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IAF-IIT Bombay Predictive Maintenance Pact for Su-30 MKI Fleet

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WHY IN NEWS:

The **Indian Air Force (IAF)** signed **three indigenous contracts with IIT Bombay** on **May 27, 2026** to deploy **predictive, prognostic and prescriptive maintenance systems** for the **Su-30 MKI** fleet — India's largest fighter platform with **~260+ aircraft**. The systems use **sensor data, AI/ML diagnostics and analytics** to estimate **remaining useful life of components** and forecast failures before they occur, with the aim of **cutting downtime and raising mission readiness**.

THE THREE CONTRACTS — QUICK MAP

CONTRACT	WHAT IT DOES	OUTCOME
Predictive Maintenance	Sensor-based failure forecasting before issues manifest	Avoid unscheduled grounding
Prognostic Maintenance	Estimate **Remaining Useful Life (RUL)** of components using degradation models	Optimise scheduled overhaul timing
Prescriptive Maintenance	Data-driven recommendations on **what action to take** (replace, refurbish, defer)	Maintenance crew decision support

Together, the three layers transform aircraft maintenance from **reactive (fix when broken)** and **scheduled (fix at fixed intervals)** to **condition-based (fix when sensors say to)**.

WHY THE SU-30 MKI

PARAMETER	DETAIL
Type	Twin-engine, twin-seat **multirole air-superiority fighter**
Manufacturer	**Sukhoi (Russia)** — licensed production by **HAL (Nashik)**
First induction (India)	**September 27, 2002**
Fleet size (2026)	**~260+** — IAF's largest fighter type
Engines	**AL-31FP** with thrust-vectoring nozzles
Avionics	**N011M Bars** radar; indigenous upgrades planned
Weapons	**BrahMos-A**, Astra Mk-1/Mk-2, R-77, R-73; bombs, rockets, anti-radiation missiles
Service life	Designed for 6,000 flight hours; mid-life upgrade planned
Annual fleet flying hours	~75,000+ across all Su-30 MKI squadrons

The fleet is the **backbone of Indian air power**. Maintenance efficiency translates directly into **available combat strength**.

WHAT PREDICTIVE MAINTENANCE LOOKS LIKE

The Old Model (TBO — Time Between Overhaul)

- Engine sent for overhaul at fixed flight-hour milestones (e.g., 1,000 hours).
- Components replaced based on **average expected life**, not actual condition.
- **Over-maintenance** (replacing parts that still have life) and **under-maintenance** (failing parts in service) both common.

The New Model (CBM+ — Condition-Based Maintenance Plus)

- Aircraft sensors continuously log **vibration, temperature, oil debris, EGT (exhaust gas temperature), fuel flow, hydraulic pressure**.
- AI/ML algorithms detect **early degradation patterns** before performance drift.
- **Prognostic models** predict RUL with confidence intervals.
- **Prescriptive engine** recommends specific actions (e.g., "replace fuel pump in next 80 hours").

METRIC	OLD (TBO)	NEW (CBM+)
Aircraft availability	~60-65%	~75-85% (targeted)
Spare-parts inventory	Large buffer	Just-in-time
Maintenance cost per flight hour	High	Reduced ~20-30%
In-flight failures	Periodic	Minimised
Component utilisation	~70-80% of life	**~95% of life**

THE INDIGENOUS STACK — IIT BOMBAY'S ROLE

ELEMENT	IIT BOMBAY CONTRIBUTION
Algorithm development	LSTM (long short-term memory) + autoencoder + Gaussian Process Regression for sensor anomaly detection and RUL prediction
Domain modelling	Aero-engine degradation physics (aero-mechanical engineering depts)
Data pipeline	Edge-cloud architecture for secure flight-data offload
Visualisation	Maintenance crew dashboard for prescriptive recommendations
Validation	Comparison against IAF's actual maintenance logs to fine-tune precision

IAF OFFICIAL	DESIGNATION
Air Marshal KAA Sanjeeb	**Director General (Aircraft)**, IAF
Programme office	IAF Maintenance Command + Air HQ
IIT Bombay	**Director: Shireesh B. Kedare**
Funding	IAF capital + revenue head; indigenous content **100%**

