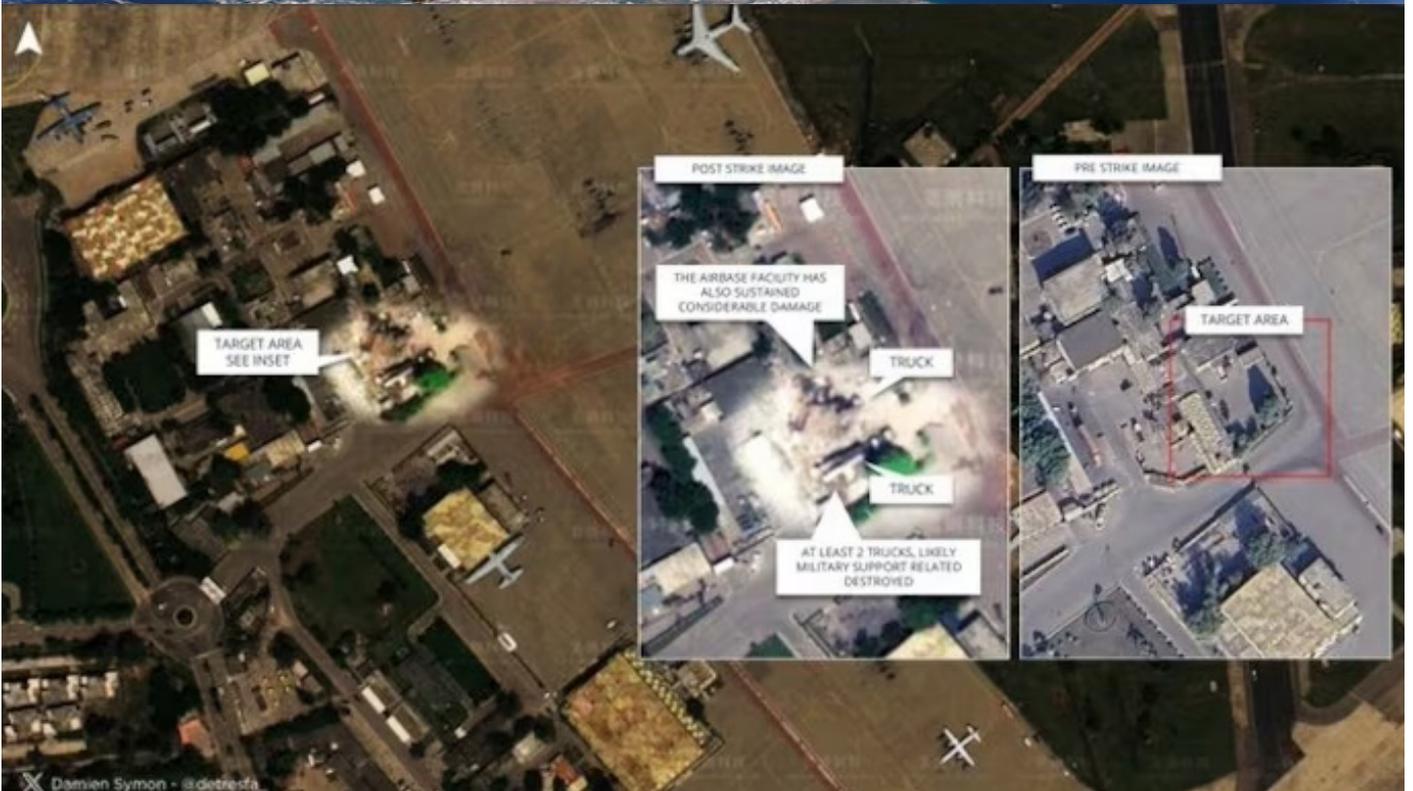




CENTRE FOR AIR POWER STUDIES (CAPS)

Forum for National Security Studies (FNSS)

AEROSPACE NEWSLETTER



Nur Khan Air Base in Pakistan Damaged

Image Courtesy: India Today

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"Operation Sindoor is not just a name but a Reflection of the Emotions of Millions of Indians."

*Shri Narendra Modi
Hon'ble Prime Minister of India*

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Operation Sindoor

Pahalgam and Beyond – Operation Sindoor and India’s Options

Air Vice Marshal Anil Golani (Retd),

Director General, Centre for Air Power Studies

| 09 May 2025

Source: CAPS India | <https://capsindia.org/pahalgam-and-beyond-operation-sindoor-and-indias-options/>



New18

The recent terrorist attack in Pahalgam that resulted in the death of 26 innocent lives led to intense speculation and debate on the involvement of Pakistan as a state sponsor of terrorism and the action that India as a country needed to take. Public pressure in a democracy for justice and action is indeed understandable and justified, and the day’s government found itself in an unenviable situation to ‘do something.’ Having carried out surgical strikes in the past by special forces in 2016, post the Uri terror attack and by the IAF in 2019, post the Pulwama terror attack, the expectation from the domestic constituency had only increased. While diplomatic steps taken by the government to hold the Indus Water Treaty in abeyance, expulsion of military advisors, closing of the border and revoking visas of Pakistan nationals

were carried out immediately, these would take time to fructify and take effect. Terror attacks in Jammu and Kashmir, followed by plausible deniability and the willingness to cooperate for a joint and impartial probe by Pakistan, is a familiar playbook that India had only got weary of listening to. Diplomatic support from the international community has been more than forthcoming, along with the advice for India to exercise restraint.

India exercised restraint, albeit for a period of fifteen days that seemed like eternity, until ‘Operation Sindoor’ was carried out on the night of 06-07 May 2025. In a deliberate and carefully planned attack that was focused, measured and non-escalatory, the Indian Armed Forces struck nine terrorist training camps, indoctrination centres, and staging areas inside Pakistan and Pakistan Occupied Kashmir. These were targeted based on credible intelligence, ensuring no loss to civilian lives and property and no military targets were struck. Pakistan indeed was taken by surprise and has since then reacted with drone and missile attacks, targeting Indian cities and airfields. The *raison d’être* of the Pakistan military, which considers itself the sole guardian of its security, is keeping the threat from India alive. Not reacting to the present situation would only have undermined its credibility and sanctity. India has not been reticent and has responded by targeting the air defence network of Pakistan from Lahore to Karachi. The onus for further escalation now rests with Pakistan, and international opinion is already against Pakistan, with the world having realised that the scourge of terrorism emanates from the country with the tacit support of the state. Any further attack by Pakistan on Indian

military targets would be at its peril, as India has already demonstrated that it would respond appropriately.

Having briefed global leaders and envoys from friendly foreign countries who understand India's predicament and the need to act against terror, India today stands on high moral ground as a responsible nation. The need for 'just' action within a specified time was felt by the leadership, which did respond, not only by sending a clear message to Pakistan that acts of terror would not be tolerated but also to its citizens that the nation would do all it could to protect its citizens. The Indian Air Force, which played a significant role in neutralising the targets, is better equipped than it was post Pulwama in 2019. The air defence umbrella that the IAF provides has ensured that the population has remained safe despite relentless attacks by Pakistan. The impregnable air defence system of the IAF, integrated with the smallest unit on the ground, remains ever vigilant and ready to respond with alacrity. Military power and capability take years to build and develop, and crises do not come knocking to give a warning. The nature of airpower is such that nations cannot necessarily buy the airpower they need in good enough time when they need it.

The Indian government has resolutely displayed its will to act against state-sponsored terrorism in bringing the perpetrators of this heinous act to justice. The Indian Armed Forces, which responded in a measured and calibrated manner at the outset, has ensured that the 'Integrated Air Defence' put in place by the IAF and controlled by the Integrated Air Command and Control System (IACCS)

responded in a manner that precluded any damage to IAF bases and cities by the attacks carried out by Pakistan. In addition, the retaliation to these attacks has been carried out by the IAF's long-range weapons that have caused damage to military targets in Pakistan.

