

OPERATION SINDOOR: INDIA'S ATMANIRBHARTA SUCCESS STORY

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Operation Sindoor, the tri-Services joint operation (May 7-10, 2025) was in response to the dastardly, heinous and religiously provocative terrorist attack on innocent Indian civilians at Pahalgam on April 22, 2025. It was a stupendous success and was able to achieve its laid down military and political objectives in less than four days. Op Sindoor established a new Indian military doctrine wherein any act of terror sponsored/supported by Pakistan would be considered an act of war.

Op Sindoor's aerial strike in the early morning hours on May 7, targeted nine terrorist training centres/camps; five across the Line of Control (LoC) in Pakistan Occupied Kashmir (POK) and four across the International Border (IB) in Pakistan. The aerial attack, in response to the Pakistan-sponsored terrorist strike at Pahalgam, was precise, measured and non-escalatory and only terrorist training camps/terrorist infrastructure were struck; military or civilian

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targets were totally avoided. Pakistan was offered an off-ramp—to avoid further strikes and de-escalate. Pakistan was also told that any follow-up strike by it would be considered as further escalation and would be befittingly responded by India. Pakistan failed to heed this sound advice and continued to progressively up the ante by, firstly, carrying out aerial strikes with hundreds of drones, missiles, rockets and loitering munitions on Indian religious sites and other civilian targets in Indian cities all along our western border and, subsequently, on Indian military targets [Indian Air Force (IAF) airfields]. The IAF responded to such escalation with precise, measured, calibrated but escalated responses—initiating the precise Suppression of Enemy Air Defences (SEAD) attacks on Pakistan Air Force (PAF) surveillance and Air Defence (AD) radars and, subsequently, coordinated, precise air strikes on eleven PAF frontline airfields. These air strikes on the PAF airfields literally forced Pakistan to wave the white flag and seek a ceasefire. Each step up the escalatory ladder by Pakistan was responded to with a befitting and escalated response by the Indian armed forces.

In less than four days (90 hours), the Indian armed forces achieved a resounding military victory—obliterating nine Pakistani terrorist training camps/infrastructure, and very systematically and professionally decimating the air defences of the PAF and their major airfields as well, leaving the Pakistani strategic and economic infrastructure targets fully exposed. The combined IAF's and Indian Army's (IA's) phenomenal defence of the Indian airspace against repeated, mass aerial attacks by aircraft, missiles, drones and loitering munitions, extending across a border exceeding 3,000 km was a masterful and unmatched performance by the Indian integrated air defence system. The fact that no Pakistani aircraft was able to enter the Indian airspace throughout the period of hostilities speaks volumes of this highly professional performance. A defining feature of Op Sindoor was that the major architects of its stupendous success were indigenous Indian-designed and developed, or Indian-manufactured, weapon systems and weapon platforms—the fruits of our *Atmanirbharta* initiative.

**ATMANIRBHARTA SUCCESS STORY:
THE CROWNING GLORY**

Though there are several reasons for the stupendous success of Op Sindoor, the biggest contributors to its success were the phenomenal performances of the indigenously developed Indian weapon platforms—the indigenously designed and developed Integrated Air Defence System (IADS), the indigenously designed and developed Akash missile system, the jointly developed [by the Defence Research and Development Organisation (DRDO) and Israel Aerospace Industries (IAI)] Medium Range Surface-to-Air Missile (MRSAM) system, the integration by Hindustan Aeronautics Limited (HAL) of the Brahmos Air Launched Cruise Missile (ALCM) onto the Su-30 MKI, the locally manufactured loitering munition (Skystriker) as well as the Precision Attack Loitering Munition (PALM) 400; the DRDO developed C-UAS system Drone, Detect, Deter and Destroy (D-4) system, the Cartography Satellite (CARTOSAT) and Radar Imaging Satellite (RISAT) satellites providing accurate targeting data, the re-engineering of the life-expired R-73s and R-27s as the Surface to Air Missile for Assured Retaliation (SAMAR) and the indigenously upgraded L-70 guns and the Zu-23 mm Schilka gun systems.

