

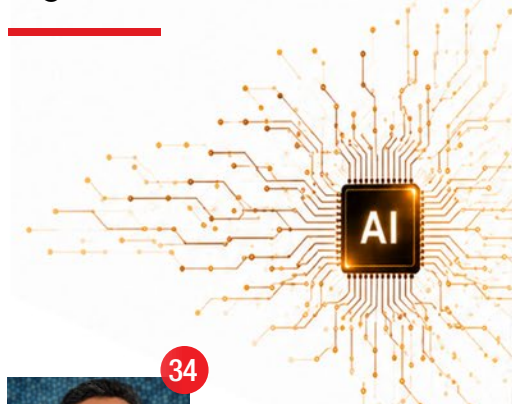
VOICE & DATA

Connecting the Digital World



MAINFRAMES ARE BACK

Quantum risks, AI workloads and data sovereignty are giving the enterprise workhorse a new role across modern digital infrastructure.



34

"One of the biggest constraints for AI is the network"

SAMIR MISHRAManaging Director, Enterprise,
Cisco India & South Asia

48

"AI is pushing security deeper into the network"

David HughesSVP – SASE and Security,
HPE Networking

India's defence drone push moves deeper into the tech stack

From sensors and propulsion to secure communications and resilient navigation, strategic autonomy now depends on controlling the technologies inside the UAV.



BY PRATIMA HARIGUNANI

In a memorable scene from the movie Uri: The Surgical Strike, national security strategist Govind Bhardwaj, played by Paresh Rawal, is looking for something that can help soldiers watch and read the enemy before executing a surgical strike. His attention falls on an intern working on what appears to be a side project.

The project is an Unmanned Aerial Vehicle (UAV), named Garuda. During a demonstration, the intern explains its camera, range, hovering capability and battery life. Bhardwaj immediately sees its potential and asks him to build more.

India has come a long way from the days when such projects were on the fringes and UAVs were a novelty in military operations. More recently, Operation Sindoor offered a glimpse of the significance of these systems.

From surveillance and attacks to real-time strategic manoeuvres, drones have become increasingly important in the defence landscape.

That is precisely why it matters for these systems to be designed, engineered, assembled and equipped within the country. Indigenisation carries a very different connotation for this category of technology. It is about more than self-reliance; it has implications for defence readiness, resilience and strategic autonomy.

BUILDING INDIA'S INDIGENOUS DRONE STACK

India's defence drone ecosystem has evolved rapidly over the past few years, says Agenda Kumar, Managing Director, Esri India, a player in geographic information systems (GIS), mapping and spatial data analytics technology.



“We are seeing serious investment beyond airframes in autonomous navigation, AI-driven decisions, secure communications, edge computing and resilient software.”

RADHA KRISHNAN

Founder & President, Detroit Engineered Products

“The emphasis has shifted towards building complete indigenous capabilities encompassing drones, sensors, command-and-control systems, AI-driven analytics, geospatial intelligence, and mission-critical software. Drones are becoming intelligent sensing platforms that continuously collect vast volumes of imagery and real-time data.”

Indigenisation has also matured, says Radha Krishnan, Founder and President, Detroit Engineered Products (DEP), a product engineering company. “Earlier, it often meant assembling products locally. Now the focus is steadily moving towards developing critical technologies within India, from flight control systems and mission software to sensors, electronics, and propulsion. There is still work to be done in some areas, but the direction is clear, and the ecosystem is becoming deeper with every passing year.”

There is also reason to be upbeat about how UAVs are changing the defence ecosystem, says Joseph Sudheer, Global CEO and Managing Director, Magellanic Cloud, a digital engineering player with a presence in drone technology.

“The biggest change I have observed is that drones are no longer viewed as support assets. They are increasingly becoming central to military planning, operational execution, and force multiplication strategies. Three or four years ago, most discussions focused on surveillance, reconnaissance, and intelligence gathering. Today, conversations have expanded significantly. Global conflicts have demonstrated the effectiveness of loitering munitions, swarm technologies, autonomous targeting systems, and precision-strike capabilities. These developments are influencing defence priorities worldwide, including in India.”