Nations chart their destinies through their polity and actions. Having eschewed violence post partition in 1947, India has emerged as a peaceful and progressive nation that is counted as a growing and responsible power in the comity of nations. Pakistan, on the other hand, has used state-sponsored terrorism as a policy through which it attempted to stymie India's growth while using its geostrategic location as an advantage to curry favour from the West. While the jury is out on whether the chickens have finally come home to roost as far as terrorism is concerned in Pakistan, both India and Pakistan can ill afford to get drawn into a conflict that could simmer unabated. Intelligence failures have plagued India since Kargil, Pulwama, Doklam and Eastern Ladakh. Having taken a slew of measures since then to plug the gaps, the recent incident serves as a stark reminder that it is not enough, and India needs to take a hard look at the shortcomings within while simultaneously making attempts to isolate Pakistan diplomatically.

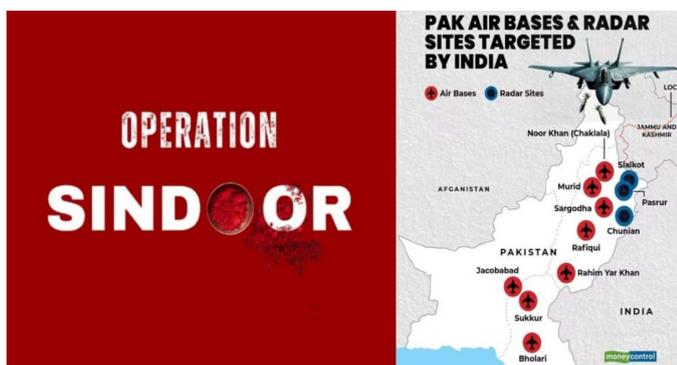
Building military capability and capacity cannot be neglected, and efforts must continue unabated. The absence or lack of capacity of a national instrument of power cannot be offset by diplomacy or economic means. India's predicament is unenviable to say the least, as far as its national security is concerned. A strong and capable military will deter, and

a united and cohesive national resolve to act will mitigate such threats from fructifying in the future. While the nation stands united in grief and anger, public sentiment should not get divided on communal lines, or else we would be playing into the hands of our adversary. India's secular fabric, that is its innate strength, needs to be preserved and protected at all costs.

Op Sindoor's Enduring Takeaway (The Ten Commandments)

*Air Vice Marshal Ashish Vohra (Retd),
Additional Director General, Centre for Air
Power Studie | 26 May 2025*

[Source: CAPS India | https://capsindia.org/op-sindoors-enduring-takeaway-the-ten-commandments/](https://capsindia.org/op-sindoors-enduring-takeaway-the-ten-commandments/)



Operation Sindoor, the Tri-Services joint operation, was launched in the early morning hours of May 07, 2025, in response to the dastardly, heinous and religiously provocative terrorist attack on innocent Indian civilians at Pahalgam on April 22, 2025. Op Sindoor was a stupendous success and achieved its laid-down military objectives in less than four days. While the success of Op Sindoor should be celebrated for its decisiveness, highly professional and

integrated execution, the Indian Armed Forces also need to do a comprehensive, honest, and unbiased analysis of the entire operation to draw the correct lessons and prepare for future more challenging battles. During Op Sindoor, a disturbing facet was noticed; there was significant military collaboration between Pakistan and its all-weather friend China. Turkey also provided military support to Pakistan not only in the run-up to Op Sindoor but even during the conflict. India needs to be cognisant of the increasingly collaborative approach of China and Pakistan and the possibility of a full-fledged two-front war. A few enduring takeaways from Op Sindoor are highlighted in the succeeding paragraphs

Defence Budget Enhancement

The defence budget of India for financial year (FY) 25 is approx. USD 79 billion (fourth largest in the world), which is slightly less than 2% of our GDP. However, it is significantly smaller than the defence budget of our Northern adversary (China) for FY 25, which is USD 245 billion. [1] It needs to be enhanced to approximately 2.5% of GDP as there are several critical capability gaps in the technological upgradation and modernisation of our Armed Forces. This enhanced commitment of funds for external security is absolutely essential for expeditiously developing our military capabilities and capacities to deter our adversaries to our West and North. We need to develop disruptive or asymmetric capabilities for credible deterrence. 'Deterrence is costly, but wars are even costlier' is a well-known military adage. Presently, India cannot afford to get embroiled in an unnecessary conflict

that diverts our focus from our nation's economic growth. India needs to ensure that national security is embedded into the edifice of financial security, implying that economic growth cannot be achieved in an unstable geopolitical environment. India has to achieve its goal of becoming a high-income nation before we become old. We need to wisely utilise our demographic dividend to accelerate our technological, economic and military development and achieve our goal of becoming 'Viksit Bharat' by 2047.

Joint and Integrated Operations

Whenever the three Services have planned their operations jointly and executed their plans in an integrated and synergistic manner, they have achieved sensational victories. The only previous example of synergistically executed operations by the Indian Armed Forces has been the 1971 war. One of the most heart-warming features of Op Sindoor was the precise articulation of the national and military objectives and complete synergy was achieved not only amongst the three Services but the Civil-Military fusion as well. Op Sindoor was a jointly planned and synergistically executed operation, wherein the core strengths of the three Services were individually applied towards attaining the common overall military objective. Another feature of Op Sindoor that needs to be stressed is that the overall integrated plans were made under the aegis of the CDS while the individual Service plans were executed under the skilful and professional tutelage of the three Service chiefs. The strengths of this highly successful joint and integrated operations should be thoroughly analysed while finalising and

implementing the impending Integrated Theatre Commands. Op Sindoor's success was also attributable to the 'whole of nation' approach – wherein all the diplomatic, informational, military and economic (DIME) measures were synergised to achieve the stated military objective of dismantling the Pakistan military-supported and sponsored terrorist infrastructure and establishing credible deterrence for the future. Any terrorism-related misadventure by Pakistan in the future would incite an even stronger response from India (costs would be higher for Pakistan) is the point that has been made amply clear to Pakistan.

Primacy of Air Power

Op Sindoor's success has once again very empathetically reiterated the undisputed primacy of air power, which implies that a nation needs to succeed in the air operations to win the war. The same is however not true for land or naval operations. During any conventional or even sub-conventional contingencies, air power is always the fastest to respond and can hit the enemy's Centres of Gravity simultaneously. In Op Sindoor, air power was used by India in an offensive, unrestrained, precise and calibrated manner for the first time after the 1971 war, and it produced exceptional results wherein the shock and awe of the sustained IAF air strikes forced Pakistan to ask for a ceasefire in slightly less than four days. Op Sindoor is the shortest military operation executed either by India or any other country, wherein the laid-down military objectives were achieved, and operations ceased within a total of 90 hours. The Balakot air strike in the aftermath of the Pulwama incident was the first time that

India offensively used air power in pursuit of the national interests in a sub-conventional contingency. In Op Sindoor, the use of air power in a sub-conventional contingency was taken to the next level with the simultaneous air strikes on nine terrorist training camps/infrastructure in Pakistan and Pakistan occupied Kashmir (PoK). Op Sindoor emphatically demonstrated that calibrated, deliberate and focused use of air power in sub-conventional contingency is non-escalatory. Air power can be utilised offensively in both conventional and sub-conventional operations, even under the nuclear overhang. Op Sindoor also unequivocally emphasised air power's ability to produce strategic effects using long-range precision weapons with minimum collateral damage without crossing the international borders (IB) and remaining within the bounds of escalatory control.

