# DRDO
## in
# OPERATION SINDOOR

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# 'सुदर्शन और आकाश' की जोड़ी ने पाकिस्तान की कमर तोड़ी

***Source: Dainik Jagran, Dt. 09 May 2025***

## टकराव के बीच दोनों देशों की रक्षा प्रणाली पर दुनिया की नजरें

संजय मिश्र ● जागरण

नई दिल्ली: पहलगाम हमले के बाद पाकिस्तानी आतंकी ठिकानों के खिलाफ शुरू सैन्य कार्रवाई आपरेशन सिंदूर पर पाकिस्तान का पहला जवाबी हमला भारत की मजबूत एयर डिफेंस प्रणाली को लांघ नहीं पाया। वहीं भारत ने हारोप ड्रोन से पाकिस्तानी एयर डिफेंस प्रणाली को कई जगहों पर भेद दिया। लाहौर में चीन निर्मित पाकिस्तान के एचक्यू 9 एयर डिफेंस को नष्ट करने के साथ ही पाकिस्तान की कई एयर डिफेंस प्रणाली को चकमा देते हुए हारोप ड्रोन ने रावलपिंडी और कराची तक पहुंच कर पाकिस्तानी सेना और सैन्य प्रतिष्ठान की बेचैनी बढ़ा दी। उत्तरी और पश्चिमी सीमा से लगे 15 शहरों के सैन्य प्रतिष्ठानों को निशाना बनाने की पाकिस्तान की जवाबी हमले की कोशिशों को रूस निर्मित एस-400 यानी सुदर्शन और स्वदेशी रडार सिस्टम आकाश ने पूरी तरह नाकाम कर दिया।

पाकिस्तानी हमले को नाकाम करने में सबसे खास बात यह रही कि इसी दौरान स्वदेशी आकाश तथा एस-400 की तैनाती से भारत की एयर डिफेंस प्रणाली को मिली मजबूती पहली ही परख में कामयाब रही। दूसरी तरफ पाकिस्तान का चीन निर्मित एयर डिफेंस सिस्टम भारत की ओर से इस्तेमाल किए गए हारोप ड्रोन को अपने हवाई क्षेत्र में पकड़ने में पूरी तरह कामयाब नहीं रहा। लाहौर में जिस एचक्यू 9 एयर डिफेंस सिस्टम को हारोप ने नष्ट किया, वह चीन निर्मित है। इसे रूस की एस-400 के अनुरूप बनाया गया है।

वास्तव में एचक्यू 9 की हारोप को भांपने की विफलता केवल

एस 400 मिसाइल प्रणाली ● फाइल फोटो

स्वदेशी आकाश।

पाकिस्तान के लिए ही चिंता की बात नहीं, बल्कि यह चीन की भी बेचैनी बढ़ाएगी। वैसे भारत के एयर डिफेंस सिस्टम एस-400 पर दुनिया की भी निगाहें हैं, क्योंकि इसकी मजबूती और रणनीतिक फीचर को लेकर सबकी उत्सुकता है। इसके साथ ही अमेरिका समेत कई प्रमुख देशों की निगाहें पाकिस्तान द्वारा इस्तेमाल किए जा रहे चीन निर्मित हथियारों और एयर डिफेंस सिस्टम की सामरिक क्षमता परखने को लेकर है। पाकिस्तानी एयर डिफेंस को भेदने में हारोप की कामयाबी का अंदाजा इसी बात से लगाया जा सकता है कि लाहौर के अलावा यह सियालकोट, गुजरांवाला, रावलपिंडी, चकवाल, बहावलपुर, मियांवाली, कराची, चोर, मियानो और अटक में अपने लक्ष्य के करीब तक पहुंच गया। रावलपिंडी में क्रिकेट स्टेडियम तक पहुंच जाने के बाद पाकिस्तान

**पाकिस्तान की जवाबी हमले की कोशिशों को एस-400 और स्वदेशी रडार सिस्टम ने पूरी तरह नाकाम कर दिया**

ने हारोप को निष्क्रिय किया। खास बात यह है कि पाकिस्तानी सेना का मुख्यालय रावलपिंडी में है। इसलिए हारोप का वहां पहुंचना पाकिस्तान को झकझोर देगा इसमें संदेह नहीं।

भारत ने गुरुवार को 30 ड्रोन हमले किए, जिसकी पुष्टि पाकिस्तानी सेना के डीजी आइएसपीआर ने की। कहा कि इनमें से 29 को लक्ष्य से पहले ही निष्क्रिय कर दिया गया। लाहौर के एयर डिफेंस को हारोप ने निशाना बनाया। एयर डिफेंस एस-400 एक लंबी दूरी की सरफेस टू एयर मिसाइल जैसा सिस्टम है। यह खुद सतह से मिसाइल फायर करके दुश्मन के राकेट-मिसाइल को हवा में ही मार गिराता है। हारोप ड्रोन भारत ने इजरायल से खरीदा है, जो दुश्मन की हवाई सुरक्षा और अन्य महत्वपूर्ण लक्ष्यों को निशाना बनाने की क्षमता के लिए विख्यात है। यूएवी के जरिये इससे मिसाइल जैसे हमले किए जा सकते हैं।

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# Decade of planning, political resolve gave India combat edge against Pak

***Source: The Tribune, Dt. 10 May 2025***

Since the first leg of Operation Sindoor launched by the military in the aftermath of the April 22 Pahalgam terror attack, India has thwarted all Pakistani attempts to breach national sovereignty. The swift Indian response establishes the strength of national air defence systems assiduously built over the past decade under Prime Minister Narendra Modi-led government's national security policy. On the other side, the Indian military's response has exposed the chinks in Pakistani air defence mechanisms.

Top official sources point to a concerted effort over 11 years to acquire cutting-edge weapon systems and point to the Integrated Counter-Unmanned Aerial System (UAS) Grid, S-400 Triumf systems, Barak-8 missiles, **Akash** surface-to-air missiles and the DRDO's anti-drone technologies as the "aerial shield over Indian skies that held firm in the face of enemy hostility".

"With its initial response, which is ongoing, India has shown it is not just defending its skies but controlling them," said a government source mentioning Operation Sindoor's ability to hit deep into the Pakistani territory and destroy a Chinese-supplied HQ-9 air defence unit in Lahore, damaging key radar infrastructure in Pakistan's second-largest city.

Senior ruling BJP leaders say graded and focused acquisitions in spite of consistent Congress-led Opposition's offensive against the critical Rafale jet deal held India in good stead since Pakistan's April 22 provocation in Pahalgam. India resisted US sanction threats to seal the Rs 35,000-crore deal with Russia for five S-400 Triumf squadrons in 2018. Three of these squadrons are now operational along the borders with China and Pakistan, securing India.

The deployment of **Barak-8** medium-range surface-to-air missiles (MR-SAM), a $2.5 billion deal signed in 2017 with Israel, continues to guard the frontline bases like Bathinda. Developed by India's Defence Research and Development Organisation and Israel Aerospace Industries, the state-of-the-art surface-to-air missile system can engage a range of aerial threats in one of India's most sensitive regions.

Indigenous high-end military technologies used in the response against Pakistan include the DRDO-developed Akash missile system with 96 per cent domestic content, counter-drone technology and Man Portable Counter Drone Systems (MPCDS) to jam and disable hostile UAVs. On the modern warfare front, Operation Sindoor saw the combat debut of loitering munitions, suicidal drones ordered under emergency procurement in 2021 and jointly developed by India and Israel. "These drones executed simultaneous, precision strikes across sectors, taking Pakistan's defences by complete surprise," said official sources.

They added that Israeli-origin Harop drones, now locally built, were also deployed to target and destroy air defence assets in Karachi and Lahore. "These platforms, combined with the strategic deployment of Rafale fighter jets equipped with SCALP and HAMMER missiles, demonstrated India's capability to project power with surgical precision," a government note said of the Indian strong tech-driven air defence shield capable of detecting, jamming and eliminating threats before they breach.

"Operation Sindoor gives a clear message of Indian dominance of the land and skies in this combat. This military operation mirrors our rise as a self-reliant defence power capable of producing high-end military technologies at home and a rising global power conscious of its responsibilities to bolster the national defence paradigm, notwithstanding internal and external opposition and threats," said a senior government source.

https://www.tribuneindia.com/news/india/decade-of-planning-political-resolve-gave-india-combat-edge-against-pak/

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# असीमित है 'आकाश' की क्षमता, पाक के 'नापाक' मंसूबो को किया नाकाम

***Source: Punjab Kesari, Dt. 10 May 2025***

**नई दिल्ली,** (पंजाब केसरी): 22 अप्रैल को जम्मू-कश्मीर के पहलगाम में हुए आतंकी हमले के खिलाफ पाकिस्तान में चलाए गए भारत के ऑपरेशन सिंदूर से बौखलाए पाकिस्तान ने गुरुवार की रात भारत के सैन्य ठिकानों को निशाना बनाने की कोशिश की, लेकिन भारतीय सेनाओं ने उनके नापाक मंसूबों को नाकाम कर दिया। इस दौरान देश में ही तैयार 'आकाश' सतह से हवा में मार करने वाली मिसाइल वायु रक्षा प्रणाली ने पाकिस्तानी ड्रोन हमलों को नाकाम करने में अहम भूमिका निभाई। 8 मई और 9 मई की दरम्यानी रात भारतीय सेना ने पश्चिमी सीमा और जम्मू-कश्मीर में नियंत्रण रेखा (एलओसी) पर पाकिस्तान की ओर से किए गए कई ड्रोन हमलों को सफलतापूर्वक नाकाम किया