The other significant contributors to the success of Op Sindoor, though not of Indian origin, were the Russian Long Range Surface to Air Missile (LRSAM)—the S-400, the French Rafale aircraft with its Meteor Beyond Visual Range (BVR) Air-to-Air Missile (AAM), SCALP and HAMMER long range precision weapon systems, the Su-30 with the locally integrated Brahmos Air Launched Cruise Missile (ALCM), Jaguar aircraft with the Rampage missile and the Israeli IAI designed loitering munitions (Harop and Harpy). The fear of the S-400 was so great that it forced the PAF to keep their HVAA and fighters away the IB and outside the launch ranges of the S-400.

The development details of a few of these *Atmanirbharta* success stories is highlighted in the subsequent paragraphs.

IACCS-cum-Akashteer Integrated Air Defence System: The undisputed star of Op Sindoor's stupendous success was undoubtedly the indigenously developed multi-layered IADS—the

IAF's Integrated Air Command and Control System (IACCS) and the Indian Army's (IA's) Akashteer.

The IACCS had successfully fused all the ground-based and airborne sensors scanning the humongous volume of the Indian airspace. The IACCS provided a clear and Recognised Air Situation Picture (RASP) to the various AD weapon systems for engaging the incoming enemy targets. It exercised timely and effective control over the numerous AD weapon systems of the IAF, from the shoulder fired Quick Reaction Surface-to-Air Missiles (QRSAMs) like the Iгла missile to the LRSAMs like the S-400. Likewise, the Indian Army's component of the IADS, the indigenously developed Akashteer, contributed to the effective monitoring of the airspace over the Tactical Battle Area (TBA) and real-time control of all the ground-based AD weapon systems in the TBA. The IACCS and Akashteer worked in synergy to ensure that the 'fog of war' was dispelled and freedom of operation was provided to all the AD weapon systems for neutralising the hundreds of incoming enemy targets comprising armed drones, swarm drones, Surface-to-Surface Missiles (SSMs), loitering munitions and even Air-to-Air Missiles (AAMs). The IACCS and Akashteer ensured that the multi-layered air defence system consisting of multiple weapon systems, comprising fighter interceptors, long-range, medium range, short range SAMs and low level AD guns were given complete freedom of action and the incoming threats were taken on by the different weapon systems, depending on their launch ranges and the type of threat. This ensured that our airspace was practically impregnable to the repeated aerial assaults by our western adversary throughout Op Sindoor. We can proudly claim that the Indian IADS performed like the Israeli Iron Dome system. However, a point to be emphasised here is that the airspace volume of Israel is only a minuscule percentage of the Indian airspace volume.

The decision to develop the IADS indigenously rather than buy a Commercial Off The Shelf (COTS) AD system was indeed a visionary decision of the IAF, which paid back handsomely in Op Sindoor. The evolution of the IADS has taken several decades, starting in the early 1960s, with incremental advancements in AD concepts over the

years.¹ The IACCS was conceptualised to integrate all the radars of the three Services and even the radars of civil aviation. One of the biggest hurdles in developing the IACCS was the need to fuse the radar picture of the vast variety of sensors different origin and different vintage. Due to the complexities involved, the development of IACCS was initially restricted within the IAF only. The IACCS was jointly developed over slightly more than a decade, through the continuous hard work, ingenuity and innovation of dedicated IAF officers (fighter controllers and engineers) and the engineers of Bharat Electronics Limited (BEL). It was completed and operationalised across the IAF in 2010.² Even post the operationalisation, it has been undergoing software upgradations and modernisations to further enhance its performance. Building on the experience and success of the IACCS, the Indian Army and BEL successfully developed the Akashteer project for similar command and control over the IA sensors and the AD weapon systems in the TBA, and integration with the IACCS. The IA inducted the first phase of project Akashteer into service on April 4, 2024.³ The entire project is scheduled to be completed by early 2027. The Indian Navy's similar command and control project is named 'Trigun' and is being indigenously designed and developed by the Centre for Artificial Intelligence and Robotics (CAIR) in DRDO and is presently in an advanced stage of development.

