALISTA)	Checkpoint-based manual scans; no national IoT standard	Zero end-to-end IoT coverage in Indian gateways
Blockchain Documentation	IATA ONE Record live; advance pre-clearance before aircraft lands (Lufthansa, AF-KLM)	Fragmented IT systems; no interoperable data layer	Customs dwell 48+ hrs vs. 12 hrs at global leaders
e-Freight / e-AWB	95%+ e-AWB + full paperless non-AWB docs (Singapore, Netherlands)	~75-80% e-AWB; non-AWB docs still physical	~15-20 percentage point gap; non-AWB docs = critical miss
Smart Warehousing	Digital twins + autonomous forklifts + apron AGVs (Dubai, Singapore)	Conventional manual WMS; cold zones inadequately monitored	No autonomous operations at any Indian cargo terminal

VI. ADVANCED TECHNOLOGIES: IMPLEMENTATION & IMPACT

Closing India's technology deficit requires a coherent, sequenced modernisation programme across six interdependent domains. The domains are interdependent by design: IoT data feeds AI forecasting models; blockchain creates the trusted document layer on which e-freight depends; smart warehousing is only as intelligent as the IoT and AI data flowing into it. A piecemeal approach risks investing in individual components that cannot deliver value in isolation.

6.1 Automation & Robotics in Cargo Handling

Automated ASRS and AGV systems replace manual sorting, stacking, and ULD movement with robotic precision, operating continuously without fatigue or shift limitations. The measurable impact at global hubs includes 40–60% reductions in cargo handling time, near-zero mislabelling rates, and the ability to maintain 24/7 performance regardless of passenger flight schedules. India's implementation path: deploy semi-automated conveyor and barcode-scan systems at Tier 1 terminals (Delhi, Mumbai, Hyderabad, Bengaluru) within 2025-27; introduce full robotic sortation and AGV fleets at mega-hubs by 2027-30; mandate full ASRS integration in all 21 approved greenfield cargo terminal designs from day one. Retrofitting automation into existing facilities costs 3-4× more than designing it in — greenfields must not repeat legacy mistakes.

6.2 AI-Based Demand Forecasting & Yield Management

AI systems process historical booking patterns, real-time market demand signals, seasonal fluctuations, and route-level capacity constraints to dynamically allocate belly cargo space and price it optimally. Emirates SkyCargo forecasts pharmaceutical demand spikes 14 days in advance, enabling pre-staged cold storage and pre-positioned freighter capacity. For India, this capability is particularly valuable given the seasonal surges in pharmaceutical and perishables exports. Commercially available cloud platforms (IBS iCargo, Swiss WorldCargo architecture) can be integrated with existing airline reservation systems within 12-18 months, requiring no bespoke development. Expected impact: 15–20% reduction in belly-cargo waste, 10-15% improvement in cargo yield per flight hour, and the operational agility to compete for high-value time-sensitive shipments currently routing through Gulf hubs.

6.3 IoT Real-Time Cargo Tracking

IoT-enabled sensors attached to ULDs and individual high-value shipments transmit continuous location, temperature, humidity, shock, and light exposure data throughout the handling chain. For Indian pharmaceutical exporters, this capability is not optional — EU and US regulatory frameworks for pharmaceutical imports require unbroken temperature documentation from origin to final destination. A phased rollout: mandate IoT sensors for all pharmaceutical and perishable shipments at the top five gateways by 2026; establish a national cargo IoT data standard aligned with IATA's CEIV Pharma certification; integrate sensor data with the ICEGATE 2.0 customs platform to enable real-time regulatory visibility without manual status updates. Expected impact: elimination of cold chain documentation gaps that currently risk shipment rejection at European ports of entry; 25–30% reduction in damaged or temperature-excursion pharmaceutical cargo claims.