Equipping IAF Appropriately

Op Sindoor demonstrated the precision, lethality and coercive impact of IAF offensive air strikes. The offensive air strikes had a profoundly demoralising effect on Pakistan's national morale and war-waging capability. It forced the Pakistanis to throw in the towel and ask for a ceasefire. The IAF is presently grappling with an acute shortage of fighter aircraft due to the repeated extended timelines in the indigenous fighter aircraft development programme and the time-consuming, cumbersome and inefficient defence acquisition procedures (with the delays in procurement of 114 x MRFA aircraft). IAF is also facing a crippling shortage of force multipliers (AWACS and AARs) for supporting offensive air operations. IAF's fighter squadron strength has dropped to a precarious level (31

Squadrons), the lowest level in the past five decades. [2] These shortages of fighters and force multipliers need to be addressed on a war footing, which has also been recommended by the high-powered defence committee led by Defence Secretary in March 2025. [3] There is an urgent need to build up IAF capabilities expeditiously so as to bridge the large capability gaps with our Northern adversary and also be able to cater for a two-front conflict.

Offensive Air Power – Fighter or UAV Dilemma?

The self-defence capabilities of the modern-day manned fighters combined with the precision, lethality and load-carrying capability; better Situational Awareness and decision-making ability in complex situations mandates that manned fighters would remain the primary aerial offensive platforms in the foreseeable future. In spite of the rapidly increasing capabilities and ranges of Unmanned Aerial Vehicles (FPV drones, loitering munitions, swarm drones and UCAVs), UAVs still have problems of survivability in contested air spaces and are capable of carrying out only limited damage to the adversarial weapon systems. UAVs would increasingly take on a lot of roles of manned aircraft but aerial offence would continue to be predominantly the preserve of manned fighters. UAVs would complement manned fighters in offensive aerial operations rather than replace them in the foreseeable future.

Space Based Capability (ISR, PNT & Communication) Enhancement

The limited number of Indian electro-optical and radar imaging, communications, and Positioning, Navigation and Timing (PNT) satellites performed creditably and provided accurate targeting data and other support services for the air operations during Op Sindoor. However, we were forced to utilise commercial imagery data (Maxar, etc.) to beef up the layered targeting imagery provided by our domestic satellites or for Battle Damage Assessment (BDA). India needs to accelerate the proposed timelines for the launches of our Space-based Surveillance network (SBS-3) satellites to shorten the revisit times to approximately 2 hours (Chinese ISR satellites presently have a revisit time of approximately 30 mts). India also needs to replace the old life-expired NavIC satellites with new satellites expeditiously, strengthen the ground segment and upgrade the NavIC services to NavIC 2.0.

Focus on Defence R&D and Induction of State-of-the-art Technologies

The mil-technological edge of India vis-a-vis Pakistan that was amply visible during Op Sindoor needs to be further enhanced while making all endeavours to narrow down the mil-technological edge that China presently enjoys with regard to India. This needs to be achieved through a dedicated focus on the development of cutting-edge technologies like high-power jet engines, hypersonics, long-range precision weapons and Artificial Intelligence and their rapid induction into the Services. A holistic approach towards technology development

must be fostered wherein failure must be accepted as a stepping stone to success. The MoD's defence R&D budget needs to be enhanced significantly, and guidance and hand-holding must be provided to the private defence industry and start-ups. MoD must encourage and foster collaboration amongst the DPSUs, the private defence industry, the start-ups and the academia.

Strengthen Atmanirbharta

Op Sindoor demonstrated the stupendous success of India's Atmanirbharta initiatives. The sterling performance and contribution of the indigenous weapon systems and weapon platforms to the success of the operations was indeed commendable and needs to be sustained. Though the gestation period for indigenous development of weapon systems is always much longer, the services must continue to encourage and support the indigenisation process. All the players – the DPSUs, the three services, the private industry, the start-ups and the academia need to be fully involved and supportive of 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 programs of Tejas Mk1A, Tejas Mk II, AMCA, the 110 kN high-performance jet engine, long-range precision weapons, larger range BVR AAMs (Astra- II, III), Ghatak UCAV, swarm drones, larger range DEW C-UAS systems and the CATS air warrior program need to be focused upon and speeded up.

Combined Joint All Domain Command and Control (CJADCC)

The IACCS and Akashteer were a huge success, the backbone of the Integrated Air Defence network centricity, and they were crucial enablers for air defence operations during Op Sindor. The IACCS and Akashteer Integrated Air Defence System endowed its numerous users with an unmatched Situational Awareness that significantly reduced the OODA (Observe, Orient, Decide and Act) loop, the Sensor-to Shooter time-lag and ensured the protection of the Indian air space. India must further enhance this network by integrating the naval sensors and their C&C network (Trigun) with IACCS. Simultaneously, India needs to start working on upgrading the integrated Tri-Service C&C network to the Combined Joint All Domain Command and Control (CJADCC), which would be capable of coordinating and controlling all the sensors and shooters in multiple domains (all five domains) – Air, Land, Sea, Space and Cyberspace.

Information Warfare/Cognitive Warfare

Information/Cognitive Warfare has become increasingly critical in shaping the strategic narrative as the perception battle is being intensely monitored and commented upon by the international media. The briefings done by the DGMOs of the three services were comprehensive and done professionally. They were very well received not only by the national but also by the international media. They helped in shaping the strategic narrative. In all future operations, this system of briefings by the DGMOs of the three services should

be followed, with interim briefings by the Ministry of External Affairs (MEA) and MoD representatives.

Conclusion

India needs to prepare for the future and expeditiously build up the capabilities of our Armed Forces as future battles/wars would be appreciably more intense, more widespread (probably two-front) and multi-domain (encompassing Land, Sea, Air, Space, Cyberspace and the Cognitive domains.) Future wars would have a greater infusion of technology and artificial intelligence and would be increasingly fought in the digital and shadowy grey zones of cyberspace, space and cognitive domains. It would need an integrated 'Whole-of-Nation' approach with even greater Civilian Military Fusion for ensuring success.

Op Sindoore Victory (Atmanirbharta Success Story – The Crowning Glory)

*Air Vice Marshal Ashish Vohra VSM (Retd.),
Additional Director General, Centre for Air
Power Studies | 13 May 2025*

Source: CAPS India | <https://capsindia.org/op-sindoore-victory-atmanirbharta-success-story-the-crowning-glory/>



The Print

In the aftermath of the barbaric, heinous, religiously targeted killings of 26 innocent civilians in Pahalgam by The Resistance Front (TRF), an offshoot of the Pakistan based UN-designated terrorist group, Laskar-e-Taiba (LeT), PM Narendra Modi on April 24, in a public rally in Bihar, very explicitly announced his intentions to not only extract revenge from the perpetrators of the terrorist strike but their backers as well. He said, 'Today, from the soil of Bihar, I say this to the whole world, India would identify, trace and punish every terrorist, supporter and conspirator. We will pursue them to the end of the Earth. They will be punished beyond their imagination.'

Towards achieving that aim, the Indian armed forces launched Op Sindoore in the early hours of May 07, 2025, targeting 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. India's response to the Pakistan-sponsored terrorist strike was precise, measured and non-escalatory; wherein only terrorist infrastructure was engaged and military or civilian targets were avoided. Pakistan was clearly warned that any follow-up strikes by Pakistan would be considered as further escalation and would be responded by India. Unfortunately, Pakistan failed to heed this sound advice. It continued to progressively up the ante by firstly carrying out aerial strikes with hundreds of drones, missiles and loitering munitions on religious sites and other civilian targets in Indian cities all along our Western border and subsequently on IAF airfields. The Indian armed forces responded to each of these escalations with precise, measured, calibrated but escalated responses – initiating with precise strikes on terrorist camps, leading to Suppression of Enemy Air Defenses (SEAD) attacks on PAF surveillance and AD radars and finally the massive, precise attack on eleven PAF frontline airbases, which forced Pakistan to wave the white flag and beg for a ceasefire. Each step up the escalatory ladder by Pakistan was responded with a befitting and escalated response by the Indian armed forces.