It is an indisputable fact that the IACCS was the backbone of the IAF's network-centricity and a crucial enabler for the air operations during Op Sindoor. The system's phenomenal capabilities endowed its numerous users with an unmatched Situational Awareness (SA) that significantly reduced the Observe, Orient, Decide and Act (OODA) loop, the sensor-to-shooter time-lag and thereby contributed immensely to the protection of the Indian airspace and also the execution of offensive air strikes by the IAF.

1. Air Marshal VPS Rana, PVSM, VSM, *Invisible Warriors—Scientific Art of Fighter Controlling* (New Delhi, KW Publishers, 2025), p. 182.

2. *Ibid.*, p. 176.

3. "Army Starts Induction of Akashteer System to Enhance Air Defence Posture", *The Times of India*, April 4, 2024, <https://timesofindia.indiatimes.com/india/army-starts-induction-of-akashteer-system-to-enhance-air-defence-posture/articleshow/109044544.cms>. Accessed on May 10, 2025.

Akash Short Range Surface-to-Air Missile System: One of the AD missile weapon systems that was a major contributor to the success of Op Sindoor with its excellent performance was the indigenously designed and developed Akash missile system, which was developed as a part of the Integrated Guided Missile Development Programme (IGMDP). The development of the Akash missile was initiated in 1983, and the IAF was intricately involved throughout its development process, through its several variants (Akash Mk-1, Akash-1S and the latest Akash prime) and the induction of the first Akash unit into the IAF in 2010.⁴ The Akash missile system was inducted into the IA in May 2015.⁵ It is capable of intercepting high speed, agile aerial threats like fighter aircraft, missiles, helicopters and Unmanned Aerial Vehicles (UAVs). The Akash system can track and engage multiple targets simultaneously and relies on its Rajendra Passive Electronically Scanned Array (PESA) 3D radar for guiding the missile to the target. The system also has a built-in Electronic Counter-Counter-Measures (ECCM) capability, thereby enhancing its kill probability even in contested Electronic Warfare (EW) environments. The Akash missile system has been designed by DRDO and is being jointly manufactured by Bharat Dynamics Limited (BDL) and Bharat Electronics Limited (BEL). The missile is a supersonic, short range SAM, with command guidance and an effective range varying from 4.5 km to 30 km and a maximum engagement altitude of 20 km. The Akash missile system is capable of engaging multiple targets simultaneously in all weather conditions. It was one of the key AD weapon systems of India's multi-layered integrated air defence system during Op Sindoor and was successful in neutralising multiple enemy aerial threats. DRDO successfully conducted a flight test of the New Generation Akash (Akash-NG) missile on January 12, 2024 and the missile is now being prepared for user trials. The Akash NG would be capable of intercepting high-performance, low-Radar Cross-Section (RCS) supersonic targets,

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4. Colonel Ajai Shukla, "First Akash Missile System to Fill Gap in Air Defence", *Broadsword*, May 22, 2010, <https://www.ajaiishukla.com>. Accessed on May 10, 2025.
 5. Press Information Bureau, Government of India, "Induction Ceremony of Akash Weapon System into Army Air Defence", May 5, 2015, <https://www.pib.gov.in/newsite/PrintRelease.aspx?reid=121193>. Accessed on May 10, 2025.

apart from other conventional targets. It would have a maximum interception range of 70 km.