और उनका माकूल जवाब दिया। सेना के अधिकारियों का कहना है कि पाकिस्तान सीमा पर मिसाइल प्रणाली तैनात की गई है। उन्होंने कहा कि देश में आकाश सतह से हवा में मार करने वाली मिसाइल वायु रक्षा प्रणाली का भारतीय सशस्त्र बलों द्वारा भारतीय लक्ष्यों पर पाकिस्तानी हमलों को विफल करने में प्रभावी ढंग से उपयोग किया गया है।

## देश को हवाई खतरों से बचाने वाला स्वदेशी हथियार है 'आकाश'

देश को हवाई खतरों से बचाने वाला भारत का स्वदेशी हथियार 'आकाश' को रक्षा अनुसंधान एवं विकास संगठन (डीआरडीओ) ने तैयार किया है। डीआरडीओ की ओर से विकसित 'आकाश' एक मध्यम दूरी की सतह से हवा में मार करने वाली मिसाइल रक्षा प्रणाली है। इसे डीआरडीओ और भारत डायनेमिक्स लिमिटेड की ओर से निर्मित मिसाइलों द्वारा विकसित किया गया है।

## 18,000 मीटर की ऊंचाई पर भी साध सकता है निशाना

'आकाश' बैटरी मिसाइल प्रणाली 18,000 मीटर की ऊंचाई पर 45 किलोमीटर दूर तक के विमानों को निशाना बना सकती है। इसमें लड़ाकू जेट, क्रूज मिसाइल और हवा से सतह पर मार करने वाली मिसाइलों के साथ-साथ बैलिस्टिक मिसाइलों जैसे हवाई लक्ष्यों को बेअसर करने की क्षमता है।

## एक बैटरी 64 लक्ष्यों को ट्रैक, 12 पर कर सकती है हमला

'आकाश' में एक राजेंद्र 3डी पैसिव इलेक्ट्रॉनिकली स्कैन्ड ऐरे रडार और चार लॉन्चर होते हैं। इनमें से प्रत्येक में तीन मिसाइलें होती हैं। यह सभी आपस में जुड़ी होती हैं। प्रत्येक बैटरी 64 लक्ष्यों को ट्रैक कर सकती है और उनमें से 12 पर हमला कर सकती है।


## कहीं भी जा सकता है आकाश

'आकाश' की सबसे बड़ी खासियत यह भी है कि यह कहीं भी ले जाया जा सकता है। इसे एलओसी या अन्य सीमा पर ट्रक या टैंक जैसे वाहनों के जरिए लेकर जाया जा सकता है। इसका एडवांस वर्जन आकाश-एनजी 70 से 80 किमी तक मार कर सकता है। इसकी रफ्तार लगभग 2,500 किमी/घंटा है। यह 150 किमी दूर तक 64 लक्ष्यों को देख सकता है। यह एक साथ 12 मिसाइलों को दाग सकता है। मिसाइल में स्मार्ट गाइडेंस सिस्टम है, जिससे आखिरी पल में भी लक्ष्य को लॉक करने में मदद मिलती है।

## आकाश की खासियत

**वॉर हेड:** 60 किलोग्राम प्री-फ्रैगमेंटेड हाई एक्सप्लोसिव वॉर हेड

**ऑपरेशनल रेंज:** 45 किमी

**अधिकतम गति:** मैक 2.5

**गाइडेंस सिस्टम मिड कोर्स:** डेटालिंक के साथ कमांड मार्गदर्शन

**टर्मिनल:** सक्रिय रडार होमिंग

**लॉन्च प्लेटफॉर्म:** टी-72 या बीएमपी-2 चेसिस या हैवी मोबिलिटी ट्रक

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# Operation Sindoor Was Justice Served, BrahMos Marks India's Defence Power: Rajnath Singh

***Source: Business World, Dt. 11 May 2025***

Union Defence Minister Rajnath Singh on Sunday hailed the Indian Army's response to cross-border terrorism through Operation Sindoor, stating that the mission served justice to anti-India forces that had "wiped the sindoor from the foreheads of many families."

Virtually addressing the inauguration of the BrahMos Integration and Testing Facility, developed by DRDO at the Uttar Pradesh Defence Industrial Corridor in Lucknow, Singh declared, "Those who attacked Bharat Mata's forehead and caused unimaginable pain have been answered through Operation Sindoor. The entire nation salutes our armed forces for this act of justice."


Highlighting the reach and impact of India's response, Singh added, "We did not limit our action to border military posts; the roar of the Indian forces reached all the way to Rawalpindi, where the headquarters of the Pakistani army is located." He underlined the significance of the event by linking it with National Technology Day, recalling the 1998 Pokhran nuclear tests led by former Prime Minister Atal Bihari Vajpayee.

"That day was a testament to the tireless efforts of our scientists, engineers, and defence personnel. Today is about acknowledging their contribution and celebrating our technological strength," Singh said.

Describing BrahMos as more than just a weapon, the Defence Minister remarked, "It is a message—of the might of our armed forces, of our deterrence capability, and of our unwavering commitment to border security." Singh added that the missile represents the peak of India-Russia defence collaboration, likening Lucknow's emerging defence hub to the spiritual confluence at Prayagraj.

The newly inaugurated facility is India's largest BrahMos integration and testing centre and is poised to generate direct and indirect employment, acting as a "growth pole" in the region. Singh expressed confidence that Uttar Pradesh would soon be counted among the world's top defence manufacturing and export destinations.

He also spotlighted the growing synergy between public and private players in the UP Defence Corridor, with major investments in aircraft, UAVs, drones, ammunition, textiles, and more.

"It is heartening to see active private sector participation," he said, noting PTC Industries Limited's titanium and super-alloy plant initiative in Lucknow, along with the foundation of seven critical projects."This is not just Uttar Pradesh's pride, but the nation's. This BrahMos facility will significantly bolster India's journey towards self-reliance in defence," Singh concluded, extending heartfelt congratulations to DRDO, scientists, engineers, and all stakeholders involved in the project.

https://www.businessworld.in/article/operation-sindoor-was-justice-served-brahmos-marks-indias-defence-power-rajnath-singh-556368

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# Amid India-Pakistan tensions, Akash missile passes its 'agni-pariksha'

***Source: The Economic Times, Dt. 13 May 2025***

With the four-day India-Pakistan conflict drawing to a close, one standout performer has captured national attention- Akash, India's homegrown missile defence system, which proved its battlefield strength when it mattered the most. It took 15 years, over a thousand scientists, and a unified effort by defence labs across the country to bring that bold dream to life. But on the night of May 8 and 9, that dream soared with Akash successfully intercepting waves of incoming drones and missiles along the western border with Pakistan, proving itself in the crucible of real battle.

"It was like watching my child take its first steps—only this child stopped enemy fire," said Prahlada Ramarao, the man who once led the Akash project under the guidance of Dr APJ Abdul Kalam, India's beloved Missile Man. "This is the happiest day of my life. It means more than my Padma Shri," TOI quoted Ramarao as saying.

**Ramarao's 'Akash' journey**

From being handpicked by Kalam at the age of 35 to leading the ambitious programme in the 1990s, to finally witnessing Akash's 'agni-pariksha', Ramarao's journey mirrors the missile's own path- relentless, resilient, and deeply rooted in Indian innovation.

Conceived in 1994 with a budget of Rs 300 crore, the Akash project faced numerous failures, but never faltered. "We failed. A lot. But every failure was a step forward," Ramarao said, recalling the painstaking development of the Rajendra radar, a critical component that enables Akash to track and engage multiple targets in real time from any direction.Today, Akash stands tall as a key pillar of India's Atmanirbhar Bharat vision- delivering unmatched performance at an unmatched cost.

"Nowhere in the world has a missile defence system been developed for just Rs 500 crore," Ramarao told TOI. "And yet, it can detect a missile 70 km away and destroy it at 30 km," he added. Akash's battlefield debut was hailed by top military brass. IAF DGMO Air Marshal AK Bharti declared that India's defence systems, including Akash and S-400 Triumf, "stood like a wall," blocking enemy incursions and proving India's readiness.

Originally inducted in 2009, Akash has evolved into a family of systems:

- Akash-1S with an indigenous seeker
- Akash Prime for high-altitude, low-temperature ops
- The Akash-NG, boasting greater range and upgraded capabilities

The IAF currently operates 15 squadrons, while the Army commands four regiments, with more on the way. India's missile mastery has also found admirers abroad. In 2022, Armenia became the first foreign buyer, inking a Rs 6,000 crore deal for 15 Akash systems. The first batch was delivered last year, further boosting India's credentials as a global defence exporter. And while Akash may now guard skies around the world, for the man who helped bring it to life, it remains personal.

https://economictimes.indiatimes.com/news/defence/amid-india-pakistan-tensions-akash-missile-passes-its-agni-pariksha/articleshow/121135559.cms

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# 'Chosen by 'Missile Man' APJ Abdul Kalam': Who is Prahlada Ramarao, man behind India's homegrown Akash Missile Defence System

***Source: The Times of India, Dt. 14 May 2025***

Long before the Akash missile defence system etched its name into India's military history, Prahlada Ramarao had already built his legacy. Personally chosen by India's 'Missile Man' Dr APJ Abdul Kalam in the early 1990s, Ramarao was appointed as the youngest project director at just 35 to lead the Akash programme. At the time, Kalam was heading the Defence Research Laboratory (DRL) in Hyderabad — much before he became the scientific adviser to the defence minister and later the President of India.

"Kalam was a true leader. A leader brings team spirit and inspires all to work towards a common goal. The country now requires 10 Abdul Kalams to grow and develop in various fields like the way the aerospace and defence sectors grew under him," Ramarao said. Reflecting further on Kalam's leadership, he added, "The biggest difficulty for India is that we are individually good, but cannot work together as a team. Kalam was very good at addressing this.He taught me how to bring the energy of individuals synergistically to achieve a purpose. That is why I feel, if we have 10 Kalams, India will truly lead," he told PTI.