In barely four days, the Indian armed forces achieved a resounding military victory – obliterating nine Pakistani terrorist training camps/centres and very systematically and professionally decimating the Pakistan Air Force, Pakistan's air defences and their major airfields; leaving all the Pakistani strategic and economic infrastructure targets fully exposed. The Indian Air Force's and Indian Army's phenomenal defence of the Indian airspace

against repeated, mass aerial attacks by aircraft, missiles, drones and loitering munitions; extending across a border exceeding 3000 kms was a masterful and unmatched performance by the Indian Integrated Air Defence system. The fact that no Pakistani aircraft could enter the Indian air space 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 the indigenous Indian designed and developed or Indian manufactured weapon systems and weapon platforms – fruits of our Atmanirbharta initiative.

Atmanirbharta Success Story – the Crowning Glory

Though there are several reasons for this stupendous success of the Indian armed forces, the most significant contributor to the success of Op Sindoor has been the phenomenal performance of the indigenously developed Indian weapon platforms – the indigenously designed and developed Integrated Air Defence System, the indigenously designed and developed Akash Missile system, the Medium Range Surface to Air Missile system (MRSAM), jointly developed by Defence Research and Development Organisation (DRDO), and Israel Aerospace Industries (IAI), 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) and the DRDO developed C-UAS system [(D-4) Drone, Detect, Deter and Destroy] system, our Regional Navigation Satellite System (RNSS) – the Navigation

by Indian Constellation (NAVIC) providing precise coordinates for our long range precision weapons, the re-engineering of life-expired R-73's as Surface to Air Missile for Assured Retaliation (SAMAR) weapons, the indigenously upgraded L-70 guns, the Zu-23 mm systems and the Schilka systems.

The other major 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, and the Israeli IAI designed Loitering Munition (Harop).

The development details of a few of these Atmanirbharta success stories are 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 Integrated Air Defence System – the Indian Air Force's (IAF's) IACCS (Integrated Air Command and Control System) and the Indian Army's (IA's) Akashteer. IACCS has successfully fused all ground-based and the airborne sensors scanning the humongous volume of Indian airspace. IACCS has provided a clear and Recognised Air Situation Picture (RASP) to the various AD weapon systems for engaging the incoming enemy targets. The IACCS exercised timely and effective control

over the numerous AD weapon systems of IAF, from the shoulder-fired QRSAMs like the Igla missile to the LRSAMs like S-400. Likewise, the Indian Army's component of the Integrated Air Defence System, 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. Both the IACCS and Akashteer worked in synergy to ensure that the 'fog of war' was dispelled and freedom of operation was provided to the all the AD weapon systems for neutralising the hundreds of incoming enemy targets comprising of armed drones, swarm drones, Surface to Surface Missiles (SSMs), loitering munitions and even Air to Air Missiles (AAMs). 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 our Integrated Air Defence System is better, if not equal to, the Israeli Iron Dome. A point to be reiterated here is that the airspace volume of Israel is only a minuscule percentage of what the IAF has to defend, and this was done with a resounding success during Op Sindoor.

The decision to develop the Integrated Air Defence System indigenously rather than buy a Commercial Off- The-Shelf (COTS) Air Defence system was indeed a visionary decision of the IAF, which has paid back handsomely in Op Sindoor. The evolution of the Integrated Air Defence System has taken several decades, starting in the early 1960s, with the incremental advancements in Air Defence concepts over the years. 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 various sensors, all of different makes and different vintages. Due to the complexities involved, the development of IACCS was initially restricted to the IAF only. IACCS was jointly developed over slightly more than a decade through continuous hard work, ingenuity, and innovation by dedicated IAF officers (fighter controllers and engineers) and the engineers of Bharat Electronics Limited (BEL). IACCS was completed and operationalised across the IAF in 2010. Even after the operationalisation, it has been undergoing software upgrades and modernisations to further enhance its performance. Building on the experience and success of IACCS, the Indian Army and BEL had 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 IACCS. IA inducted the first phase of project Akashteer into Service on April 04, 2024. The entire project is scheduled to be completed by early 2027. The Indian Navy's similar command and control project is named 'Trigun.' It 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 its development.

It is indisputable that the IACCS was the backbone of 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 that significantly

reduced the OODA (Observe, Orient, Decide and Act) loop, the Sensor-to-Shooter time-lag and thereby contributed immensely to the protection of the Indian air space and also the execution of offensive air strikes by IAF.

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 and 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 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 IAF in 2010. The Akash missile system was inducted into the IA in May 2015. The Akash missile system 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 Countermeasures (ECCM) capability, enhancing its kill probability even in contested EW environments. The Akash missile system has been designed by DRDO and is being jointly manufactured by Bharat Dynamics Limited (BDL) and 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 can engage 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. Akash NG would be capable of intercepting high-performance, low-RCS supersonic targets apart from conventional targets. It would have a maximum interception range of 70 kms.

Medium Range Surface to Air Missile (MRSAM)

The exceptional performance of the MRSAM was another contributing factor to the success of Op Sindoor. The MRSAM, is an indigenous variant of the Israeli Barak-8 SAM system, has been jointly developed by DRDO and Israel Aerospace Industries (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' program. MRSAM can simultaneously engage multiple aerial threats like fighter aircraft, guided and unguided munitions and cruise missiles, both in single and saturation attacks, up to a maximum range of 70 kms. The first unit of MRSAM was inducted into IAF in Sep 2021 and into the IA in Feb 2023. The IAF and IA variants are slightly different, with the IAF version being semi-static and the IA version being mobile.

Integration of Brahmos ALCM on Su-30 MKI Conclusion

The successful indigenous integration of the Brahmos ALCM by HAL on the locally centre pylon modified Su-30 MKI in 2017 has been another success story that significantly enhanced the deep strike capability of the IAF. The precise and massive damage inflicted on the PAF airbases by the Brahmos attacks has indeed been highly demoralising to Pakistan. It would be of immense deterrence value in the future. Brahmos missile presently has a maximum range of 290 kms, but this would get enhanced to 800 kms in the Brahmos ER, which is currently under development.

Locally Manufactured Loitering Munition (Skystriker) & DRDO Developed C-UAS system (D-4)

The Israeli Elbit Systems designed, Alpha Design Technologies locally manufactured Skystriker loitering munition and the DRDO designed and developed C-UAS system (D4) were other huge success stories. They 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 in the early morning of May 07. The DRDO developed the D4 C-UAS system, with its 3 km engagement zone, which was successful in neutralising the repeated attacks by the enemy drones and contributing to the safety of our VA/VPs.

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 they contributed massively towards the phenomenal success of Op Sindoor. Even though the gestation period for indigenous development is relatively longer, all the players – from the DPSUs to the three Services to the private industry to the Start-ups need to not only persist with it, but they 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 programs of Tejas Mk1A, Tejas Mk II, AMCA, the 110 kN high-performance jet engine, Ghatak UCAV, larger range C-UAS systems and the CATS air warrior program need to be focused upon and speeded up.

IACCS: Proves Mettle of IAF's Network Centric Operations

Group Captain (Dr) Dinesh Kumar Pandey (Retd) | 23 May 2025

Source: CAPS India | <https://capsindia.org/iaccs-proves-mettle-of-iafs-network-centric-operations/>



Hindustan Times

During Operation Sindoor, the Integrated Air Command and Control System (IACCS) played a significant role successfully managing air operations. On May 07, 2025, these Operations commenced by targeting nine terrorist hideouts, training camps, etc., in Pakistan. Network -centric operations were used to conduct offensive as well as Air Defence operations successfully. Defending its airspace during Operation Sindoor was not a fluke but proof of India's well-organised air defences. Central to achieving this success was the IACCS, which links information, observational networks, AD weapon systems and decision-making mechanisms from the IAF, Army, and related forces.

