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Issue Brief

From Reactive Repairs to Predictive Power: An AI Digital-Twin 'Health Index' for the Su-30 MKI

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Summary

A predictive maintenance model that processes data at high speed supports faster decision-making and real-time monitoring through sensors. The model reduces downtime, improves mission readiness and flight safety for pilots and translates into better fleet and safe availability for operations. While indigenous predictive maintenance is a low-cost force multiplier, its value will depend on data integrity, cyber hardening, and timely project completion.

Introduction

On 27 May 2026, the Indian Air Force (IAF) and the Indian Institute of Technology (IIT) Bombay formalised three landmark agreements to develop an indigenous, AI-driven maintenance model for the Su-30 MKI fighter aircraft. The Su-30 is already going through several upgrade programmes, and this agreement is a further boost. It is a meaningful step towards ‘Atmanirbhar Bharat’ (self-reliant India). This development can strengthen day-to-day fleet operations and, just as important, lay a path for AI integration across other defence equipment and systems.

This brief argues that indigenous predictive maintenance is a low-cost force multiplier. Still, its value will depend on data integrity, cyber hardening, and completing the project on time. The brief studies the Su-30 upgrade programmes, examines the requirement for AI in the fleet and how it can lift operational efficiency, looks at similar efforts by other air forces, and finally suggests measures to keep in mind while executing such projects.

The Su-30 MKI and Its Upgrade Trajectory

The Su-30 MKI is a twin-seat, long-range fighter built for multirole and air-superiority missions.¹ It was first inducted into the IAF in September 2002.² The Russian-origin air-dominance fighter pairs heavy firepower with super-maneuvrability and, with in-flight refuelling, can roughly double its range of about 3,200 km on internal fuel.³ The Su-30 forms the backbone of the IAF, with over 270 aircraft in the fleet, making India the world's largest operator of the type. There have been steady efforts to modernise the aircraft and keep pace with global technological advances.⁴

In 2024, the Ministry of Defence advanced the ‘Super Sukhoi’ modernisation—a project costing around Rs 60,000 crore—to be carried out by Hindustan Aeronautics Limited (HAL) with support from the Defence Research and Development Organisation (DRDO). It aimed to add advanced indigenous mission and weapons systems, stronger electronic warfare protection, new radars for better air-to-air and air-to-ground detection and engagement, and upgraded avionics for

¹ [“SU-30 MKI”](#), Hindustan Aeronautics Limited (HAL).

² [“Induction Ceremony: SU-30 MKI at Air Force Station Halwara”](#), Press Information Bureau, Ministry of Defence, Government of India, 25 September 2012.

³ Rajat Pandit, [“Sukhoi-30 MKI Jets Inducted into IAF”](#), *The Times of India*, 27 September 2002.

⁴ [“India Deploys Russian-Origin Su-30MKI Fighter to France for Joint Exercises with Local Rafales”](#), *Military Watch Magazine*, Force Index, 24 November 2025.

greater combat capability. The project has now reached the radar-integration testing stage.⁵

In addition, in September 2024, the Cabinet Committee on Security cleared a purchase worth about Rs 26,000 crore for 240 AL-31FP engines, to be made at HAL’s Koraput division with more than 54 per cent indigenous content, keeping the fleet flying for years to come.⁶ The IAF has also worked with the private sector and academic institutions—including IIT Bombay and IIT Jodhpur—to automate maintenance using Artificial Intelligence (AI) and robotics.⁷

The IAF–IIT Bombay Project: Agreement’s Scope and Architecture

In a data-driven era, one of the most significant steps in this upgrade journey is the IAF signing three contracts with IIT Bombay on 27 May 2026 to build an indigenous ‘predictive maintenance’ system for the Su-30 MKI fleet.⁸ They aim to develop maintenance technologies that are ‘prognostic and prescriptive in nature’ and built entirely on Indian know-how.⁹

The project will be run by the Centre for Machine Intelligence and Data Science (C-MInDS) and the Mechanical Engineering Department of IIT Bombay, and will monitor engines undergoing mid-life maintenance.¹⁰ The team’s goal is an AI-driven model—a smarter way to read the ‘health index’ of the gas-turbine engines. It will create a virtual copy of each real engine—a ‘digital twin’—to assess the engine’s condition.¹¹ The ‘digital twin’ is a ‘physics-informed’ model—it blends AI with established engineering, so the virtual engine behaves like the real one, predicts

⁵ Sarahbeth George, [“IAF’s Sukhoi Fighter Jets to Get a Rs 60,000 crore Booster : Here Are All the Upgrades for the SU-30 MKI”](#), *The Economic Times*, 20 February 2024; [“India’s Super Sukhoi Upgrade Reaches Critical Radar Integration Milestone with Virupaksha AESA Testing”](#), Indian Defence Research Wing, 19 May 2026.