Now 78 and a Padma Shri recipient, Ramarao was overwhelmed with pride when Akash proved its worth under fire, successfully intercepting waves of Pakistani drones and missiles during the night of May 8 and 9 along the western border. "My eyes welled up when my baby worked so well. It is the happiest day of my life. This is bigger than my Padma award," he told TOI.

**The Akash Project**

The Akash project, which spanned 15 years, involved over a thousand scientists and numerous DRDO labs across the country under Ramarao's leadership. The indigenous missile shieldwas launched in 1994 with an initial budget of Rs 300

crore. "When you invent something, you fail several times. We also failed. But we learnt from our mistakes," he said, highlighting that the biggest hurdle was developing Rajendra — a complex multifunction electronically scanned phased array radar. The budget was later revised to Rs 500 crore. "I guarantee you, nowhere in the world a missile defence system could have been invented in just Rs 500 crore. Our Akash is the cheapest but most effective missile shield. It can detect a hostile missile from a distance of 70km and kill it at a 30km range," Ramarao added.

Despite undergoing several trials and eventual user acceptance, the May 8-9 incident marked Akash's first real-world combat test. Indian defence officials hailed the performance of Akash and other systems like S-400 Triumf. IAF DGMO Air Marshal AK Bharti stated, "India's defence systems stood like a wall," successfully neutralising the attack. Akash's capabilities have evolved significantly since its development in 2009, resulting in newer variants such as Akash-1S with an indigenous seeker, Akash Prime for high-altitude and extreme weather use, and Akash-NG with extended range and advanced features.

The IAF currently operates 15 squadrons, while the Army has inducted four regiments and is looking to expand further. The missile system's efficiency even impressed Armenia, which became the first foreign buyer in 2022, signing a Rs 6,000 crore deal. The first batch was delivered last year to secure Armenia's borders. From being mentored by Kalam to seeing Akash perform flawlessly in actual combat, Ramarao's journey is a testament to perseverance, innovation, and the power of indigenous development.

https://timesofindia.indiatimes.com/city/bengaluru/chosen-by-missile-man-apj-abdul-kalam-who-is-prahlada-ramarao-man-behind-indias-homegrown-akash-missile-defence-system/articleshow/121150216.cms

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# Operation SINDOOR: The Rise of Aatmanirbhar Innovation in National Security

***Source: Press Information Bureau, Dt. 15 May 2025***

Operation SINDOOR emerged as a calibrated military response to an evolving pattern of asymmetric warfare, one that increasingly targets unarmed civilians along with military personnel. The terrorist attack on tourists in Pahalgam in April 2025 served as grim reminder of this shift. India's response was deliberate, precise, and strategic. Without crossing the Line of Control or international boundary, Indian forces struck terrorist infrastructure and eliminated multiple threats.

However, beyond tactical brilliance, what stood out was the seamless integration of indigenous hi-tech systems into national defence. Whether in drone warfare, layered air defence, or electronic warfare, Operation SINDOOR marks a milestone in India's journey towards technological self-reliance in military operations.

**Air Defence Capabilities: Tech as the First Line of Protection**

On the night of 07-08 May 2025, Pakistan attempted to engage a number of military targets in Northern and Western India including Awantipura, Srinagar, Jammu, Pathankot, Amritsar, Kapurthala, Jalandhar, Ludhiana, Adampur, Bhatinda, Chandigarh, Nal, Phalodi, Uttarlai, and Bhuj, using drones and missiles. These were neutralised by the Integrated Counter UAS (Unmanned Aerial Systems) Grid and Air Defence systems.

Air Defence systems detect, track, and neutralise threats using a network of radars, control centres, artillery, and both aircraft- and ground-based missiles. On the morning of May 8, the Indian Armed Forces targeted Air Defence Radars and systems at a number of locations in Pakistan. An Air Defence system at Lahore was neutralised.

**Performance Of Systems**

As part of Operation SINDOOR, the following were used:

- Battle-proven AD (Air Defence) systems like the Pechora, OSA-AK and LLAD guns (Low-level air defence guns).
- Indigenous systems such as the Akash, which demonstrated stellar performance

AKASH is a Short Range Surface to Air Missile system to protect vulnerable areas and vulnerable points from air attacks. The AKASH Weapon System can simultaneously engage Multiple Targets in Group Mode or Autonomous Mode. It has built in Electronic Counter-Counter Measures (ECCM) features. The entire weapon system has been configured on mobile platforms.

India's Air Defence Systems, combining assets from the Army, Navy, and primarily the Air Force, performed with exceptional synergy. These systems created an impenetrable wall, foiling multiple attempts by Pakistan to retaliate. The Integrated Air Command and Control System (IACCS) of the Indian Air Force brought all these elements together, providing the net-centric operational capability vital for modern warfare.

**Offensive Actions with Pinpoint Accuracy**

India's offensive strikes targeted key Pakistani airbases- Noor Khan and Rahimyar Khan with surgical precision. Loitering munitions were used to devastating effect, each finding and destroying high-value targets, including enemy radar and missile systems. Loitering munitions also known as "suicide drones" or "kamikaze drones", are weapons systems that can hover or circle a target area, searching for a suitable target before attacking. All strikes were executed without loss of Indian assets, underscoring the effectiveness of our surveillance, planning, and delivery systems.

The use of modern indigenous technology, from long-range drones to guided munitions, made these strikes highly effective and politically calibrated. Indian Air Force bypassed and jammed Pakistan's Chinese-supplied air defence systems, completing the mission in just 23 minutes, demonstrating India's technological edge.

**Evidence of Neutralized Threats**

Operation SINDOOR also produced concrete evidence of hostile technologies neutralized by Indian systems:

- Pieces of PL-15 missiles (of Chinese origin)
- Turkish-origin UAVs, named "Yiha" or "YEEHAW"
- Long-range rockets, quadcopters and commercial drones

These were recovered and identified, showing that despite Pakistan's attempts to exploit advanced foreign-supplied weaponry, India's indigenous air defence and electronic warfare networks remained superior.

**Performance of Systems: Air Defence Measures of the Indian Army**

On May 12, Lt Gen Rajiv Ghai, Director General Military Operations, in the Operation SINDOOR press briefing highlighted the excellent performance of a mix of legacy and modern systems:

**Preparedness and Coordination:**

Since precise strikes on terrorists were conducted without crossing the Line of Control or International Boundary, it was anticipated Pakistan's response would come from across the border.

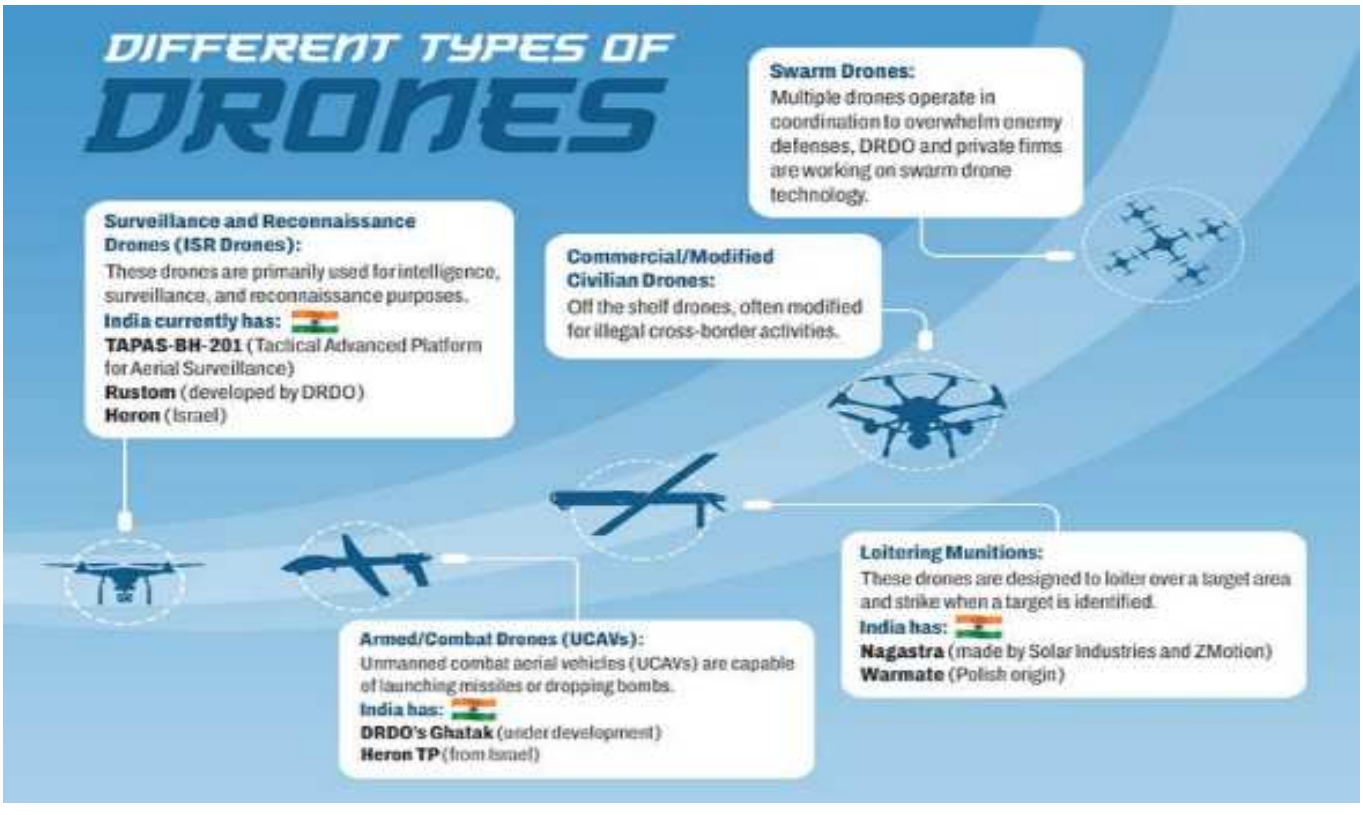
- A unique blend of Counter Unmanned Aerial Systems, Electronic Warfare assets, and Air Defence Weapons from both Army and Air Force
- Multiple defensive layers from the International Boundary inward:

a) Counter Unmanned Aerial Systems

b) Shoulder-Fired Weapons

c) Legacy Air Defence Weapons

d) Modern Air Defence Weapon Systems




This multi-tier defence prevented Pakistan Air Force attacks on our airfields and logistic installations during the night of May 9-10. These systems, built over the last decade with continuous government investment, proved to be force multipliers during the operation. They played a crucial role in ensuring that both civilian and military infrastructure across India remained largely unaffected during enemy retaliation attempts.