As a vital part of Indian air defence, the IACCS has a network that allows it to detect, track, and identify aerial targets as Hostile when they appear. Thanks to the use of the Air Force Network (AFNET), AI, satellite, and a

broad range of sensors, the IACCS was able to achieve better air superiority and better coordination with joint operations. All air actions of Operation Sindoor were controlled and co-ordinated from IACCS.

Background on Operation Sindoor

On May 07, between 01:05 am and 01:30 am, India launched a tri-service operation called 'Operation Sindoor', targeting nine terror infrastructure sites in Pakistan and PoK (Pakistan occupied Kashmir). This was in retaliation to several terrorist activities and the deadly Pahalgam terror attack on April 22, 2025. Four terrorists killed 26 civilians, including 25 Indians and one Nepali national. These terrorists were launched by 'The Resistance Front (TRF)', a proxy of Lashkar-e-Taiba (LeT). The air strikes, part of the Op Sindoor, were precise and measured without co-lateral damage. The strikes avoided all non-terrorist targets, including Pakistani military sites, to keep the situation non-escalatory. Also, no civilian locations were targeted.

The Pakistani Government's propaganda machinery claimed that India was acting aggressively by targeting civilians. Pakistan decided to extend support to terrorist groups, exposing, once again, their explicit nexus with terrorist outfits. In response, the Pakistani Army launched an offensive by air strikes, drones, missiles, and rockets on Indian vital installations, including Jammu, Pathankot and Udhampur. This forced India to intensify its air defence, and IACCS was at the forefront of this effort.

Understanding IACCS

During Operation Sindoor, IACCS was the nerve centre for not only Air Defence operations, but also for Offensive Operations. IACCS is an indigenously developed Command and Control system provided by the IAF, built to accelerate its activities in air defence and make network-centric warfare possible. The system includes input from all types of radars, whether homogeneous, heterogeneous, two-dimensional or three-dimensional, as well as AWAC (Airborne Warning and Control System) planes, UAVs, airbases, air traffic control radars for civil aviation and observation posts. Using information from ground sensors, airborne sensors, air defence weapon systems and command systems, IACCS makes a 'Recognised Air Situation Picture (RASP)' to help manage air threats.

With IACCS, commanders at all levels — strategic, operational, and tactical, are able to track and watch every development in the air in real-time. The Akashteer system which has been recently installed by the Indian Army, is a subset of IACCS. Therefore, IACCS is making Air Defence operations comfortable, for both the Land and air forces to work together.

Commanders exploited IACCS to monitor the air situation in real time which allowed them to update their situational awareness. The AFNET, a fast and secure digital grid, launched on September 14, 2010, hosts IACCS. AFNET depends on Internet Protocol (IP) and Multiprotocol Label Switching (MPLS) for dependable transmission of data, voice and video over its network.

With the help of IACCS, commanders could react promptly to the developing air activity as their situational awareness was up-to-date. With IACCS, the air defence functions have become quick. Appropriately selecting sensors and interceptor fighter aircraft and surface to air AD weapon systems of varying ranges ensures that there is no duplication of action and the incoming target is being successively engaged in multiple layers from the IB to the VA/VP.

The Role IACCS During Operation Sindoor

During Operation Sindoor, Pakistan attacked Indian military installations and civilians with drones, missiles and rockets. IACCS facilitated the Indian Air Force to deal with these threats efficiently and effectively. The main contributions of IACCS are appended below:

(a) **Detection and Tracking:** IACCS presented the integrated air data, obtained from ground radars, AWACS aircraft and Airborne Early Warning and Control (AEW&C) systems to detect and track any aircraft in Indian airspace. The system could even detect Pakistani drones and missiles, with low RCS, before they could reach their destination.

(b) **Real-time Situational Awareness:** Commanders could rely on the RASP provided by IACCS, which congregated all necessary air information in one place for rapid action. A picture of the IACCS node displayed at the briefing on May 12, 2025, clearly showed people using an IACCS picture to monitor the air situation.

(c) **Coordination and Command:** IACCS enabled the appropriate selection of the weapons available, like the S-400, Akash missiles, and homemade counter-UAV systems to stop and destroy the threats. IACCS architecture works to ensure that assets from the Army, and Air Force are exploited on merits for smooth operations.

(d) **Activation of Akashteer:** Integration of Akashteer AD system with IACCS had been achieved a few months prior to Ex Sindoor. Akashteer synergised the joint operations, where ground-based resources and the IAF's air defence teams could efficiently work together, leading to the best possible solution. Akashteer has led to orders for more than 400 C2C centres, and 107 of them have been delivered so far, with full integration planned by the end of the year.

(e) **Successful Interceptions:** With operational assistance from IACCS, Pakistani drones and PL-15 missiles were successfully detected and shot down from May 08 to May 10, 2025. Briefings by military leaders underlined that current battles could only be won because the net-centric operation strategies were successful.

(f) IACCS prevented Pakistan's aerial threats from causing damage by quickly neutralising them. The system was so quick and accurate, that the attackers could not penetrate the Air Defence shield and enter the airbases, schools, temples, and civilian places.

Pakistan's loss was attributed to India's strong and advanced air defences which

were directed from the IACCS. Meanwhile, Pakistan's failure to use its Chinese HQ-9 system, which could not detect or hit Indian strikes, made the IACCS seem more effective.

Implications

The real-time Command and Control from IACCS ensured that India's air defence was better than Pakistan's, as most of the latter's Chinese systems, had several technical and operational flaws. IACCS with Akashteer have reinforced the Indian Air Defence system in exploiting networks for warfare, improving its response to aerial attacks. India's achievement in Operation Sindoor reflects its ability to rely on its defence technology and enhance its readiness against nearby rivals.

AI is being used in IACCS to help monitor enemy planes and ensure the best possible use of weapons. During the next decade, IACCS wants to support in-flight movement of missile target assignments to enable changing the type of attack "on the fly." Old THD-1955 3D radar equipment will be replaced with modern high-power radars (range at 600 kilometres) to strengthen IACCS.

Air Power Musings: Maverick is Supersonic, will be there in Thirty Seconds...

Group Captain VP Naik VM | 14 May 2025

[Source: CAPS India | https://capsindia.org/air-power-musings-maverick-is-supersonic-will-be-there-in-thirty-seconds/](https://capsindia.org/air-power-musings-maverick-is-supersonic-will-be-there-in-thirty-seconds/)



SPO India

We have all seen Top Gun, where Maverick responds to all situations with the cool and vivacious dialogue, “Maverick is supersonic, will be there in thirty seconds.” Those were the days of aerial close combat, designed to make the fighter pilot look good. The modern battlefield is a far cry from it. It is more lethal, complex, precarious, dense, and, more importantly, unforgiving.

A pertinent question that comes to the fore is what makes the modern aerial battlefield so different from the earlier one? There are no set patterns or definitions to understand the modern battlefield clearly. However, specific characteristics make it different from what was prevalent in the 20th Century. In the early days of air combat, there was a sensor and a shooter. The sensor would identify a potential target, and the shooter would decide whether it is hostile or not and shoot it down. The less time the sensor takes to shoot, the more effective the

system. As technology improved, so did the sensors and capabilities of the shooter. With time, the number of sensors increased, and the shooter, therefore, had many inputs to work on and decide whether to shoot or not, eventually saturating the mind of the shooter with too much information, often termed as situational overload or SITOL. From one sensor and shooter, the battlefield transformed into multiple sensors and multiple shooters, and finally, there was a humongous network of sensors and shooters linked with each other to achieve the original aim of short sensor-to-shooter time. Technology like computers, complicated algorithms and multiple sensor tracking was introduced to sift through the vast amount of data available, so that a recognised and refined picture would be available for the shooter to take the call. With time, essential decisions started being taken by a series of professionals on the ground, who would identify hostile targets and hand them over to the shooter to do the needful. The aerial battlefield was linear with clearly defined players in the kill chain, and the need of the hour was information superiority, viz., the operational advantage derived from the ability to collect, process and disseminate an uninterrupted flow of information while exploiting or denying an adversary’s ability to do the same. Maverick could handle it all and come out with flying colours.