⁶ Gordon Arthur, [“India Orders Hundreds of New Engines for SU-30MKI Fighters”](#), *Defense News*, 17 September 2024; [“Cabinet Committee on Security Approves Procurement of 240 Aero-engines for IAF’s Su-30 MKI Aircraft”](#), Press Information Bureau, Ministry of Defence, Government of India, 2 September 2024.

⁷ Dalip Singh, [“IAF Moving Towards Automation of Aircraft Maintenance”](#), *The Hindu Businessline*, 3 November 2024.

⁸ [“Indian Air Force Signs Three Contracts with IIT Bombay to Enhance Su-30 MKI Aircraft Maintenance System”](#), *ANI News*, 27 May 2026; Surendra Singh, [“IAF Signs 3 Contracts with IIT-Bombay to Enhance Su-30 MKI Maintenance System”](#), *The Times of India*, 29 May 2026.

⁹ Prakhya Singh Rajput, [“IAF Partners with IIT Bombay for Indigenous Predictive Maintenance Technology for Su-30 MKI Fleet”](#), *RNA-Research News Analysis*, 28 May 2026.

¹⁰ Dalip Singh, [“IAF Partners with IIT Bombay to Develop ‘Health Index’ for Su-30 MKI Engines”](#), *The Hindu Businessline*, 28 May 2026.

¹¹ [“IAF, IIT Bombay Use AI Digital Twins for Su-30MKI Maintenance”](#), *NewsBytes*, 28 May 2026.

likely faults early, spots problems quickly, flags where attention is needed and suggests the best fixes, while tracking the engine’s key health parameters.¹²

At GMC’25 (the Global Manufacturing Conclave), the Principal Investigator (PI) of this project highlighted how industrial AI and digital twins can transform operations, improve sustainability, and increase throughput—and stressed that data sits at the centre of any AI model.¹³ According to the PI, the impact on the IAF could be significant: engine maintenance turnaround times would fall, leading to cost savings and longer engine availability. IIT Bombay further stated that this shift will strengthen the IAF’s operational readiness, deepen technical self-reliance and push Indian aerospace towards predictive, data-driven engineering. The team is also building related models for radar systems and helicopters, which should improve inventory management and raise the availability and use of these systems.¹⁴

Contextualising the Transition: From Reactive to Predictive Maintenance

To appreciate the significance of this programme, it is necessary to understand what it displaces. Traditional maintenance regimes have historically been either reactive—addressing faults after they manifest as failures—or calendar-based (service as per the OEM’s manual), prescribing servicing intervals at fixed flying-hour thresholds regardless of the actual condition of components. Both approaches carry substantial inefficiencies: reactive maintenance risks aircraft availability and crew safety, while calendar-based maintenance consumes resources on servicing components that remain serviceable and may miss emerging faults that fall between inspection intervals.

Predictive maintenance, by contrast, continuously monitors system health against a reference state, providing early warning of developing faults with sufficient lead time to plan and execute corrective action without unscheduled grounding. For a fleet under operational pressure, the ability to sustain higher availability rates without proportionate increases in maintenance resource expenditure is of direct strategic consequence. Prognostics estimate how much useful life a part has left, while prescriptive analytics recommend exactly what to do.

¹² Ibid.

¹³ [“PlayBook-Case Study: Industrial AI in Action: Industry 4.0 and Digital Twin by Asim Tewari”](#), *The Economic Times*, 21 December 2025.

¹⁴ Dalip Singh, [“IAF Partners with IIT Bombay to Develop ‘Health Index’ for Su-30 MKI Engines”](#), no. 10.

The Su-30MKI is the Right Starting Point: Operational Significance

The IAF is facing a shrinking number of fighter squadrons, and with the MiG-21 era now over,¹⁵ more weight falls on the existing combat fleet to be kept in the highest state of readiness—and the Su-30 sits at the top. Because the Su-30 has been in service for more than 20 years, substantial data is available to build a reliable AI-driven maintenance model. Beyond data, its central role in combat missions makes it a vital choice for such upgrades.