India's defence ecosystem, he explains, is moving towards integrated unmanned capabilities where surveillance, targeting, communication relays, electronic



IN BRIEF

- India's defence drone story is moving beyond assembly as indigenous capabilities expand across flight systems, sensors, AI and mission software.
- Drones are moving to the heart of warfare, combining surveillance, targeting, communications and precision engagement in integrated operations.
- Simulation, GeoAI and extreme-condition testing are accelerating how indigenous UAVs are designed, validated and prepared for missions.
- India's toughest localisation battle now lies inside the drone, from advanced sensors and propulsion to semiconductors and secure communications.
- Contested operations raise the stakes as spoofing, jamming and interception make survivability and resilient navigation mission-critical.
- The ultimate test of self-reliance is technology control: who owns what allows a drone to sense, navigate, communicate, survive and strike.



“Beyond manufacturing, India must strengthen testing, certification and export competitiveness to build globally competitive drone technologies entirely at home.”

JOSEPH SUDHEER

Global CEO & Managing Director, Magellanic Cloud

How Deep Does Drone Indegenisation Go?

Mapping India's strengths, gaps and the technologies that will define the next phase.



STRONGER DOMESTIC CAPABILITY

Areas where Indian industry has built depth and delivered.



Airframes



Software and firmware



Guidance and navigation



Mission software



System integration



AI-enabled analytics



Payload integration



LOCALISATION GAPS REMAIN

Critical components and technologies still dependent on external sources.



Ruggedised flight controllers



EO/IR and specialised sensors



Advanced propulsion systems



EW-resilient communication modules



Semiconductors



Advanced batteries



Testing infrastructure



THE NEXT TECHNOLOGY TEST

As UAVs operate in contested environments, localisation must extend into:



Secure communications
Encrypted, tamper-proof and resilient links



Anti-jamming capability
Robust links and spectrum agility to stay connected



Resilient navigation
GNSS-independent systems for GPS-denied ops



Autonomous fail-safe systems
Smart decision-making with built-in safety protocols



Electronic warfare
Detect, withstand and respond to EW threats



Survivability
Low observability, hardening and mission resilience

warfare and precision engagement work together within a single operational framework.

“Defence production and exports have both witnessed strong growth in recent years, reflecting increased confidence in indigenous technologies. From my perspective, we are not moving away from surveillance; we are building upon it. Surveillance remains the starting point, but the future battlefield increasingly demands systems that can sense, analyse, decide, and act with greater speed and precision than ever before.”

India's manufacturing sector has also advanced self-reliance in defence, aerospace and electronics, with local capabilities in drone platforms, including airframes, software and components, as well as aircraft electronics, mission systems and electronic warfare, says Alvin Anthony, Co-Founder and Chief Executive Officer, NextLeap Aeronautics.

Kumar illustrates how technologies surrounding drones are also becoming important. “Indo ArcGIS enables the integration of data from drones, satellites, sensors, and field assets into a common operational picture, providing commanders with real-time situational awareness and AI-driven decision support.”



“Indigenous development gives greater control over critical technologies, enables mission-specific customisation and reduces lifecycle dependence on external vendors.”

ALVIN ANTHONY

Co-Founder & Chief Executive Officer, NextLeap Aeronautics

He adds that Esri India works with organisations such as the Defence Research and Development Organisation (DRDO) and Bharat Electronics Limited (BEL) on geospatial technologies. Such capabilities can support operational coordination, situational awareness and faster decision-making for the armed forces.

DEEPENING THE INDIGENOUS TECHNOLOGY STACK

Krishnan points to engineering and simulation as another area supporting the development of next-generation defence drones. “Instead of waiting days or weeks for simulation results, engineers can predict aerodynamic, structural and thermal performance in minutes, explore multiple design options, and optimise them early in the development cycle. That means faster prototyping, quicker validation, and more time spent improving mission capability rather than running repetitive simulations.”

From an indigenisation standpoint, he says these capabilities enable Indian defence organisations to build AI models using their own engineering data and domain knowledge. This can reduce reliance on external datasets and long development cycles while helping create sovereign engineering intellectual property.