6.4 Blockchain for Documentation & Customs Transparency

Blockchain creates an immutable, distributed ledger of every document exchange in the shipment lifecycle — booking,

airway bill issuance, customs declaration, transit handling, and delivery — accessible simultaneously by all authorised parties. IATA's ONE Record framework, adopted by

Technology Domain	Near-Term (2025–27)	Medium-Term (2027–30)	Long-Term (2030–35)	Expected Impact
Terminal Automation	Semi-auto conveyors + barcode scan at DEL, BOM, HYD, BLR	Robotic sortation + AGVs for ULD movement at Tier-1 hubs	Full ASRS at all 4 mega-hubs; mandatory in all greenfields	40–60% handling time reduction; near-zero mislabelling
AI Forecasting	Deploy cloud cargo mgmt platforms (IBS iCargo) at Indian carriers	Real-time yield management + 14-day demand models at all major gateways	National AI cargo network integrating all hubs and carriers	15–20% belly-cargo waste reduction; improved yield/flight-hr
IoT Tracking	Mandate IoT for pharma/perishables at top 5 gateways; CEIV Pharma alignment	RFID ULD tracking system-wide; ICEGATE 2.0 integration	Full national IoT cargo network; autonomous status updates	Eliminate cold chain documentation gaps; 25–30% damage claim reduction
Blockchain Docs	Pilot IATA ONE Record at Delhi IGIA with Air India Cargo	Extend to all 33 international airports; integrate with NSWS	India interoperable with global ONE Record ecosystem	Customs dwell: 48+ hrs → under 12 hrs
e-Freight	95%+ e-AWB by 2026; mandate NSWS digital clearances	All non-AWB export docs accepted electronically by regulators	Full paperless cargo — zero physical document requirements	80% document processing cost reduction per shipment
Smart Warehousing	Deploy WMS + RFID at top 5 terminals; digital inventory dashboards	High-bay ASRS at mega-hubs; cold zone monitoring at 20+ airports	Autonomous forklifts and apron AGVs; digital twin management	30–40% space utilisation gain; cold chain integrity ensured

Lufthansa Cargo, Air France-KLM, and Cathay Cargo, enables advance digital document verification before the aircraft lands, reducing customs dwell from 48+ hours to under 12 hours. For India, the recommended pathway is to pilot IATA ONE Record at Delhi IGIA (highest cargo volume, most developed customs infrastructure) in 2025–26, with Air India Cargo as the first-mover airline. The DPIIT has already explored blockchain for trade finance under the National Logistics Policy — extending this into air cargo documentation is a natural, low-cost adjacency that would position India as an early adopter at a moment when the global standard is still being established.

6.5 Paperless e-Freight & Regulatory Harmonisation

Full e-freight — covering not just the airway bill but all accompanying export documents (certificates of origin, phytosanitary certificates, drug controller approvals, FSSAI clearances) in electronic form — reduces document processing costs by up to 80% per shipment and eliminates the paper bottleneck that currently adds hours to cargo dwell despite e-AWB adoption. India's path to full e-freight is primarily a regulatory harmonisation challenge, not a technology one: DGCA, CBIC, APEDA, FSSAI, and the Drug Controller General must all accept digitally signed electronic certificates. The National Single Window System (NSWS), under development by DPIIT, is the correct consolidation platform. Mandating all regulatory export clearances through NSWS by 2027 — alongside a target of 95%+ e-AWB penetration by 2026 — would close the gap

with Singapore and the Netherlands within the study's near-term window.

6.6 Smart Warehousing & Autonomous Ground Vehicles

Smart warehouses integrate digital twins, real-time inventory management systems, ASRS, and IoT sensors into a self-managing facility connected to inbound flight schedules — so storage zones are pre-allocated and picking sequences are prepared before the aircraft lands. Dubai World Central's autonomous ground vehicles (AGVs) move cargo between aircraft and terminal without human intervention, and DHL Frankfurt's autonomous forklifts operate continuously in cold-chain zones where human shift limits apply. For India, the near-term priority is deploying warehouse management systems (WMS) with RFID inventory tracking at the top five cargo terminals — a relatively modest capital outlay that delivers immediate dwell time and space utilisation improvements. Full autonomous warehousing becomes economically justified at mega-hub scale as India approaches the base and optimistic 2035 volume projections.