ISRO's contribution: At an event on May 11, ISRO Chairman V Narayanan mentioned that At least 10 satellites are continuously working round-the-clock for the strategic purpose to ensure the safety and security of the citizens of the country. To ensure the safety of the country, the nation has to serve through its satellites. It has to monitor its 7,000 km seashore areas. It has to monitor the entire Northern part continuously. Without satellite and drone technology, the country can't achieve that.

**The Business of Drone Power: A Rising Indigenous Industry**

The Drone Federation India (DFI), is a premier industry body representing over 550 drone companies and 5500 drone pilots. DFI's vision is to make India a global drone hub by 2030, and it promotes the design, development, manufacturing, adoption and export of Indian drone and counter-drone technology worldwide. DFI enables ease of doing business, promotes the adoption of drone technology, and hosts several programs like Bharat Drone Mahotsav.Some companies involved in the drone space are:

- Alpha Design Technologies (Bengaluru): Partnered with Israel's Elbit Systems to build SkyStriker.
- Tata Advanced Systems offers a full range of integrated solutions across Defence & Security and has served as a trusted partner to India's armed forces for over six decades.
- Paras Defence & Space Technologies operates within the Defence and Space segments, distinguished by Indigenously Designed Developed and Manufactured (IDDM) capabilities.
- IG Drones is a Drone Technology Company for manufacturing and R & D of Drones specialized in defence and other industry applications along with provider of drone related services like drone surveying, mapping & inspection by industry experts. The company has partnered with Indian Army, Government of India , multiple State Governments, among others..

The Indian drone market is projected to reach $11 billion by 2030, accounting for 12.2% of the global drone market.

**Drones at the Centre of Modern Warfare**

The integration of drone warfare into India's military doctrine owes its success to years of domestic R&D and policy reform. Since 2021, the ban on imported drones and the launch of the PLI (Production Linked Incentive) scheme have catalyzed rapid innovation. The scheme of Production Linked Incentive for drones and drone components of Ministry of Civil Aviation was notified on 30th September, 2021 with a total incentive of Rs 120 crores spread over three Financial Years (FYs), FY 2021-22 to FY 2023-24.

The future lies in autonomous drones with AI-driven decision-making, and India is already laying the groundwork. Defence exports crossed the record figure of about Rs 24,000 crore in Financial Year 2024-25. The aim is to increase the figure to Rs 50,000 crore by 2029, and make India a developed nation and the world's largest

defence exporter by 2047. Make in India continues to power the growth of the defence sector.

India has emerged as a major defence manufacturing hub, driven by the "Make in India" initiative and a strong push for self-reliance. In FY 2023–24, indigenous defence production reached a record ₹1.27 lakh crore, while exports soared to ₹23,622 crore in FY 2024–25, a 34-fold increase from 2013–14. Strategic reforms, private sector involvement, and robust R&D have led to the development of advanced military platforms like the Dhanush Artillery Gun System, Advanced Towed Artillery Gun System (ATAGS), Main Battle Tank (MBT) Arjun, Light Specialist Vehicles, High Mobility Vehicles, Light Combat Aircraft (LCA) Tejas, Advanced Light Helicopter (ALH), Light Utility Helicopter (LUH), Akash Missile System, Weapon Locating Radar, 3D Tactical Control Radar, and Software Defined Radio (SDR), as well as naval assets like destroyers, indigenous aircraft carriers, submarines, frigates, corvettes, fast patrol vessels, fast attack craft, and offshore patrol vessels.

The government has backed this growth with record procurement contracts, innovations under iDEX, drives like SRIJAN, and two Defence Industrial Corridors in Uttar Pradesh and Tamil Nadu. Key acquisitions such as LCH (Light Combat Helicopters) Prachand helicopters and the ATAGS (Approval for Advanced Towed Artillery Gun System) highlight the shift towards indigenous capability. With targets of ₹3 lakh crore in production and ₹50,000 crore in exports by 2029, India is firmly positioning itself as a self-reliant and globally competitive defence manufacturing power.

**Conclusion:**

Operation SINDOOR is not just a story of tactical success. It is a validation of India's defence indigenization policies. From air defence systems to drones, from counter-UAS capabilities to net-centric warfare platforms, indigenous technology has delivered when it mattered most.

The fusion of private-sector innovation, public-sector execution, and military vision has enabled India to not only defend its people and territory but also assert its role as a hi-tech military power in the 21st century. In future conflicts, the battlefield will increasingly be shaped by technology. And India, as shown in Operation SINDOOR, is ready, armed with its own innovations, backed by a determined state, and powered by the ingenuity of its people.

https://www.pib.gov.in/PressReleasePage.aspx?PRID=2128746

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# Sindoor, a made-in-India arms story

***Source: The Times of India, Dt. 15 May 2025***

As the dust settles after Operation Sindoor, directed against Pakistan and terror actors on its soil, what is becoming clear is the resounding success of India's nascent defence industry. It is believed India used BrahMos supersonic cruise missiles and other precision-strike weapons to inflict damage to terror bases and military installations deep inside Pakistan. Indian armed forces also deployed indigenous Akash air defence missiles and D4 anti-drone systems to repel wave after wave of Pakistani aerial strikes, letting very little pass through.

"During this operation, the credibility of our Made-in-India weapons was firmly established. The world now recognises that the time for Made-in-India defence equipment in 21st-century warfare has arrived," PM Narendra Modi said on May 12 in his address to the nation after Operation Sindoor's success. For the past several years, the govt has been pushing to maximise acquisition of defence equipment through indigenous sources and promote domestic manufacturing to reduce dependence on foreign-origin weapons as part of its flagship 'Atmanirbhar Bharat' programme. Parallelly, India's defence exports reached a record high of Rs 23,622 crore in 2024-25, a 12% surge over the previous year.

**The might of BrahMos**

BrahMos (the name represents two rivers: the Indian Brahmaputra and Moskva of Russia) flies at a speed of Mach 2.8, or almost three times the speed of sound, and is considered to be one of the world's fastest supersonic cruise missiles. It is produced by BrahMos Aerospace Pvt Ltd, a Delhi-based joint venture between Defence Research and Development Organisation (DRDO) and Russia's NPO Mashinostroyeniya or NPOM.

BrahMos can be launched from submarines, ships, aircraft, or land platforms. India has successfully tested all variants of BrahMos and inducted the missile system into its military years ago. In 2019, the range of this home-grown missile was enhanced up to 450km with a top official then saying, "India is now the only country in the world to integrate long-range missiles into fighter jets [Sukhoi 30]".India recently exported these missiles to the Philippines as part of a $375 million deal signed in 2022.

Efforts are also on to develop a hypersonic version of the missile, tentatively named BrahMos-II. According to the memorandum of understanding (MoU) between New Delhi and Moscow, BrahMos-II will be based on a hypersonic scramjet technology. The main purpose of such a weapon is to target deeply buried enemy nuclear bunkers and heavily protected locations; all three military services will utilise this weapon. Referring to the new BrahMos integration and testing facility that was inaugurated in Lucknow last week, former DRDO chief G Satheesh Reddy said it is capable of delivering 100-150 missiles annually. India has two more BrahMos production facilities — in Hyderabad and Thiruvananthapuram.

**The Akash Shield**

Developed by DRDO and manufactured by state-run Bharat Dynamics Ltd (BDL), Akash is a short-range surface-to-air missile (SAM). It is part of India's multi-layered air defence system, which played a decisive role in thwarting Pakistani aerial incursions into India recently. Akash is probably the first-of-its-kind system in the world that is capable of engaging four aerial targets simultaneously at a range of 25km. The new variant — Akash-NG — has an extended range of 70-80km.

The missile is equipped with electronic counter-countermeasure (ECCM) capabilities, enabling it to penetrate enemy jamming and other evasion tactics. The Akash system is designed for mobile platforms, making it highly agile and capable of rapid deployment anywhere. While some analysts have likened India's Akash with Israel's famous Iron Dome missile system, there are some fundamental distinctions between the two. First, Akash is a larger platform than the Israeli one.

Also, while the Iron Dome is a potent shield against short-range rockets and artillery shells, Akash is capable of intercepting missiles, combat drones as well as aircraft. India reportedly signed a deal with Armenia in 2022 to export 15 units of the Akash missile systems. Brazil and Egypt have also shown interest in this weapon.

**How D4 disabled enemy drones**

India resorted to both kinetic and non-kinetic (jamming) warfare to thwart Pakistani drone swarms. Reports suggest the DRDO-developed D-4 anti-drone system was used in the recent military operations. It can disable ordinary drones as well as unmanned combat aerial vehicles (UCAVs) employing electronic jamming and spoofing techniques. D4 (Drone-Detect, Deter and Destroy) also has a laser-based kill mechanism to destroy enemy drones. It's unclear if this hard-kill method was used in the recent conflict.