The modern aerial battle space has a huge array of sensors and shooters constituting multiple kill chains spread across multiple of land, sea, air and cyberspace domains. Linear kill chains have transformed into complex kill webs; therefore, plain old information superiority is inefficient. This is where Kelly

McGillis's character of Charlotte "Charlie" Blackwood, Instructor, Top Gun, comes in with the famous dialogue to Maverick, "It takes a lot more than just fancy flying." Maverick would therefore need to evolve and change because the modern aerial battlefield has also undergone a transformation. Decision superiority is required, viz., the degree of dominance in the cognitive domain an air force must achieve through its decision-making processes that enables it to acquire and maintain an advantage over its adversary. Maverick is just another lethal weapon system available, amongst many other systems which a commander could use to achieve kills. So, does that make Maverick irrelevant? The answer is no. Maverick will always remain relevant because, when used judiciously, only Maverick can deliver lethal and decisive firepower.

Key features of the modern aerial battle field are trans and cross domain operations, network centric architecture, technology ranging from small drones to Unmanned Combat Aerial Vehicles (UCAVs), Close-in Weapon Systems (CIWS) to Quick Reaction Surface to Air Missiles (QRSAMs), Medium and Long-Range Surface-to-Air Missiles (MR and LR SAMs), stealth aircraft, long range and stand-off precision weapons, electronic and cyber warfare; Hypersonic weapons and space-based combat support. All this is being augmented by the use of Artificial Intelligence (AI) and big data integration. As a result, the kill web that has been created is far more complex and therefore needs closer evaluation, critical thinking and unmatched decision superiority. Many questions come to the fore when we look at the attributes of war fighting in such

an environment. How does one fight a war in such an environment? How will we decide which weapon system to use and when? What response options are available to a developing situation and which is most optimal? Are concepts like Favourable Air Situation (FAS), Air Superiority and Air Supremacy relevant? What doctrinal precepts are to be followed when fighting the modern war? Will the classical Offensive Counter Air (OCA) and Air Defence (AD) pan out the way we have seen in the past few years? When do the air, land and sea campaigns begin and end? How does one handle cyber and information warfare, which is spread across the entire spectrum of conflict, affecting the entire continuum? These are just a few questions that must be answered when planning for future warfare.

Certain events that have unfolded in the period following the dastardly terror attacks at Pahalgam give us all a glimpse of what is to come in the future. A lethal attack on innocent tourists by state-sponsored terrorists was the trigger event. The event triggered a response strategy by India against Pakistan, which involved action in the diplomatic, information, economic, and military domains. What was interesting was the way events unfolded in the military domain. In response to the terror attacks, India launched Op Sindoor with precision long-range attacks by the Indian Air Force (IAF) on terrorist infrastructure without physically crossing the International Boundary (IB) or the Line of Control (LoC). The Pakistani armed forces responded in the form of large-scale mass drone attacks with drones ranging from quad copters to large UCAVs on military targets successfully repelled by India's robust

Air Defence (AD) comprising of weapons of differing vintage and capability, including hard and soft kill using Counter Unmanned Aerial Systems (CUAS). What followed was kinetic action using manned aircraft to target airfields and other critical military infrastructure, albeit from within their own territory by both sides. Under a nuclear overhang, this was a new kind of war, far different from the one between Russia and Ukraine or Hamas and Israel. While the Indian Navy was deployed in a deterrent posture in the Arabian Sea and the land forces were looking eye to eye, no direct ‘conventional’ exchange of firepower took place between the two armies and navies. Tanks did not roll and heavy artillery had not fired, yet, there was significant damage to Pakistani critical military infrastructure and war-waging potential. No FAS or Air Supremacy was established, yet targets well within Pakistani and Indian territory were taken on. There was no formal declaration of war, nor can this be termed as Responses Short of War (RSOW). Civil defence measures like air raid sirens and blackout measures saw a return after decades of hibernation. Conventional wisdom on how wars between India and Pakistan would pan out has been thrown out of the window, and the war was swift, deadly, modern, sophisticated, and multi-domain; the ceasefire was the only thing that was swifter. In the entire gamut of things as they unfolded, our beloved Maverick was very relevant and instrumental in delivering decisive punches. Yet, he was also ever so vulnerable because our thought process on how to use him had not changed.

This war has brought out certain important lessons that must become inputs for revising

our doctrines and helping us fight tomorrow’s wars. This conflict has clearly shown us that, though the nature of war has not quite changed, the character of war has undergone significant changes. As Lt Col Frank G Hoffman wrote in his article on Hybrid Warfare and Challenges, “the most distinctive change in the character of modern war is the blurred or blended nature of combat. We do not face a widening number of distinct challenges but their convergence into hybrid wars.”[1] As we debate the scale and shape of our Armed Forces, an acute appreciation of history’s hard-earned lessons will remain useful. Tomorrow’s enemies will still get a vote and remain as cunning and elusive as today’s foes. They may be more lethal and more implacable. We should plan accordingly.[2] The problem will be response strategies to completely newer ways of warfighting—whether kinetic, non-kinetic, lethal, or non-lethal—directed not only at the armed forces but at the country in general. I want to end by bringing out certain takeaways from this war and highlight some facts on air power and its application in modern combat.

(a) There is and will remain adequate space for conventional and sub-conventional action in wars under a nuclear overhang. This, therefore, calls for recalibration of red lines and response options.

(b) Use of air power in this conflict has again demonstrated how it can seamlessly transcend the outer rings of Warden’s model of centre of gravity and hit where it hurts.

(c) AD operations are inextricably linked to the conduct of OCA operations. The two campaigns will remain symbiotic.

(d) Air power may not achieve conventional levels of air control like FAS or Air supremacy. Still there will be windows of opportunity for conventional OCA forces to go through, and these must be fully exploited.

(e) There can never be adequate soft power without credible and adequate hard power. Ultimately, hard power will prove decisive and must be built up.

(f) There are glaring gaps in our hard power capability. Conventional air power needs a major impetus, especially in a scenario like the one we saw during Op Sindoor. IAF needs adequate squadrons and aircraft to remain relevant and effective because numbers matter. A strong and modern IAF will help deter any future misdeeds by Pakistan.

(g) Legacy weapon systems have an essential role and will always remain relevant. These systems' maintenance and life cycle management is essential to maintain the right balance.

(h) The classical OCA versus AD battle may not play out how it has been envisaged, and Maverick does not need to go through every time. There is a need to change that mindset. Offensive AD can do a lot, especially if one has the longer stick.

(j) Centralised planning, distributed control, and decentralised execution were amply displayed in this conflict. Integrated application of combat power, irrespective of ownership, is key to success in modern warfare.

(k) There is a need for a joint planning set-up at the apex level. Joint planning has always been our weak area and must be addressed. Towards this, setting up of Joint Forces Headquarters (JFHQ) is essential.

(l) Manned aircraft will always remain relevant because no number of unmanned systems can deliver lethal and decisive air power like a manned aircraft. We have seen the vulnerability of drones in a contested environment; therefore the narrative that unmanned systems will replace manned aircraft should be safely discarded. At best, they will augment but not replace.

(m) The present Japanese Navy Chief had mentioned in his address during Raisina Dialogue 2025 that the battlefield has changed from being platform-centric to network-centric and now to decision-centric. Kill chains have transformed into kill webs. We must invest in AI and big data to suitably handle such a complex battle space to enable decision superiority, which will prove decisive.