“With capabilities such as AI-driven geometry optimisation and autonomous engineering workflows, it can support the rapid development of future-ready drone platforms designed, validated and evolved entirely within India’s defence ecosystem.”

Sudheer reinforces the change taking place across the ecosystem. “Over the last five years, I have witnessed a remarkable transformation in India’s UAV ecosystem. When we started discussing drone indigenisation seriously, most manufacturers were assembling imported components. Today, India has developed strong capabilities across airframes, flight controllers, mission software, AI-enabled analytics, and specialised payload

integration. Government initiatives such as the Drone Rules 2021 and the Production Linked Incentive (PLI) scheme have accelerated this transition.”

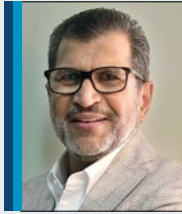
This shift, however, goes deeper than a ‘Made in India’ tag. Indigenisation draws its significance from the ecosystem of capabilities that can be built into and around these aerial platforms.

Krishnan echoes this direction. “Over the last few years, the conversation has shifted from simply buying drones to building a complete drone ecosystem. That is a far more meaningful change. Today, we are seeing serious investment not just in airframes, but in the technologies that make drones reliable in contested environments: autonomous navigation, AI-driven decision-making, secure communications, edge computing, swarming, and resilient mission software.”

Anthony points to developments at the core of these systems as well. “We see investments happening in semiconductor development, which is one of the key requirements for all the electronic components required for the aerospace and defence sector. India has made strong progress in system-level design integration and manufacturing for defence, aerospace, and electronics.”

Kumar adds that the real value lies in converting the data generated by drones into actionable intelligence. “This is where GIS and GeoAI play a critical role. These technologies enable commanders to integrate data from multiple sources, visualise the operational environment in real time, assess threats, plan missions, and make faster, more informed decisions.”

Drone imagery can also be rapidly processed into high-quality 2D and 3D mapping products. “These outputs can be quite consequential to support mission planning, terrain analysis, border surveillance, infrastructure monitoring, damage assessment, and enhanced situational awareness. By transforming raw



“By transforming raw drone imagery into actionable geospatial intelligence, defence teams can make faster, more informed and mission-critical decisions.”

AGENDRA KUMAR
MD, Esri India

drone imagery into actionable geospatial intelligence, defence personnel can make faster, more informed operational decisions.”

Testing is as important as manufacturing because the consequences of real-world use are considerably greater than in most commercial applications. Sudheer cites work undertaken in challenging regions such as Leh.

“Establishing UAV development, testing, and maintenance capabilities at high altitudes is an achievement in itself. These environments allow us to validate aircraft performance under low air density, extreme temperatures, and demanding operational conditions that many drone systems struggle to handle. The insights gained from such testing directly improve the reliability and robustness of our platforms.”

CLOSING THE CRITICAL LOCALISATION GAPS

What has been achieved so far represents only part of what will be required as the role of UAVs in military surveillance and operations becomes deeper and more sophisticated. That translates into a need for greater self-sufficiency across multiple layers of the technology stack.

Advanced propulsion systems, high-end electro-optical sensors, semiconductor dependencies and specialised battery technologies still require deeper localisation, Sudheer says. “Beyond manufacturing, India must also strengthen testing infrastructure, certification pathways, and export competitiveness. I believe the next phase will be about creating globally competitive drone technologies that are designed, engineered, and continuously evolved in India.”

Anthony says India has achieved strong localisation in airframes, precision-machined parts, software and firmware, guidance and navigation systems, and system integration, supported by domestic engineering capabilities.

But challenges persist at the component level. These include “high-performance ruggedised flight

controllers, specialised sensors (e.g., EO/IR payloads), advanced propulsion systems (motors, ESCs), secure EW-resilient communication modules, and advanced batteries”, which remain partially import-dependent because of the developing semiconductor ecosystem and testing infrastructure.

For Sudheer, true self-reliance extends far beyond manufacturing components domestically. “It means developing the engineering expertise, testing environments, supply chains, and operational capabilities required to build reliable systems for India’s unique conditions.”