This system integrates radars, RF (radio frequency) sensors, and EO/IR (electro-optical/infrared) cameras, thereby offering a multi-sensor and 360-degree approach to detect incoming drones. Multiple DRDO labs, including the Electronics & Radar Development Establishment (LRDE), Bengaluru; Defence Electronics Research Laboratory (DLRL), and the Centre for High Energy Systems and Sciences (CHESS), both in Hyderabad; and Instruments Research and Development Establishment (IRDE), Dehradun, contributed towards developing this system.

**Indo-Israeli collaborations**

Weapons jointly developed with Israel such as Barak-8 missiles and SkyStriker kamikaze drones also contributed significantly to India's defensive and offensive actions during Operation Sindoor. Barak-8 is a medium range surface-to-air missile (MRSAM) jointly developed by DRDO and Israel Aerospace Industries. India's military last month conducted successful tests of this air defence system.

The MRSAM includes mobile launchers that can be deployed on land or on navy vessels. The missile is capable of intercepting targets of up to 70km range.In India, it is produced by BDL, Kalyani Rafael Advanced Systems (KRAS) and Tata Advanced Systems (TASL). SkyStriker is a loitering munition jointly developed by

Israel's Elbit Systems and Adani Group's Alpha Design Technologies. Although a drone, SkyStriker can be used as a precision weapon. It hovers over the target area to identify and engage threats, operating either autonomously or under human supervision.

**Import dependence**

While India did demonstrate the effectiveness of its Made-in-India weapons, it still remains heavily dependent on arms imports. According to the Stockholm International Peace Research Institute (SIPRI), India is the second-largest arms buyer in the world, with an 8.3% share of global imports between 2020 and 2024.

Russia remains India's main weapons supplier, accounting for 36% of its arms imports. Russia's overall share, however, has been steadily declining (72% in 2010-14 and 55% in 2015-19) with India increasingly turning to countries like France, Israel and the US.

https://timesofindia.indiatimes.com/india/sindoor-a-made-in-india-arms-story/articleshow/121171309.cms

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# The ex-DRDO scientist who spent 34 years of his career building 'Akash' missile system

***Source: The Hindu, Dt. 17 May 2025***

It is no secret that Hyderabad is the base for key DRDO projects and many products developed here have played a stellar role in the recent confrontation with Pakistan during Operation Sindoor. One such was the short range surface-to-air missile 'Akash' that turned out to be the bulwark, along with other weapons systems, against the spree of drones and missiles fired from across the border during the tense period.

"Akash, which was indigenously built from scratch, was used in combat zone for the first time and has proved to be robust and effective. The automated missile system caught the other countries by surprise," exults former project director Gaddamanugu Chandramouli, who spent his entire 34 years of career in its development.

The missile, fired from mobile platforms, can neutralise a variety of targets simultaneously, including fighter jets, choppers, UAVs, subsonic cruise missiles, smart bombs with supersonic speed and automated air defence functions irrespective of the altitude or size, says the ex- DRDO's outstanding scientist.

Hailing from Madhira (Khammam, Telangana), Mr.Chandramouli, a mechanical engineering graduate from NIT Warangal and M. Tech. from IIT Delhi, was part of the maiden team of three members, when noted scientist Prahalad Rama Rao, was entrusted with making the Akash missile system by former President A.P. J. Abdul Kalam while heading the Integrated Guided Missile Development Programme.

"Kalam used to say 'first develop technology', the rest will follow. From design to ground based radar system, propulsion and weapon head, it was a 14-year work, throughout the week in the lab. We faced many failures at various stages. But to develop and supply at least something to our armed forces egged us on," explains Mr. Chandramouli. "Very few were ready to believe that we will come up with a potent missile that would become the mainstay for our country's defence system. There was cynicism all over. We were put up to scrutiny at every stage, yet we were calm, patient and persevering," he recalls.

As a core member of Project Akash in DRDL-DRDO, the scientist led many teams from various organisations contributing towards successful accomplishment of design, development, flight testing and user trials since inception in 1983 till superannuation in 2018. The first successful flight was in 1994 and final evaluation trials in 2006-07 before Akash was formally inducted both in the Indian Army (2015) and Indian Air Force (2015) under his leadership. Thus, India could become only the second country after Russia to have the capability to design, develop and produce solid ramjet propulsion based supersonic missiles.

"Kalam and other leaders created an ecosystem, where there were no egos, only goals. I learned many things from Kalam, Prahlada Rama Rao, R.R. Panyam,

G.N. Rao, Ajit Chaudhary and many others, helping me execute this mega project. There was team work, transparency, support and motivation among us to surmount hurdles," he avers.

After becoming the project director in 2011, Mr. Chandramouli streamlined production, delivery and induction of Akash into the armed forces, coordinating with 13 DRDO labs, nine defence production units and five ordnance factories to transfer complex technologies to local industries for production. The scientist is also getting ready with a book chronicling Project Akash.

https://www.thehindu.com/news/national/telangana/this-ex-drdo-scientist-spent-his-entire-career-building-akash-missile-system/article69583175.ece

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# Operation Sindoor was also a DRDO and Indian industry success story

***Source: The Week, Dt. 18 May 2025***

India watched in awe as drones were shot out of the night skies over many of its cities and photographic evidence of precision strikes across the length and breadth of Pakistan emerged. Many never believed we were capable of this modern-age warfare. We not only defended our airspace but also penetrated Pakistan's much touted air defence network, striking at the heart of its terror network and military installations with telling effect.

Operation Sindoor vindicates the need for and indeed the success of atmanirbharta in defence. It was one of the pillars of the Atmanirbhar Bharat initiative and naysayers have been firmly silenced. And BrahMos and Akash have become household terms.

BrahMos, developed and produced with Russian collaboration, has a range of 280km, within Missile Technology Control Regime limit of 300km. Its range could be extended to 400km, and to 800km, if required. BrahMos delivers a massive payload of up to 250kg of explosives with a circular error probability of 10 metres (if the BrahMos missile was fired multiple times, it would hit within 10 metre of the target in 80 per cent of the attempts). A precision strike would thus cause huge destruction.

It travels at Mach 3 (thrice the speed of sound), can be launched from land, sea or air and follows random trajectories (sometimes 2 to 5 metres above the earth or water surface) making it difficult to detect, much less intercept. The destruction seen on the runway at the Rahim Yar Khan airfield and the radar near Lahore was most likely caused by BrahMos strikes.

The Akash air defence system showcases atmanirbharta in defence in its truest sense. Its development is fully indigenous and components almost so. It has a range of 25km to 45km and intercepts targets 20km high. Its 60kg warheads explode with proximity fuses, fragmenting to assure destruction on reaching even the vicinity of the intended targets in the air. The sophisticated, DRDO-developed Rajendra radar system detects and tracks 64 targets and guides eight missiles simultaneously. The high kill rate that was on display during the days of hostilities proves Akash's efficacy in battle against drones and aircraft.

Nagastra-1 is the newest inductee into the atmanirbharta hall of fame. These loitering munitions or kamikaze drones hover over targets and attack at the opportune moment. Nagastra, made by Nagpur-headquartered Solar Industries, is 80 per cent indigenous. It can be equipped with cameras, has a range of 30km and a payload capacity of up to 1.5kg (Israeli made SkyStrikers have a range of 2km and 5kg payload capacity). The Nagastra has a recovery mechanism, including a parachute system, in case a target is not detected or a mission is aborted.

The atmanirbharta policy boosted self-reliance, but not 100 per cent self sufficiency, yet, as is evident from the minor levels of imported content. India will achieve niche capabilities such as advanced chips in due course, but cannot be held back from the development of advanced weapon systems for want of these. India's expenditure on defence imports has dropped from 46 per cent of overall procurement to 36 per cent in recent years. It is set to drop drastically in the next five years.

Meanwhile, defence exports have grown steadily. By 2023, exports hit $1.9 billion, a 240 per cent rise compared with 2019. It then grew to $2.54 billion by end of FY24. India has set a defence production target of $25 billion, with exports up to $5 billion in 2025 with the aim to raise it to $6.02 billion by 2028-29. We may now surpass it if we play to our strengths. In the wake of the recent hostilities, these proven weapons systems are likely to be sought by friendly foreign countries.

Atmanibharta in defence is here to stay. Its pace will now receive a boost. Incentives to local developers and manufacturers, particularly MSMEs, is the way forward for the government. Industry players, who till now felt that minimum order quantities by the Indian armed forces was the only way to manage their bottom lines, can capitalise on the battle worthiness that was on show to improve export figures.

The DRDO for its part needs to focus on fundamental research and speedily off-load its technologies to private industry players. Operation Sindoor was as much a DRDO and Indian industry success as it was a military success.

https://www.theweek.in/theweek/cover/2025/05/17/operation-sindoor-was-also-a-drdo-and-indian-industry-success-story.html

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# Indigenous weapons pipped Chinese systems in Operation Sindoor, says DRDO chief

***Source: The Times of India, Dt. 23 May 2025***

Operation Sindoor undoubtedly proved the superiority of India's indigenous weapons systems over those made in China, said chairman of Defence Research and Development Organisation (DRDO), Samir Kamat, here on Thursday." Pakistan deployed an array of systems procured from China. Our indigenous weapons easily outmatched the Chinese systems pitched by Pakistan," said Kamat.

However, he said some lessons were learnt from the conflict, and the country's premier defence research agency will look at improvements and induction of newer weapon systems. Not divulging specifics, he said some measures will be taken on an urgent basis. At the same time, he stressed the country's air defence system has proven to be highly effective.

Kamat was in the city to tour the defence manufacturing establishments located here, including Solar Defence and Aerospace Limited (SDAL), a private sector ammunition maker, apart from DRDO's own chemical warfare unit and a facility of Brahmos Aerospace Private Limited (BAPL). The Nagastra-1 loitering munition made by Solar was reportedly used in Operation Sindoor. Even the propulsion system of BrahMos missiles that pounded Pakistan came from the company.