The Su-30 MKI's operational record speaks to its versatility and reliability. It has featured in every major tactical exercise, air defence patrol cycle, and combat-oriented operation—air defence, long-range patrols, escorting and strike-supporting missions. Most significantly, the aircraft played a pivotal role in contesting for air superiority during Operation Sindoor,¹⁶ where approximately 40 Su-30 MKI were central to the IAF's strike effort, conducted long-range precision strikes using BrahMos missiles against Pakistani air bases, while simultaneously performing escort and air-superiority missions.¹⁷

Global Benchmarks: AI Integration in Global Fighter Fleets

AI can be a cost-effective way for countries to boost capability, and it is increasingly a force multiplier in conflict. To gain an edge in AI, all major powers such as the United States and China are investing heavily in AI for military systems and weapons. The United States runs extensive programmes for autonomous and semi-autonomous aircraft systems, predictive maintenance and logistics—for example, AI-enabled diagnostics on the F-16 for early detection of mechanical issues. Independent assessments report that AI-driven predictive maintenance can cut aircraft downtime by roughly 30–40 per cent and reduce costs. The US has further extended AI applications to include adversary simulation for pilot training, mission-planning algorithms, autonomous target recognition systems and decision support.¹⁸ Official US Air Force doctrine explicitly envisages the capacity to engage

¹⁵ [“A Sentinel of the Skies: After 62 Years in Service, IAF Bids Farewell to MiG-21; Iconic Fighter Jet Takes Final Bow”](#), *The Times of India*, 26 September 2025.

¹⁶ [“‘Su-30 MKI’ Upgrade: Op Sindoor Hero to Get Big Anti-jamming Update Under ‘Super Sukhoi’ Programme”](#), *The Economic Times*, 27 May 2026.

¹⁷ [“Operation Sindoor: How BrahMos Strikes and Precision Strikes Became Turning Points in the Standoff”](#), *The Economic Times*, 12 May 2025; [“Sneak Peek Inside IAF’s ‘Super Sukhoi’ Plan to Ensure Su-30 MKI Stays Lethal”](#), *The Times of India*, 14 May 2026.

¹⁸ Prawal Pokharel, [“Artificial Intelligence Modernization in the US Air Force: Strategic Implications, Readiness, and National Security Impact”](#), SSRN, 17 November 2025.

any target, strike at any location, and do so at any time with precision targeting and tracking.

China, too, has pursued an equally ambitious programme of AI integration into the People’s Liberation Army Air Force. It is upgrading its entire military force and weapon systems. It is reported to be adding advanced AI to its J-20 stealth fighter aircraft (China’s most advanced operational platform), with massive AI capabilities for situational awareness, sensor fusion, and pilot assistance for operational decision-making at speeds beyond unaugmented human cognitive capacity. China’s military AI investment reflects a doctrinal conviction that the decisive advantage in future high-intensity conflict will be achieved by building up the force to a level at which it can process, interpret, and act on operational data faster than its adversary.¹⁹

Challenges

AI-driven models live on data. The performance of any AI model is fundamentally constrained by the quality and completeness of the data on which it is trained and upon which it operates. For the IAF’s Su-30 MKI fleet, a substantial portion of historical maintenance records exists in paper format, accumulated over more than two decades of operations across multiple bases. The process of digitising, validating and structuring this legacy data for ingestion into the AI model constitutes a non-trivial preparatory challenge, and the quality of this process will materially affect the model’s predictive accuracy during its early operational phase.

Global air forces also had similar issues. The most ambitious AI-enabled maintenance network yet fielded—the F-35’s Autonomic Logistics Information System (ALIS)—offers a clear warning. US government auditors found that inaccurate or missing data in ALIS sometimes grounded flight-ready aircraft, and that the system was being re-designed into a cloud-based successor (ODIN).²⁰ They also flagged that ALIS routed all fleet data to a single central point with no backup, so any failure in it would eventually affect the whole fleet.²¹ This raised concerns about how such a system collects and shares its data. These are exactly the risks an Indian model must design out from the start.

¹⁹ Abhinav Yadav, [“Beyond Human Limits’: The Terrifying AI Upgrade Inside China’s J-20 Stealth Fighter](#), *WION*, 14 May 2026.