Table 5. Phased Technology Implementation Roadmap for India

VII. RESULTS & DISCUSSION

7.1 CAGR Deceleration: Structural Diagnosis

The decade-long CAGR decline — domestic from 7.6% to 2.9%, international from 6.3% to 2.6% — is entirely attributable to supply-side disruption, not demand weakness. Without the Jet Airways collapse and COVID-19, the underlying demand trajectory was consistent with 6–7% CAGR through 2025. This diagnosis has a clear policy implication: the structural constraints that caused the deceleration (dedicated freighter scarcity, terminal throughput ceilings, carrier concentration risk) are remediable through targeted intervention. Demand is not the problem — it is already there. The binding constraints are supply-side and institutional.

7.2 Foreign Carrier Dependency: Systemic Risk

The fact that 83.3% of India's international air cargo is carried by foreign airlines — with decisions made in Dubai, Doha, and Frankfurt — represents a strategic vulnerability that no amount of infrastructure expansion can mitigate on its own. When Emirates or Qatar Cargo reduces capacity, India's exporters have no domestic alternative to absorb the difference. The Jet Airways episode proved this empirically: a single Indian carrier's exit dropped India's market share by 7 percentage points overnight. The path to resilience requires Indian carriers — Air India Cargo, IndiGo Cargo, and new entrants — to collectively reach 30–35% international market share by 2030. This requires bilateral ASA expansion for all-cargo routes, differential ATF tax treatment for cargo operations, and a regulatory environment that makes dedicated freighter economics viable for Indian operators.

7.3 SWOT Synthesis: 2035 Strategic Position

Table 6. SWOT Analysis — India Air Cargo Sector (2035 Perspective)

STRENGTHS	WEAKNESSES
- Within 9 hrs of 60% of world population - Supplies ~20% of global generic medicines 14 sectors growing under PLI scheme 841 aircraft; Air India adding long-range routes	83% of intl. cargo flown by foreign airlines - Only 2 dedicated cargo airlines (~8 freighters) - Cold storage at 12 airports; needs 30+ - Logistics costs 13% of GDP (world avg: 8%)

• Record fuel use shows strong aviation growth	• Cargo growth slowed to ~3%/yr last decade
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OPPORTUNITIES	THREADS
- Online exports growing; +2-3L MT by 2035 - UAE deal active; UK and EU talks ongoing 21 new airports approved with cargo zones - Pharma air-freight zone can be world-class	- Dubai, Doha, Abu Dhabi are rival hubs 45% exports via Middle East - conflict risk - High fuel tax (39% of costs) hurts airlines - Carbon costs rising from 2027 (CORSIA)

7.4 Technology Gap: Competitive Consequence

India's technology deficit is not a long-term aspiration gap — it is an active competitiveness constraint today. High-value cargo categories that could route through Indian gateways (electronics, luxury goods, time-sensitive express freight) currently prefer Gulf hubs precisely because of the speed, reliability, and documentation transparency those hubs offer. Every additional hour of customs dwell is a routing decision that goes to Dubai rather than Delhi. The six technology domains collectively represent a coherent modernisation agenda: automation raises throughput per square metre; AI forecasting improves capacity utilisation; IoT eliminates cold chain documentation gaps; blockchain compresses customs dwell from 48+ to under 12 hours; e-freight removes paper bottlenecks; smart warehousing connects the physical and digital layers. The interdependencies mean the programme delivers exponentially more value.