Talking to TOI, Kamat said the purpose of the visit was to check facilities here, and coming to Nagpur was very fruitful. "It's important to have a robust private sector that's involved in both manufacturing and R&D to sustain long-drawn conflicts," he said.

Kamat said a variety of systems can be put in place to counter drone attacks. He also mentioned that a range of sensors that can be used to detect and neutralise drones are expected to be inducted over the next six months or a year. Kamat also stressed upon the need to coordinate between stakeholders in the defence sector, including the PSU and private manufacturers.

On indigenisation of conventional systems, he said the country is swiftly moving towards it. For example, in artillery, Advanced Towed Artillery Gun System (ATAGS) and Dhanush guns have been developed. There may be some subsystems that have to be imported, but the dependence on foreign sources has reduced, he said. On upcoming systems, he said DRDO includes VSHORADS, man-portable air defence systems, man-portable anti-tank guided missiles (MPTAGM), vertically launched short-range surface-to-air missiles (VLSRSAM), heavyweight and advanced lightweight torpedoes.

https://timesofindia.indiatimes.com/city/nagpur/indigenous-weapons-pipped-chinese-systems-in-operation-sindoor-says-drdo-chief/articleshow/121347631.cms

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# AI in the battlefield: How India leveraged new age warfare to thwart Pakistan's aerial attacks

***Source: The Indian Express, Dt. 16 May 2025***

In the four-day military conflict between India and Pakistan, which began on the intervening night of May 6 and May 7, defence sources said that New Delhi managed to hit multiple military installations in the neighbouring country and thwarted a barrage of attacks from them due to a successful integration of the country's "space know how", "electronics" and "computing expertise using artificial intelligence (AI)".

Sources said that India having its indigenous navigation systems, air defense ability to intercept enemy objects through both hard and soft kill techniques and its deeper and precise penetration ability to strike strategic locations in Pakistan demonstrated the country's growing capabilities to use technological advances as a strategic advantage. AI for situational awarenessThe Indian armed forces used AI cloud-based integrated air command and control systems to detect and position any hostile objects in the sky.

"From detecting a radar picture of an enemy object in the sky, or taking a strategic position to shoot it down from land, sea and air was demonstrated using AI cloud-based state of the art integrated air command and control systems," a defence source said.

Many of the country's integrated technology capabilities were deployed towards creating an impenetrable shield against incoming aerial threats from Pakistan during the military conflict of the past week. The use of these technologies found its roots more than half a decade ago, when the armed forces began the thought work to utilise AI in their defensive and offensive capabilities.

**AI roadmap**

In 2018, the Ministry of Defence (MoD) had set up a multi-stakeholder task force to study issues around the strategic implications of AI from a national security perspective. Based on the recommendations of this task force, the MoD created the Defence AI Council (DAIC) and Defence AI Project Agency (DAIPA) for providing necessary guidance to enable the development of an operating framework, policy level changes and structural support for AI adoption in the armed forces.

In 2022, the government also finalised a roadmap for defence public sector companies under which 70 defence specific AI projects were finalised, of which 40 had been completed. Until 2026, a total of 129 AI-based projects have been greenlit in the defence sector of which 77 have been completed. As of 2022, Rs 100 crore was allocated by each defence service for AI implementation.

Bharat Electronics Limited, for instance, has developed an AI-based system for enemy aircraft activity recognition and classification which enables the armed forces to automatically recognise and identify enemy aircraft's plans, leading to improved situational awareness.

This solution is likely to be available in India's Integrated Air Command and Control System (IACCS). The PSU has also developed the Indian Air Force's IACCS that integrates data from all air defence assets to give the armed forces comprehensive situational awareness during air operations, allowing them to respond to a wide range of aerial threats.

The Indian Army has developed an AI-Based Intercept Management System (IMS) to analyse and automate intercepts of an adversary in Western Theatre. The software makes use of visualisation techniques and AI to interpret op-critical data, generating an accurate intelligence picture. The IMS can carry out automated analysis and interpretation using AI, and categorise and visualise intercepts using data science tools.

The **Centre for Artificial Intelligence & Robotics (CAIR)** under the Defence Research & Development Organisation (DRDO) has also developed a Air Defence Control and Reporting System (ADC & RS), which is used to detect all aerial targets and neutralise the threat well away from vulnerable areas by effective integration of all air defence weapon systems.

https://indianexpress.com/article/business/ai-india-pakistan-conflict-aerial-attacks-10009639/

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# DRDO expects international demand for 'Akashteer' air defence system after Op Sindoor success

***Source: Hindustan Times, Dt. 23 May 2025***

India's top defence scientist is confident that the success of the indigenously-developed 'Akashteer' air defence system during Operation Sindoor will draw interest from other countries. 'Akashteer', the fully automated air defence control and reporting system, emerged as the invisible force of new war capabilities during Operation Sindoor, launched against nine terror sites in Pakistan and Pakistan-occupied Kashmir.

"Definitely, our air defence system has performed exceedingly well, and I am sure there will be interest from other countries," Defence Research and Development Organisation (DRDO) chief Samir V Kamat told PTI on Thursday evening.

*The Ministry of Defence hailed Akashteer as a breakthrough, saying it "sees, decides, and strikes faster than anything the world has fielded*

The DRDO chairman spoke about India's march for 'Atmanirbhar' (self-reliance) in the defence sector, saying that while substantial advancements have been made, more work is necessary to become completely self-reliant. "I think we have achieved a very significant level, but we still have some work to do. And I am sure in the coming years, we will become totally Atmanirbhar," he said.

Kamat expressed optimism regarding the future of India's defence technology during a visit to Nagpur, where he toured facilities focused on manufacturing drones, missiles, and rockets. The 'Akashteer' system enables detection, tracking,

and engagement of enemy aircraft, drones, and missiles by integrating various radar systems, sensors, and communication technologies into a single, mobile, vehicle-based framework, making it easier to handle in hostile environments.

Replying to a question whether conventional weapons will take a back seat in future conflicts as warfare shifts to domains where drones and signal jamming take centre stage, Kamat said future warfare will blend traditional equipment with emerging technologies, such as drones and electronic warfare. "Future warfare will be a combination of the traditional equipment as well as these new things...We have to be prepared for both," he said.

Kamat ruled out the potential for robots to play the role of soldiers on the battlefield in future conflicts and said, "There will be a day when that may happen, but not in the near future." To a question about the progress in the development of indigenous 5.5 generation stealth fighter aircraft – Advanced Medium Combat Aircraft (AMCA), Kamat said, "Our project for developing AMCA started last year, and we are hopeful that it will be completed by 2034 and then it should go into induction by 2035."

A full-scale model of the AMCA was unveiled at Aero India 2025 held in Bengaluru in February. The Aeronautical Development Agency (ADA), a division of DRDO, is actively working on cutting-edge technologies, including AI-powered pilots, net-centric warfare systems, integrated vehicle health management, and internal weapon bays.

https://www.hindustantimes.com/india-news/drdo-expects-international-demand-for-akashteer-air-defence-system-after-op-sindoor-success-101747992940455.html

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# Need to go full throttle on indigenous defence systems: DRDO ex-chief Satheesh Reddy

***Source: The Hindu, Dt. 26 May 2025***

India has shown complete dominance during Operation Sindoor, showcasing its air power and air defence capability, said G. Satheesh Reddy, former Secretary, Research and Development, and Chairman, Defence Research and Development Organisation (DRDO), while expressing happiness that the majority of them are indigenous systems. He cautioned that technology is changing very fast, and the process of induction should not be so long that the technology gets outdated by the time it is inducted.

"I want to say that this war brought many positive things to India. First, many indigenous systems have been used very effectively, so the confidence of the armed forces in the indigenous equipment has reached all-time highs. I believe this will lead to more vigorous and efficient induction of indigenous systems.

The morale of the scientists community today is very high, and this paves the way for the development of many more advanced systems. Industry is now more confident of getting production orders for indigenous systems, and they should hence gear up and be ready to absorb bulk orders," Dr. Reddy, currently President of the Aeronautical Society of India, said in a conversation with The Hindu.

"The international community has seen what India's capability is, so I feel the exports also will see another period of marked growth. These are significant takeaways for India from this conflict — and they have given an opportunity of growth and challenges to all stakeholders who are also gearing up to meet the same."

The country's multi-layered air defence system worked seamlessly during the conflict from May 7 to May 10, integrating a range of systems from the long-range S-400, medium-range surface-to-air missile (SAM) systems, Akash and Spyder, and various air defence guns.

Dr. Reddy said he is particularly proud of the Akash SAM, one of the missiles developed under the Integrated Guided Missile Development programme. "It was a project which was conceived by none other than Dr. A. P. J. Abdul Kalam. I heard that our armed forces are extremely happy with the performance of that system."

Noting that almost all attempts of attack by the enemy were neutralised by the country's air defence systems mid-air itself, Dr. Reddy said that Operation Sindoor proved the effectiveness of India's air defence systems, largely home-grown, while also showcasing the depth in its attack arsenal to be able to target and neutralise any base locations of the enemy.

On what the country should focus on in the near future, he stressed that investing in niche technologies is key as also intuitively investing in countering of these niche technologies, especially those to target at longer ranges with cost effective means and counter technologies that can counter enemy attacks by detecting and engaging them at farther ranges using both hard-kill and soft-kill mechanisms.

**Excerpts from the interview:**

**What is your overall assessment of Operation Sindoor?**

Firstly, it is important to understand that what has happened in this conflict is different compared to the earlier conflicts, unlike any other typical war that India has fought till date. Firstly, this was largely an airborne or aerial warfare which completely tested the air power and air defence of our country, across both manned and unmanned platforms. Secondly, for India, it has been a moment of reckoning, which has validated our domestic defence manufacturing ecosystem.