He adds: “Beyond manufacturing, we have invested heavily in indigenous flight systems, autonomous technologies, AI-powered analytics, and mission-specific payload integration. This enables us to tailor solutions for defence, surveillance, industrial inspection, and critical infrastructure sectors. For me, localisation is ultimately about building confidence in Indian technology.”

There are several areas that will need to be strengthened as the industry expands. While significant advances have been made in vertical take-off and landing (VTOL) architectures, payload flexibility, mission software, AI integration, endurance and platform customisation, Sudheer believes the next phase of competitiveness will be defined by survivability and mission effectiveness.

Collaboration is another important shift, Krishnan points out. “Large defence companies, startups, MSMEs, academia, and government organisations are working much more closely than before. That creates a stronger innovation pipeline because different players bring different strengths to the table. No single company can build the future of autonomous defence systems alone.”

PREPARING DRONES FOR CONTESTED OPERATIONS

Limitations in current devices and systems are also

A drone may carry a Made in India tag, but true autonomy lies in who controls its flight controller, sensors, data links, propulsion and core mission software.

emerging in soft-kill counter-drone capabilities, particularly against autonomous drones, pre-programmed routes, frequency-hopping links and one-way attack UAVs, according to Fortune Business Insights.

This is driving the development of hard-kill interceptors, high-power lasers, radio-frequency effectors and integrated command-and-control systems capable of detecting and classifying threats, assigning an effector and neutralising the threat. The direction is towards integrated counter-UAS systems combining radar, radio-frequency detection, electro-optical and infrared tracking, command and control, electronic warfare, and kinetic or non-kinetic interceptors for fixed-site and mobile deployments.

Modern drone operations also increasingly face threats such as GPS spoofing, jamming, signal interception and communication disruption, Sudheer observes.

“Indian manufacturers are investing heavily in secure communications, encrypted data links, anti-jamming technologies, autonomous fail-safe capabilities, AI-enabled mission planning, and resilient navigation systems. The goal is not simply to assemble drones in India, but to design, test, manufacture, and continuously improve systems that can perform reliably in some of the world’s most demanding environments.”

Kumar also points to the importance of capability building. “We are doing it through training on our Indo ArcGIS platform, helping develop a skilled geospatial workforce that supports India’s vision of ‘Atmanirbhar Bharat’ and future-ready defence preparedness.”

Indigenisation holds particular significance in defence because it directly affects strategic autonomy, operational readiness and long-term national security, Anthony argues.

“Dependence on imports can create vulnerabilities in times of geopolitical uncertainty, supply-chain disruptions, or urgent operational requirements. Indigenous development ensures greater control over critical technologies, enables mission-specific

customisation, and reduces lifecycle and maintenance dependencies on external vendors.”

That is ultimately where the significance of India’s evolving defence drone ecosystem lies. The challenge is no longer simply to assemble or manufacture UAV platforms domestically, but to deepen indigenous capability across the technologies that determine how those platforms perform: flight controls, sensors, propulsion, communications, navigation, AI, geospatial intelligence, mission software and electronic warfare.

The challenge for indigenisation, however, lies deeper in the technology stack. India has built capabilities across airframes, software, guidance and navigation, system integration and mission technologies, but dependencies remain in areas such as high-performance flight controllers, specialised sensors, advanced propulsion systems, secure communication modules, semiconductors and batteries.

And this is where the stakes rise. As UAVs move from surveillance towards autonomous and contested operations, it is not enough for these machines to fly; they must remain dependable when the operating environment turns hostile. GPS spoofing, jamming, signal interception and communication disruption put secure communications, resilient navigation, anti-jamming technologies, autonomous fail-safe capabilities, testing infrastructure and dependable supply chains to the test.

How far India’s defence drones can ultimately fly will depend on how deep indigenisation can go. The real measure will be less about where a UAV is manufactured and more about who controls the technologies that allow it to sense, communicate, navigate, survive and complete its mission. That is where localisation stops being a manufacturing achievement and becomes a strategic capability.

Perhaps that also gives a different weight to Bhardwaj’s words to Garuda’s young creator in the movie: “You might have just won us the war, son!” 🙏

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