Medium Range Surface-to-Air Missile (MRSAM): The exceptional performance of the MRSAM was another contributing factor for the success of Op Sindoor. The MRSAM, which is an indigenous variant of the Israeli Barak-8 SAM system, has been jointly developed by DRDO and IAI as an advanced network-centric combat air defence system. The MRSAM has been a significant step in our *Atmanirbharta* initiative and has contributed to the Make in India, Make for the World Programme. The MRSAM is capable of simultaneously engaging multiple aerial threats like fighter aircraft, guided and unguided munitions and cruise missiles, in both single and saturation attacks, upto a maximum range of 70 km. The first unit of MRSAMs was inducted into the IAF in September 2021⁶ and into the IA in February 2023. The IAF and IA variants differ slightly, with the IAF version being semi-static and the IA version being mobile.

Integration of Brahmos ALCM on the Su-30 MKI: The Brahmos, a long range supersonic cruise missile has been jointly developed by DRDO and NPO Mashinostroyeniya of Russia. The successful indigenous integration of the Brahmos ALCM by HAL on the locally modified centre pylon of the Su-30 MKI in 2017⁷ has been another success story that significantly enhanced the deep air strike capability of the IAF. The precise and massive damage inflicted on the PAF air bases by the Brahmos missile attacks had indeed been extremely demoralising for Pakistan. It would be of huge deterrence value even in the future. The supersonic cruise speed of the Brahmos minimises the chances of its interception by enemy AD systems. The Brahmos company is already in the process of developing a smaller and lighter variant of the missile (Brahmos NG), which would be almost half the weight of the present missile. Due to its lesser weight, the Brahmos

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6. Press Information Bureau, Government of India, "DRDO Hands Over Air Defence Missile (MRSAM) System to Indian Air Force in Presence of Raksha Mantri Shri Rajnath Singh at Jaisalmer, Rajasthan", September 9, 2021, <https://www.pib.gov.in/PressReleasePage.aspx?PRID=1753559>. Accessed on May 11, 2025.
 7. R.K. Tyagi, "Inside Story: How Brahmos Missile got Integrated with Su-30 Fighter Plane", *The Print*, November 29, 2017, <https://theprint.in/opinion/inside-story-how-brahmos-missile-got-integrated-with-sukhoi-30-fighter-plane/19329/>. Accessed on May 11, 2025.

NG would be compatible with the MiG-29, Mirage-2000 and Tejas Mk1A, thereby enhancing its operational utilisation. In spite of its lesser weight, the Brahmos NG would have similar ranges as the current version (290km). The Brahmos NG will be ready for trials early next year. The company is also developing the Brahmos ER, which would have a range of 800 km.

Locally Manufactured Loitering Munition (Skystriker, PALM 400) and DRDO Developed C-UAS System (D-4): The Israeli Elbit Systems-designed and Alpha Design Technologies locally manufactured Skystriker loitering munition, AVision locally manufactured PALM 400 loitering munition and the DRDO designed and developed C-UAS system (D4) were other significant success stories that had a decisive impact on Op Sindoor. The IA-operated Skystriker loitering munitions were instrumental in the precise destruction of the terror training camps and other training infrastructure in PoK and Pakistan on the early morning of May 7. Another loitering munition that was successfully utilised by the IAF and IA in Op Sindoor was the PALM (Precision Attack Loitering Munition) 400, which is being produced by an India-Israel joint venture named AVision Systems, in Hyderabad. AVision Systems is a joint venture of the Israeli company UVision Air Ltd and the Indian company Aditya Precitech Private Ltd (APPL). The loitering munition has a range of more than 100 km and has electro-optical/infrared cameras for detecting and engaging targets, during both day and night. Other notable Indian drone manufacturing companies like Paras Defence and Space Technologies, Tata Advanced Systems Limited, Adani Defence Systems and Technologies, IG Drones and IdeaForge are also supplying drones to the three Services which were utilised during Op Sindoor. The DRDO-developed D4 C-UAS system, with its 3 km engagement zone, was highly successful in neutralising the repeated attacks by the enemy drones/drone swarms and contributed to the safety of our Vulnerable Areas/Vulnerable Points (VA/VPs).