We have been discussing (and executing) over the last 10 years or so the procurement and induction of more indigenous weapons. Today, this has happened to a large extent, and as the reports and press briefs and MoD releases have stated, Operation Sindoor has been fought with the majority of indigenous weapons and equipment.

Our resolve over the last decade or so has been to strengthen our indigenous ecosystem, and the events in the last few years, especially the Russia-Ukraine crisis and the COVID pandemic, have again highlighted the risks in sourcing from the global supply chain. According to me, Operation Sindoor not only vindicated our Atmanirbharata resolve but also laid down a path for future procurement strategies as well.

Overall, Operation Sindoor highlighted India's complete dominance, where in the first attack, complete terrorist camps were eliminated and in the second, the enemy air defence radars and other systems were neutralised, which was then followed by attacking their air bases and leveraging our air defence systems to prevent counter attacks on our bases. It is heartening to see that almost all attempts by the enemy to attack were neutralised by our air defence systems in mid-air itself – few that sneaked through were not as effective as they did not do any significant damage per se.

Operation Sindoor proved the effectiveness of India's air defence systems (largely home-grown) while also showcasing the depth of the attack arsenal to be able to target and neutralise any base locations of the enemy. I am extremely happy that the majority of the systems used were indigenous systems. It is time for the Government and industry to go full throttle on further strengthening the indigenous defence manufacturing and R&D ecosystem.

***We are talking a lot of Indian systems integrated with imported systems, all of which functioned seamlessly. So what stands out to you in terms of the success story? And are there any limitations or aspects that need to be focussed on?***

Firstly, Operation Sindoor witnessed multiple indigenous systems being used including air defence radars which have performed very well. The integrated operation of the complete radar network with the other elements of the air defence have worked very well, and the layered air defence with multiple weapons has also proved very effective – be it Akash, Mediurm Range Surface Air Missiles (MRSAM) or others.

I think the command and control centre was fully aware of the situation, and to be able to track and target every incoming object with the appropriate weapon, required strong and comprehensive connectivity with the entire ecosystem. We hear the anti-drone systems have also been fully functional and were able to handle almost all the incoming drones and drone swarms.

This reiterates the fact that there needs to be investment in much more advanced systems, with strong connectivity and integration, such that one system can speak to another. We need to have/create that vision and invest in niche and futuristic areas so that we can be ahead of the technology curve. The enemy understands our capability now, and this makes it all the more imperative that we continue to evolve and be more advanced in our attack and defence for the future.

***What should be our priority in the next 5-10 years?***

Investing in niche technologies is key, and intuitively investing in countering these niche technologies as well. If there is a technology, more likely that the enemy also knows about it, and hence it is important to have a counter to that as well as a deterrent or defence mechanism. For instance, technology developments in the unmanned systems domain (across land, sea and air) are growing at an exponential rate.

We as a country need to focus on both manned, unmanned and anti-unmanned technologies in a big way - from micro drones to mini-Unmanned Aerial Vehicles (UAV) to drone swarms, to the stealthy High Altitude Long Endurance (HALE) and fighter aircraft versions and to the Unmanned Ground Vehicles (UGV) and Unmanned Underwater vehicles (UUV). We need to work vigorously towards high technology areas, including hypersonics, quantum technologies, laser weapons, electromagnetics, higher precision and long-range sensors, as well as highly miniaturised electronics.

We need to look at technologies which can target longer ranges with cost-effective means, and we also need to look at cost-effective technologies that can counter enemy attacks by detecting and engaging them at farther ranges using both hard kill and soft kill mechanisms. We also need to consider the possibility that the future warfare may revolve around space and/or cyber only, and hence we need to continue our R&D and innovation in these areas parallelly as well, at a faster pace and with a stronger resolve.

***If you have to pick one major system as a success story, what would that be?***

I feel more proud of the Akash missile systems, as it is one of the missiles that has been developed under the Integrated Guided Missile Development Programme (IGMDP). It was a project which was conceived by none other than Dr A. P. J. Abdul Kalam. I heard that our armed forces are extremely happy with the performance of that system. That, for sure, is a proud moment for me and for every Indian, I must say.

There are other weapons also, like the other SAMs and also the BrahMos, which have reportedly performed very well. Our radars and multiple sensors (both airborne and on ground) have effectively negated enemy attacks.

I would like to add that for the plethora of weapons which are currently being developed, if they come up quickly, our armed forces will be significantly strengthened. With current indigenous content in the armed forces at 60-65%, which soon will go to 75-80%, it will be another major leap towards indigenisation. We need to work out mechanisms and processes to ensure that the procurement cycle from development to induction happens in the most efficient and effective manner.

***So how do you ensure the development and procurements happens fast?***

Processes have to be simplified and sequential induction processes should also be removed. An integrated system should be brought in such that it is an integrated process from development to induction, and roadmap for usage of every project deliverable should be very clearly defined.

This will enable the industry to plan their capacities and capabilities and come up with the production facilities right in the beginning itself. There are couple of systems where development, production and induction have happened quickly, and that should be replicated for other procurement as well. Technology is changing fast and the internal process from development to induction should not allow the technology to get outdated by the time it is inducted.

I want to say that this war brought many positive things to India. First, many indigenous systems have been used very effectively, so the confidence of the armed forces in the indigenous equipment has reached all-time highs. I believe this will lead to more vigorous and efficient induction of indigenous systems. The morale of the scientific community today is very high, and this paves the way for the development of many more advanced systems.

Industry is now more confident of getting production orders for indigenous systems, and they should hence gear up and be ready to absorb bulk orders. The international community has seen what India's capability is, so I feel the exports will also see another period of marked growth. These are significant takeaways for India from this conflict, and they have given an opportunity for growth and challenges to all stakeholders who are also gearing up to meet the same.

https://www.thehindu.com/news/national/operation-sindoor-showed-indias-full-dominance-need-to-go-full-throttle-on-indigenous-systems-dr-satheesh-reddy/article69618578.ece

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# How homegrown sats can take India's defence to next level

*Source: The Time of India, Dt. 26 May 2025*

How homegrown sats can take India's defence to next level

**Operation Sindoor showed what satellite intelligence can do. Now, India is racing to build a network big enough to protect every inch of its land, sea and sky**


Hyderabad-based Skyroot launched India's first private rocket into suborbital space in Nov 2022. It's preparing to send its first orbital launch vehicle, Vikram-1, into space later this year

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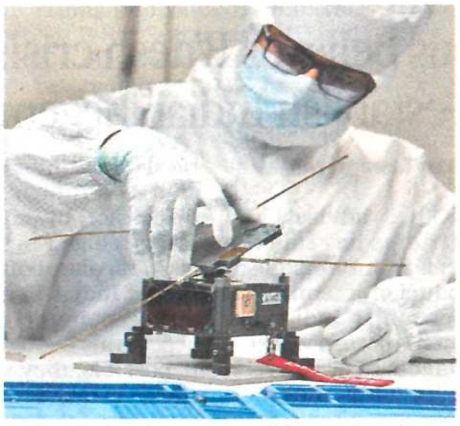
They were the unseen heroes, invisible but vigilant eyes in the sky during Operation Sindoor. Cartography satellites (Cartosats), radar imaging satellites (Risats), and Earth-observation satellites (EOSs) played a key role in the precision hammering of Pakistan's air defence systems and air bases. That has driven home the importance of having more such silent sentinels in space in the era of high-tech warfare.

## Need To Scale Up

India currently has around 10 surveillance satellites in various orbits. Both Indian Space Research Organisation (Isro) chairman V Narayanan and space regulator Indian National Space Promotion and Authorisation Centre (IN-SPACe) chairman Pawan Goenka have recently stressed on the need to beef up the country's surveillance capabilities.

At the Global Space Exploration Conference 2025 held during May 7-9 in New Delhi, Goenka said India plans to put a constellation of 52 spy satellites in orbit over the next five years. Of these, 21 will be developed by Isro with the remaining 31 coming from private players.



Hyderabad's Dhruva Space is set to launch its first commercial satellite, P-30, later this year

The national space agency was set to launch its 101st satellite, the EOS-09 (Risat-1B), on May 18. The Earth-observation satellite, equipped with an advanced C-band Synthetic Aperture Radar (SAR) system capable of capturing high-resolution images in all-weather conditions, was intended to be a key addition to India's surveillance fleet. However, an anomaly in the third-stage propulsion system of the PSLV (Polar Satellite Launch Vehicle) rocket resulted in the mission suffering a setback.

## India's Big Surveillance Push

Narayanan recently noted that India now operates around 55 satellites and plans are afoot to add another 100-150 to comprehensively cover its borders and 7,500-km coastline. "For national security, we must rely on our satellites," he said at the Central Agricultural University convocation on May 11 in Agartala amid reports of Pakistani drones intruding into Indian airspace despite the ceasefire announced the day before. "Monitoring our seashores and sensitive zones isn't possible without satellite and drone tech," he stressed.

So far, Isro has put around 127 Indian satellites in orbit, including those of private players and academic institutions. Of these, 22 govt-owned satellites are currently operating in low Earth orbit (LEO), while 29 are in geo-synchronous Earth orbit (GEO).

But space experts point out that India needs thousands of satellites to match rivals like China, which has drawn up plans to deploy nearly 20,000 of them.

Dr Subba Rao Pavuluri, former Isro scientist and founder-chairman and MD of Ananth Technologies, believes that

India requires at least 10,000 satellites over the next five to 10 years. These, he says, would not only serve surveillance needs but also support communication, Earth observation, navigation, weather forecasting, scientific research, etc.

## Private Players Step Up

Ananth Technologies, the first private Indian player to get IN-SPACe's nod to offer GSO communication satellite services in Ka-band (a radio frequency range that allows faster data transfer and higher bandwidth) is already developing India's first private GEO satellite, weighing up to 3,000kg. It also plans to roll out another two to three satellites over the next few years.