This war has been significantly different from previous ones, with many lessons that can be drawn. Air power as an instrument of war will always remain crucial and critical in any conflict and must therefore remain effective and credible. We cannot afford to dwindle air power away in penny pockets, nor can we let it deteriorate. While autonomous unmanned systems have utility, the manned fighter is irreplaceable and essential. Maverick will need to be called in at the right time and place to deliver the decisive blow, and for that we will need decision superiority, and a change of mindset. The fighter pilot is here to stay;

wish him away at your peril. When Maverick requests a flyby, the classical Top Gun response, “Negative Ghost rider, the pattern is full”, may be the right response until that window of opportunity arises and he can go in, guns and missiles blazing.

Opinions and Analysis

Defence Uncut | The Fight Pakistan Expected vs. The One It Got

31 May 2025

Source: [QUWA.org](https://quwa.org/podcasts/defence-uncut/defence-uncut-the-fight-pakistan-expected-vs-the-one-it-got/) | <https://quwa.org/podcasts/defence-uncut/defence-uncut-the-fight-pakistan-expected-vs-the-one-it-got/>



The recent conflict with India initially unfolded along the lines Pakistan expected: Following the Balakot incident and Operation Swift Retort in 2019, the Pakistan Air Force (PAF) had prepared for a large-scale Indian Air Force (IAF) strike at stand-off range.

Equipped with new Long-range air-to-air missiles (LRAAM), long-range surface-to-air missiles (SAM), and dense electronic warfare

(EW) coverage, the PAF planned to directly intercept an IAF stand-off range strike while the attacking aircraft were still within India.

During those first crucial hours of May 7th, it appeared that the PAF had successfully built upon its strong showing in 2019. However, over the next 72 hours, India regrouped and brought a fight that the PAF – and the Pakistani military at large – was not prepared to fight.

India brought “a very different kind of fight.”

India took the IAF off the field and, in its place, heavily leaned on a vast array of loitering munitions and, most importantly, a gamechanger strike asset in the BrahMos supersonic-cruise missile (SSCM).

Indeed, while the initial – i.e., IAF-led – action of Operation Sindoor evidently did not proceed as planned, India was, nonetheless, credibly able to show it could penetrate Pakistan’s burgeoning air defence system and engage the PAF before its fighters could even get off the ground.

Ultimately, neither Pakistan or India will disclose their actual losses, but the battery of satellite imagery over the PAF’s key facilities – including major operating bases (MOB) in its interior, like Shahbaz Air Base – told the story: if the BrahMos was used at scale, Pakistan’s airpower could have been deprecated.

Strategically, India held the momentum at the end of the conflict.

When Advanced Air Defence Meets Geographical Reality

In our inaugural episode, our analysts – Arslan Khan and Aseem ul-Islam – assessed that while Pakistan’s newly acquired air defence systems from China, like the HQ-9BE and HQ-16FE, did intercept a number of BrahMos SSCMs, Pakistan’s air defence system was not equipped to intercept the BrahMos at scale.

This was not an indictment on the inherent quality or performance of the HQ-9BE or HQ-16FE; rather, the actual issue was the fundamental mismatch between systems designed for China’s vast strategic depth to Pakistan’s relatively compressed geo-strategic space.

“From detection to interception, it’s a matter of seconds,” explained Arslan Khan, “Something like the FD-2000, the claimed interception range on the data sheets is about six to 20 kilometers. That does not give you a whole lot of time.”

This geographic constraint creates a detection and engagement problem that even sophisticated air defense systems struggle to solve. When supersonic cruise missiles can reach interior Pakistani air bases within minutes of launch, the traditional layered defense approach faces basic physics limitations.

The experience mirrors historical patterns in South Asian conflicts.

In 1971, India’s introduction of the subsonic Styx anti-ship cruise missile created similar challenges for Pakistan’s Navy, which lacked adequate countermeasures at the time. The

Brahmos appears to represent a comparable technological disruption.

The Production vs. Design Dilemma

Pakistan’s counter-operation on May 10th – Operation Bunyan’un-Marsus – revealed another weakness: the gap between defense design capabilities and production capacity.

While Pakistan claimed to destroy S-400 systems and Brahmos sites, the operation appeared rushed and primarily designed for domestic consumption rather than strategic effect.

This reflects a broader problem in Pakistan’s defense industry approach.

As aerospace engineer Asim al-Islam observed in our discussion, Pakistan showcases impressive designs at trade shows – including numerous loitering munition concepts – but struggles with production scale when operational requirements emerge.

“Pakistan only started doing loitering munitions a couple of years ago,” notes Islam. “I don’t think we have enough of a stockpile to have responded to India on those nights.”

The contrast with India’s deployment of hundreds of various loitering munitions – from advanced Harop and Harpy systems to simpler designs – illustrated this production gap.

Pakistan’s defense industry has become “design-heavy but production-light” – i.e., it can showcase a product or even develop a prototype,

but can it ramp up to full-scale production? In this episode, we look at several options Pakistan could employ to build its loitering munitions stockpile.

Battle Damage Assessment and the Space Disadvantage

Perhaps the clearest indicator of the conflict's outcome was the battle damage assessment (BDA) each side could provide. India produced satellite imagery showing precise damage to Pakistani facilities, while Pakistan struggled to provide equivalent evidence for its claimed strikes against Indian targets.

This disparity reflects Pakistan's underdeveloped space capabilities compared to India's mature satellite reconnaissance program. In an era where international perception increasingly relies on visual evidence, the ability to "show receipts" has become as important as actual operational success.

The BDA gap also highlighted deficiencies in Pakistan's intelligence, surveillance, and reconnaissance (ISR) capabilities. Unlike the 2019 Swift Retort operation, where the PAF provided detailed footage from H-4 standoff weapons, the 2025 strikes lacked comparable documentation.

Strategic Implications and Lessons

The May 2025 conflict offers several strategic lessons for Pakistan's defense planning:

Integrated Response Requirements

Pakistan's counter-operation appeared to lack the operational-level cohesion demonstrated by India's phased approach. While individual services performed adequately, joint coordination seemed insufficient for the intensity of modern conflicts.

Industrial Base Limitations

Pakistan's inability to respond with comparable munition volumes highlighted the need for either domestic production scaling or strategic partnerships with countries possessing industrial capacity.

Space and ISR Gaps

The inability to control post-conflict narratives through credible BDA represents a critical vulnerability in an era of perception-driven conflicts.

Geographic Constraints

Pakistan's limited strategic depth necessitates defense solutions specifically designed for its operational environment rather than adapted from other theaters.

'Pakistan's Retaliation Will Invite More Indian Attacks'

Archana Masih | 09 May 2025

Source: [Rediff.com](https://www.rediff.com/news/interview/operation-sindoor-pakistans-retaliation-will-invite-more-indian-attacks/20250509.htm) | <https://www.rediff.com/news/interview/operation-sindoor-pakistans-retaliation-will-invite-more-indian-attacks/20250509.htm>



IMAGE: Security personnel stand guard at Lal Chowk in Srinagar, May 7, 2025. Photograph: Reuters Video/ANI

Pakistan's attempt to target military installations in Punjab, Jammu and Kashmir, Rajasthan and Gujarat was foiled by India's air defence systems.

In response, the Indian Air Force destroyed Pakistan's air defence systems, particularly in Lahore.

"Our air defence systems are on high alert," says retired Air Vice Marshal Anil Golani, Director General, Centre for Airpower Studies.

A fighter pilot who has flown the Jaguar and Ajeet jets, AVM Golani has commanded an air defence detection centre and an operational base. He has served in high appointments in joint services commands and is a well-known writer on air power and national security.

"The Indian Air Force dominates the skies 24x7x365. The entire Indian airspace is monitored and controlled," he tells Rediff's Archana Masih.

Pakistan has Retaliated after India Struck Terror Infrastructure. What should we be Prepared for?

India struck 9 terror sites in PoK and Punjab as a response to the Pahalgam terror attack.

India's response was measured, focused and non-escalatory as stated in the press briefing by the foreign secretary.