Surface-to-Air Missile for Assured Retaliation (SAMAR) AD Weapon System: The SAMAR air defence weapon system has been developed by 7 and 11 Base Repair Depots (BRDs) under the Maintenance Command, in collaboration with Indian private

companies Simran Flowtech Industries and Yamazuki Denki. SAMAR has been developed by re-engineering the Russian life-expired R-73 and R-27 air-to-air missiles for surface-to-air defence. Though these missiles are no longer safe for aerial launches from aircraft, they can still be utilised for surface-to-air launches. They are capable of engaging low-flying aerial threats within a range of 12 to 30 km upto a maximum speed of 2.5 Mach, and were effective in neutralising the low level aerial threats of drones, missiles and rockets over the northern cities like Srinagar, Jammu and Amritsar during Op Sindoor.

Locally Upgraded L-70 and Z-23mm Schilka Air Defence Guns:

One of the biggest and most surprising successes of Op Sindoor was the performance of locally upgraded legacy gun systems, such as the L-70 and the Z-23mm Schilka guns, in neutralising the Pakistani drones and swarm drone threats. The Bofors 40mm L-70 guns were locally upgraded by BEL, wherein the gun was integrated with a radar for target detection and identification; electro-optical sights for target acquisition under all weather conditions; auto-tracking systems, and video tracking; and all hydraulic drives were changed with electric drives. The L-70 gun has a Rate of Fire (RoF) of 240-300 rounds per minute and an effective range of 4 km. The Russian origin Schilka has four 23mm guns and it has been locally integrated with the Flycatcher radar that can track upto 20 km. The Schilka gun was also upgraded with proximity fuse rounds and radar guided tracking, making it highly effective against slow moving targets like drones and rockets. The L-70 and Z-23mm Schilka guns were fairly accurate and highly cost-effective in neutralising the threat of the slow-moving drones and swarm drones during Op Sindoor.

Space-Based Capability [Intelligence, Surveillance, Reconnaissance (ISR), Positioning, Navigation and Timing (PNT) & Communication Enhancement]: The limited number of Indian electro-optical and radar imaging; and communications and PNT satellites performed creditably and provided accurate targeting data and other support services for the air operations during Op Sindoor. However, India was also forced to utilise commercial imagery data (Maxar) to enhance the layered targeting imagery provided by its domestic satellites and for Battle Damage Assessment (BDA). India

needs to enhance its space-based ISR and space support capabilities. It needs to accelerate the proposed timelines for the launches of our Space-Based Surveillance (SBS-3) network satellites so as to shorten the revisit times to approximately two hours (Chinese ISR satellites presently have a revisit time of approximately 30 minutes). India also needs to replace the old life-expired Navigation with Indian Constellation (NAVIC) satellites with new satellites expeditiously, strengthen the ground segment and upgrade the Services of NavIC to NavIC 2.0.

CONCLUSION

The most obvious and enduring lesson of Op Sindoor has been that India's *Atmanirbharta* initiatives towards the indigenous development of weapon systems and weapon platforms have started bearing fruit, and contributed significantly towards the phenomenal success of Op Sindoor. However, rather than celebrate the success, India needs to focus on enhancing the scale and speed of the development of cutting-edge technologies and state-of-the-art indigenous weapon systems. Even though the gestation period for indigenous development is relatively long, all the players—from the Defence Public Sector Units (DPSUs) to the three Services to the private industry to the start-ups—need to not only persist with it, but also need to speed up the indigenisation process. The *Atmanirbharta* initiative needs to be further strengthened with a whole-of-nation approach and be made more broad-based. The indigenous development programmes of the Tejas Mk1A, Tejas Mk II, Advanced Medium Combat Aircraft (AMCA), the 110 kN high-performance jet engine, Ghatak Unmanned Combat Aerial Vehicle (UCAV), larger range C-UAS (Unmanned Aerial System) and the Combat Air Teaming System (CATS) air warrior programme need to be focussed upon and speeded up.