Pavuluri said India has a huge requirement for communication satellites, a view echoed by Pawan Kumar Chandana, co-founder & CEO of Skyroot Aerospace.

"That presents a great opportunity for Indian startups to build capabilities, not only to cater to the domestic market but also to tap into the rapidly growing global space market," Chandana said. Skyroot successfully launched India's first private rocket into suborbital space in Nov 2022 and is now preparing to send its first orbital launch vehicle, Vikram-1, into space later this year.

Tanveer Ahmed, co-founder & CTO of Bengaluru-based space tech startup Digantara, says India's mantra over the next few years should be "launch, baby, launch" to close the capability gap with rivals like China.

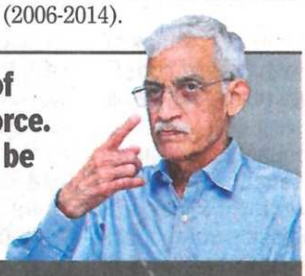
Digantara, which launched SCOT (Space Camera for Object Tracking) — the world's first commercial space situational awareness (SSA) satellite — in Jan this year, now plans to launch around 40 more of those in the next few years. "We must not only match the technical capabilities of the world's best space-faring nations but also emulate the scale of countries like China. If we play our cards right, we should be able to do so within a few years," Ahmed said, pointing to the key role of technology indigenisation in meeting such an objective.

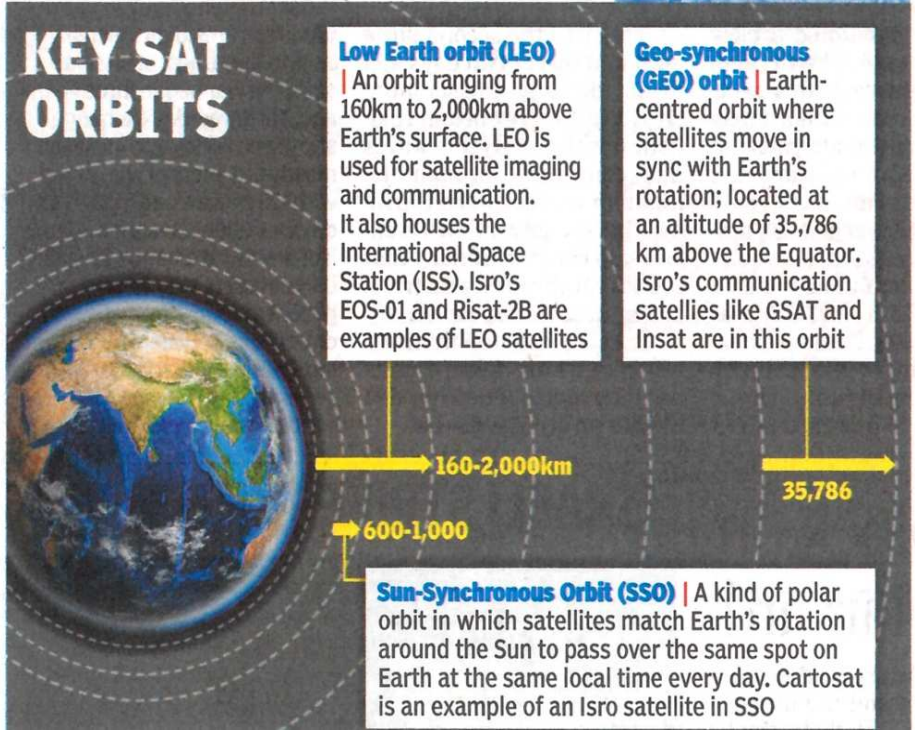
According to Dr V K Saraswat, Niti Aayog member and former director-general of Defence Research and Development Organisation (DRDO), what India urgently needs is "an umbrella of satellites" in low Earth orbit (LEO) to provide real-time information within about a 1,500-3,000km radius of its geographical borders.

"We need satellites with early warning capabilities that will be able to detect even the plume of a rocket or missile the moment it takes off," says Saraswat, who also served as chief scientific advisor to then defence minister A K Antony (2006-2014).

**"Space will become the fourth segment of defence after the Navy, Army, and Air Force. These four, along with cyberspace, are going to be most crucial in the near future**

—AVINASH CHANDER | FORMER DG, DRDO






Another former DRDO DG, Avinash Chander, believes that space will become the fourth segment of defence after the navy, army and air force. "These four, along with cyberspace, are going to be most crucial," he said.

"We currently have 9 to 11 satellites that have improved our intelligence, surveillance and reconnaissance (ISR) capabilities. But, for distant ISR — which means 24x7 surveillance — we require many more," said Indian Space Association (ISpA) director general Lt Gen A K Bhat.

## Beyond Defence

Not just military applications, a growing number of Indian space tech startups are already pursuing satellite projects to aid sectors like mining, navigation, geospatial mapping and agriculture.

Data from the Department for Promotion of Industry and Internal Trade (DPIIT) shows that, as of 2023, India had 189 space tech startups. To boost private participation, the govt has already relaxed FDI limits to 100% in areas like satellite manufacturing and operation, etc. It has also announced a Rs 1,000-crore venture capital (VC) fund, managed by IN-SPACe, to boost investments in the sector.

Among the startups making waves is Bengaluru-based GalaxEye Space, which is gearing up to launch the world's first multi-sensor imaging satellite in Oct this year. "Multi-sensor imaging satellites equipped with synthetic aperture radar and multi-spectral imager will be able to provide weather information for any location on Earth, even through cloud, smoke or rain. It offers a range of benefits to sectors such as defence, mining and agriculture," said GalaxEye co-founder Pranit Mehta.

"We're looking at launching a constellation of around six satellites over the next few years and, if demand scales, we can expand to a little over 10," Mehta added.

Hyderabad-based Dhruva Space, too, is set to launch its first commercial satellite, P-30, later this year. This 20-50kg class Earth-observation satellite, to be put in LEO, will carry a hyper-spectral imager for an Australian client along with other payloads.

## Race With Reason

But India still has a long way to go, and challenges remain, says ISpA founding-director Wg Cdr Satyam Kushwaha. "It's like comparing a Ferrari with a Maruti 800. China launching 'X' number of satellites doesn't mean we should follow suit. We need to see what our security challenges are and what the solutions for them could be. We need to be rational."

**INDIA'S EYES IN SKY**

**Cartosat** | Isro's eyes in the sky, these optical Earth- observation satellites are part of India's remote sensing programme and help with cartography (or mapping) urban and rural planning, coastal land use, and disaster management.

**Risat** | A series of radar imaging reconnaissance satellites developed by Isro. Equipped with synthetic aperture radar (SAR), these satellites capture images of the Earth, enabling all-weather, day and night observation.

**EOS** | Earth-observation satellites collect data for environmental monitoring, disaster management, and resource management. They are equipped with sensors to capture images, measure atmospheric conditions, and analyse the surface of the Earth.

**C-band SAR system** | A remote-sensing technology, it uses radar signals in the C-band frequency range (around 5.4 GHz) to create high-resolution images of Earth's surface through clouds and darkness. It sends radar pulses from a sensor platform and analyses the echoes reflected from the ground. Used in environmental monitoring, military systems, etc.

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# 'Equipments are war-tested': India's defence exports set to rise after Operation Sindoor, says DRDO Chief

***Source: The Times of India, Dt. 29 May 2025***

India's defence exports are expected to increase following Operation Sindoor, as indigenous equipment used in the operation is now considered "war-tested," DRDO Chairperson Samir V Kamat said on Thursday.

Speaking to reporters at the CII Annual Business Summit 2025, Samir V Kamat said that weapons used in Operation Sindoor have boosted confidence among potential buyers. "I am hopeful that exports will increase after Operation Sindoor because now these (equipments) have been war-tested," Kamat said.

"After Operation Sindoor, I sincerely hope that exports will increase because they have just been tested. Equipment and other countries will show a lot of interest in buying them right now," he added. India currently exports defence equipment to over hundred nations, and this number is likely to expand post-operation. "Already we are exporting to hundred countries, then I sincerely hope that this equipment will go to the hundred Countries and some other countries who are not buying us right now will also be interested in buying our equipment right now," he told reporters.

Additionally, Kamat discussed the newly approved execution model for the Advanced Medium Combat Aircraft (AMCA) programme, which enables private sector participation in fighter aircraft development. On May 27, the defence ministry sanctioned this model to enhance India's domestic defence capabilities.

The Aeronautical Development Agency will implement the programme through industry collaboration. The execution model ensures equal opportunities for both private and public sectors to participate, allowing them to bid independently, form joint ventures, or create consortia. The bidding entity must comply with Indian laws and regulations.

"In this execution model, the HAL can bid. Private sector can bid. They can also bid as a joint venture. So this will open a participation of private sector four fighter aircraft," Kamat added. Kamat further said that the development of the Advanced Medium Combat Aircraft (AMCA) is expected to be completed by 2034, with production starting in 2035. The first prototype flight is planned by the end of 2029.

Earlier, during the CII plenary session, defence minister Rajnath Singh said that under the AMCA project, the government—along with industry partners—plans to develop five prototypes of the 5th generation fighter jet, which will later move into series production. Singh, addressing the CII Annual Summit, termed this decision a significant achievement in the 'Make in India' initiative.

The project he said aims to promote Atmanirbharta in defence, marking the first instance where private sector entities can participate alongside public sector companies in a major defence project.

https://timesofindia.indiatimes.com/business/india-business/indias-defence-exports-set-to-rise-after-operation-sindoor-drdo-chief/articleshow/121488147.cms

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The Tribune

The Statesman

पंजाब केसरी जनसत्ता

The Hindu

The Economic Times

Press Information Bureau

The Indian Express

The Times of India

Hindustan Times

नवभारत टाइम्स

दैनिक जागरण

The Asian Age

The Pioneer