Table 5. India Air Cargo 2035 Growth Scenario Projections

Scenario	CAGR	2035 (TMT)	Indian Carrier Share	Key Structural Assumption
Conservative	6%	~4,500	~20%	Moderate infra; partial customs digitalisation by 2030
Base	7.5%	~5,300	~25%	Air India/IndiGo freighter growth; SWIFT 2.0 at 33 airports by 2027
Optimistic	9%	~6,200	~35%	National cargo airline; full AI hub management; 30+ cold chain airports

The optimistic scenario is not speculative — it is contingent. Achievement of 9% CAGR requires: AI-driven cargo hub management at the four major gateways, 95%+ e-AWB penetration, 5–8 dedicated cargo airlines operating domestically, and India's emergence as a transshipment node for South Asian freight. Without the technology foundation modelled in Sections 5 and 6, the throughput ceilings at existing terminals ensure the sector converges on the conservative scenario regardless of demand growth.

VIII. CONCLUSION

India's air cargo sector has demonstrated remarkable resilience, recovering from a 35.4% COVID-induced collapse to reach a new all-time high of 25.53 Lakh MT in FY 2024-25. The foundational ingredients for top-five global market status exist: demand scale, geographic position (within 9 hours of 60% of the global population), pharmaceutical export dominance (~20% of global generics), PLI-driven manufacturing momentum, and an improving regulatory environment.

What this study makes unambiguous is that the path to that target requires deliberate structural intervention on three fronts simultaneously: dedicated freighter capacity and Indian

carrier market share growth; cargo hub infrastructure development to international standards at Delhi, Mumbai, Hyderabad, and Chennai; and a coordinated six-domain technology modernisation programme.

Table 6. Strategic Recommendations for India's Air Cargo Sector (2025–2035)

#	Recommendation	Rationale	Priority	Horizon
1	Expand Indian carrier international cargo share from 16.7% to 30–35% by 2030 via bilateral ASA expansion for all-cargo routes and differential ATF tax treatment	Addresses systemic foreign carrier dependency; single most critical structural vulnerability	Critical	2025-30
2	Develop 4 multimodal cargo mega-hubs (Delhi, Mumbai, Hyderabad, Chennai) with 24/7 operations, specialist pharmaceutical handling benchmarked to Singapore standards	Removes throughput ceiling constraining growth to conservative scenario; enables high-value cargo attraction	Critical	2025-30
3	Fast-track customs digitalisation: achieve sub-4-hour dwell for all air cargo; mandate SWIFT 2.0 at all 33 international airports by 2027; pilot IATA ONE Record blockchain at Delhi by 2026	Compresses dwell time gap vs. Gulf hubs; improves India's routing attractiveness for time-sensitive freight	High	2025-27
4	Mandate IoT sensors for all pharmaceutical and perishable shipments at top 5 gateways by 2026; establish national IoT data standard aligned with IATA CEIV Pharma	Closes cold chain compliance gap that risks pharma shipment rejection at EU/US customs; protects India's largest high-value cargo stream	High	2025-27
5	Achieve 95%+ e-AWB penetration by 2026; mandate all regulatory export clearances digitally through NSWS by 2027 — harmonising DGCA, CBIC, APEDA, FSSAI	Eliminates paper bottleneck that negates e-AWB speed benefits; reduces document processing cost 80% per shipment	High	2025-27
6	Deploy WMS + RFID inventory tracking at top 5 terminals immediately (2025-26); design all 21 greenfield cargo terminals with full ASRS	Delivers near-term dwell time improvements at low capex; ensures greenfields are built to 2035 throughput standards not 2025 ones	High	2025-32
7	Reduce ATF tax for all-cargo operations; create dedicated freighter policy framework to stimulate entry of 5-8 new dedicated cargo airlines	Dedicated freighter deficit is both the most critical gap and most attractive investment opportunity; policy stimulus is the enabling condition	High	2026-30
8	Establish a national cold chain air infrastructure programme connecting pharma clusters and farm belts to airport cold rooms	Unlocks pharmaceutical export corridor and agricultural perishables export	Medium	2026-30

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