²⁰ [“Weapon System Sustainment: DOD Needs a Strategy for Re-Designing the F-35’s Central Logistics System](#)”, GAO-20-316, U.S. Government Accountability Office, 6 March 2020.

²¹ [“F-35 Sustainment: DOD Needs a Plan to Address Risks Related to Its Central Logistics System](#)”, GAO-16-439, U.S. Government Accountability Office, 14 April 2016.

Another crucial point that deserves attention is timely delivery. If the project slips badly, it loses relevance: technology moves on, costs rise, and fresh hurdles appear. India’s own record—including the long, drawn-out Super Sukhoi journey—cautions against the timely completion of any project.²² It is therefore imperative for the IIT Bombay team to work to firm timelines and field the system on schedule. It also helps to decide upfront how success will be judged: shorter engine turnaround times, fewer unscheduled engine removals, and a higher fleet serviceability rate are the obvious yardsticks.

But the same AI that strengthens a force can also make it vulnerable. Because AI systems run on data of varying sensitivity, it matters greatly what data is fed in and who is allowed to access it. Data deliberately corrupted by an adversary (data poisoning) can mislead the system and lead to costly, even dangerous, errors, and a machine that miscalculates in combat can do real harm.²³

Finally, security sits at the heart of all this. An AI model acts on whatever data it is given, and a central repository holding the health of the entire fleet is a tempting target: a breach could expose the fleet’s readiness in seconds, and poisoned data could quietly corrupt the system’s decisions. Strong protections are therefore essential—careful control over what data enters the system and who can access it, classification of sensitive data, network safeguards such as air-gapping where appropriate, and built-in redundancy with an offline fallback so that no single point can bring the fleet down.

Strategic Assessment

Air forces across the world are modernising their military assets by integrating AI into their systems. For a fleet flying harder and over wider areas, every serviceable Su-30 carries the weight of national security. The squeeze in the number of aircraft reduces combat capability. A predictive maintenance model that processes data at high speed enables faster decision-making and real-time monitoring via sensors. Continuous data analysis of aircraft performance enables faster troubleshooting, fewer breakdowns, lower repair and maintenance costs, faster fixes, and easier handling of major repairs. These together reduce downtime, improve mission readiness and flight safety for pilots, and therefore translate into better fleet and safe availability for operations. AI data-driven, predictive maintenance model tells

²² Javaria Rana, “[As Super Sukhoi Awaits Clearance, IAF Turns to Russia for Parallel Upgrade](#)”, *The New Indian Express*, 25 February 2026.

²³ “[Air Force Doctrine Note 25-1, Artificial Intelligence](#)”, US Air Force, 8 April 2025.

engineers what to inspect and when. It is a low-cost force multiplier for a squadron-short air force, and a real milestone in modernising India’s frontline fleet.

Conclusion

Technological upgrades and AI integration have become the need of the hour for any air force that wants to keep pace with global forces. Keeping a fighter fleet at the highest state of readiness is a core task, and serviceability—having aircraft ready to fly at short notice—feeds directly into deterrence. For years, India depended on foreign original equipment manufacturers (OEMs) for upgrades, software, and even maintenance schedules. These manuals set periodicity, life limits, and the logic for judging a part’s health. Building its own health-monitoring model lets India begin to own that knowledge.

The deeper strategic logic of the agreement is to give impetus to ‘Atmanirbhar Bharat’ and the wider vision of ‘Viksit Bharat’, extending self-reliance into genuine civil-military fusion. For too long, the armed forces, national laboratories and universities worked in separate silos, rarely sharing problems or talent. A partnership with a premier civilian institute like IIT Bombay fuses academic research with operational need, turning campus expertise into hard military capability—a sign of a maturing Indian defence ecosystem.

The success of the project can be ascertained by institutionalising it with steady funding and firm timelines. Build in redundancy and an offline fallback to ensure that no single hub can ground the fleet. It is also important to establish clear data governance and cyber security standards—classification, access control, and robust cyber defence—because the value of the whole system rests on data quality, the prevention of unauthorised access, and an uncompromised process. And define success by hard measures: engine turnaround time, unscheduled removals, and fleet serviceability; reduce aircraft downtime; improve repair accuracy; and streamline spares and logistics. The same physics-informed approach can later extend to other systems. A cyber-safe AI maintenance system for the Su-30 MKI can make India’s jets smarter, better maintained and ready for longer—deepening technical self-reliance and strengthening the IAF’s operational readiness for the years ahead.

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