THE BIGGER PICTURE — CIVIL-MILITARY ACADEMIC FUSION

India's defence-academic partnerships have accelerated:

PARTNERSHIP	YEAR	FOCUS
DRDO-IIT-IISc joint Centres of Excellence	2010 onwards	Long-running
iDEX (Innovations for Defence Excellence)	**April 2018**	Startup ecosystem
iDEX-Prime	2021	Larger grants up to ₹10 cr
Defence India Startup Challenge (DISC)	Multiple rounds since 2018	
Mission DefSpace	2022	Space-defence convergence
Aatmanirbhar Bharat indigenisation lists	4 + lists notified, ~509 items	
IIT Bombay - IAF Su-30 contract	**May 2026**	**Production-grade AI for live fleet**

WHY PREDICTIVE MAINTENANCE MATTERS FOR INDIA

REASON	DETAIL
Squadron strength	India's authorised strength is **42 squadrons**; actual is closer to 31 — increasing availability of existing fleet is the fastest squadron-equivalent
Russian spares dependency	Russia-Ukraine war has constrained spares supply; predictive maintenance reduces spare consumption
Lifecycle cost	Su-30 MKI lifecycle cost is ~₹100-150 crore over 30 years per aircraft — maintenance is **40-60%** of total
Mission readiness	Higher availability rate = effectively more aircraft without procuring new ones
Export potential	If the system works, it can be offered to Su-30 operators globally (Algeria, Vietnam, Indonesia, Malaysia)

BEYOND SU-30 — FUTURE APPLICATIONS

- **HAL Tejas Mk1A / Mk2** — newer indigenous platform with embedded health-monitoring built in.
- **AMCA (Advanced Medium Combat Aircraft)** — designed with CBM+ from the start.
- **C-130J Super Hercules, IL-76, IL-78** transport fleet.
- **Mi-17 / Apache / Chinook** helicopter fleet.

- **Naval — Rafale-M, MiG-29K, Sea Harrier** maintenance optimisation.

WATCHPOINTS

- **Cyber security** — flight data is sensitive; data-pipeline security is critical.
- **Skill development** — maintenance crews need data-literacy training.
- **Algorithm trust** — humans must understand "why" the model recommends an action.
- **Pilot acceptance** — pilots must trust the prognostic recommendations.
- **Spare-parts ecosystem** — predictive maintenance only works if spares are available on call.

WAY FORWARD

- **CBM+ across all major IAF platforms** — fleet-wide implementation.
- **DGAQA (Directorate General of Aeronautical Quality Assurance)** — standards for AI-driven maintenance certifications.
- **HAL's role** — co-development of CBM+ tools with IIT Bombay for indigenous platforms.
- **Skill stream** — Indian Air Force Academy + ITI partnerships for aero data engineers.
- **International collaboration** — selective tech-share with friendly nations (Tejas + CBM+ as a package).

UPSC RELEVANCE

GS Paper 3 — Science & Technology / Security:

- Achievements of Indians in science & technology; indigenization of technology and developing new technology.
- Various Security forces and agencies and their mandate.
- Awareness in the fields of IT, computers, robotics, AI.

Analytical hooks for Mains:

- AI in defence — operational vs strategic implications.
- Defence-academic partnerships — institutional design.
- Atmanirbhar Bharat in maintenance, repair, overhaul (MRO).

FACTS CORNER

Contracts signed: May 27, 2026 (announced May 29).

Number: 3 contracts — predictive + prognostic + prescriptive maintenance.

Aircraft: Sukhoi Su-30 MKI — IAF's largest fighter type, ~260+ in service.

First Su-30 MKI induction: September 27, 2002.

Manufacturer: Sukhoi (Russia), licensed production by HAL (Nashik).

Engines: AL-31FP with thrust-vectoring.

Indian partner: IIT Bombay (Director: Shireesh B. Kedare).

IAF lead: Air Marshal KAA Sanjeeb, Director General (Aircraft).

CBM+: Condition-Based Maintenance Plus — sensor-driven.

iDEX: Launched April 2018 for defence startup ecosystem.

IAF authorised squadron strength: 42 (actual ~31).

Indigenous content: 100%.

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Sources: PIB, IAF, ANI

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