The onus on escalation lies on Pakistan. They will target military or civilian establishments because there is no terror infrastructure in India to target.

We are prepared for an appropriate response. The retaliation will invite further retribution from India. [This interview was conducted before Pakistan struck Jammu and other border areas on the night of May 8]

At present, international opinion is in India's favour.

India's army, navy and air force are on high alert to counter any Pakistani misadventure.

In this Situation, how is the Security and Domination of the Indian Skies Achieved?

The Indian Air Force dominates the skies 24x7x365. The entire Indian airspace is monitored and controlled around the year.

Our air defence systems are on alert. Domination of the skies is not only done when tensions flare up or when a situation escalates like it has presently.

We are presently in a heightened state of alert, but as far as air defence is concerned, the Indian Air Force does it irrespective of heightened alert or tension.

The Balakot Strikes Deterred Pakistan from Executing a Large Scale Terror Attack for Six Years Till the Attack in Pahalgam on April 22. How Long do you think these Missile Strikes will keep Pakistan at bay?

The Pakistani State has to realise that the pigeons have come home to roost and that it does not pay to sponsor terror.

Ultimately, the Pakistani nation needs to realise that their army leadership is pulling wool over the eyes of its own people.

What the Pakistan army is doing is not good for the country in the long term.

India has an army. The Pakistan army has a nation.

How does the Pakistan Air Force Compare to the Indian Air Force?

It is competent and professional. We must not underplay or underestimate the adversary.

What are your Thoughts about Operation Sindoor Reportedly Carried out Largely by Missiles Fired from Rafale and Mirage 2000 Jets?

IAF officers train for such action all their professional lives. The air force has done well striking the assigned targets simultaneously without collateral damage to civil property or life.

They struck the terror infrastructure in Pakistan.

What is the Importance of Executing these Strikes Deep Inside Pakistan Something we haven't done Since the 1971 War?

In Balakot, we went across the Line of Control. This time our weapons have been fired from our side of the LoC.

The government's message is clear that such acts will not be tolerated and there will be a cost to Pakistani misadventure.

It was the correct decision to strike after two weeks and exemplifies India's measured and mature response.

What Kind of Assistance is China Likely to Provide Pakistan at this Time?

China will not actively get involved in a conflict, but will continue to assist Pakistan with aircraft and ammunitions.

China also has to realise that it loses its own standing by siding with a nation which harbours terrorists. Moreover, China would be

concerned about the safety of the CPEC (China Pakistan Economic Corridor) that passes through Balochistan if the situation escalates further.

Modi's Watershed War Doctrine Lurks Well Below Pakistan's N-Threshold

Sandeep Unnithan | 15 May 2025

Source: India Today | <https://www.indiatoday.in/india/story/modis-watershed-war-doctrine-lurks-well-below-pakistans-n-threshold-2724974-2025-05-15>



PM Modi at Punjab's Adampur airbase after the success of Operation Sindoor

At 8 pm on May 12, Prime Minister Narendra Modi addressed the nation in a 22-minute speech that will define his legacy. Speaking over 72 hours after the IAF's devastating air strikes against Pakistan's terrorist and military infrastructure, the Prime Minister described how Operation Sindoor had established a new normal in India's fight against terrorism. "India's drones and missiles attacked with precision," he said, "damaging Pakistani airbases and causing unimaginable damage in the first three days."

PM Modi outlined a three-pronged strategy to tackle state-sponsored terrorism: a fitting response for every act of terror, no differentiation between state sponsors of terror and terrorists and, significantly, 'striking precisely at terrorist hideouts developing under the cover of nuclear blackmail.' Operation Sindoor, unprecedented in its scale, scope and audacity, has many firsts. India has signalled that it has seen through the Pakistan army's perfidy of using terrorists to strike at India. The strikes were triggered by the April 22 massacre of 26 tourists in Pahalgam, but given its scale, was a retaliation for over three decades of proxy war waged by the Pakistan Army against India -- from Punjab, Jammu and Kashmir, to the streets of Mumbai -- relentlessly targeted by the Pakistan Army in three attacks between 1993 and 2008, which killed over 600 Mumbaikars.

Operation Sindoor marks India's first tri-services cross-border counter-terror mission—the army struck from along the LoC, the air force pounding targets deep inside Pakistan and an Indian Navy carrier battle group positioned to strike from south of Karachi. These punitive strikes, which killed 100 terrorists, were undeterred by Pakistan's nuclear weapons arsenal. And this is why Operation Sindoor is a watershed -- one which will be studied by military strategists for decades.

India has become the first nuclear-weapon state to attack another nuclear power using the air force. Nuclear weapons were used just

once when the US bombed the Japanese cities of Hiroshima and Nagasaki in August 1945. In the Cold War that followed, the USSR and the US both fielded over 70,000 nuclear warheads with weapons kept on hair-trigger alert. The prospect of a conventional conflict spiralling into nuclear weapons exchange is principally why the superpowers never fought militarily. They battled instead through proxies in Vietnam and Afghanistan.

Nuclear-armed countries have militarily clashed only twice before. The Sino-Soviet border war of 1969 and the India-Pakistan war in Kargil, 1999. Both conflicts were confined to the border. The air forces of either side did not cross the border for fear of escalation.

Both India and Pakistan who had fought three wars since 1947, tested nuclear weapons in 1998 to become overt nuclear weapon states. India's nuclear weapons programme is steered by its civilian Prime Ministers. In Pakistan, the military seized the N-weapons programme from the civilian government after General Zia's coup in 1976, five years after Pakistan's dismemberment in 1971. Pakistan's bomb was to ensure it did not suffer further loss of territory. But somewhere down the line, its nuclear weapons became an enabler of the terrorist proxies the Pakistan Army began rearing after the Afghan war of 1979-1988. Pakistan perfected this double-game during the US Global War on Terror (GWOT) which began after the 9/11 terror strikes which killed 2,977 people. Between 2001 and 2021, Pakistan befooled the US. The so-called frontline state in the GWOT was also sheltering the Taliban and Al-Qaeda, which were killing US soldiers in Afghanistan. With India,

the duplicity was further refined. If India struck Pakistan using its larger military in response to a terror strike by its proxies, it would force it to use nuclear weapons, or so the Generals threatened. This bizarre Nuclear Weapons Enabled Terrorism (NWET) was emboldened in the face of India's limited retaliatory options to Pakistan's provocations.

General Musharraf sent three brigades of his Northern Light Infantry to capture the Kargil heights in 1999. The audacious intrusions occurred nearly a year after the nuclear tests of 1998. Vajpayee sent in the Indian military to evict the intruders, but forbade his forces from crossing the LoC or the international border. In December 2001, as Pakistan-sponsored Jaish-e-Mohammed terrorists struck the symbol of India's parliament, over half a million Indian soldiers waited for the order for punitive strikes on the Pakistan military. Vajpayee never gave the order. Operation Parakram ended in an embarrassing withdrawal six months later.

“Unke paas bomb hain,” (they have the bomb) a worried Vajpayee told Indian military brass in an Operation Parakram briefing. The Pakistan military escaped unpunished. Prime Minister Vajpayee weathered international opprobrium when he ordered Indian nuclear weapon tests on May 10, 1998. But the Pakistan army's NWET hydra was a beast even the great Vajpayee had no answer to. The answer came from the pylons of Indian Air Force fighter jets in the early hours of May 7, 2025. Dozens of precision-guided munitions spun out over the nighttime skies, hurtling towards pre-selected targets inside Pakistan. On the ground below, BrahMos missiles streaked at three times the

speed of sound, death-diving into the Jaish-e-Mohammed's headquarters where Parliament attack mastermind Maulana Masood Azhar preached war against India. The IAF and Pakistan Air Force duelled in beyond-visual-range combat, blasting hundreds of beyond-visual range missiles at each other in the 21st century's largest single-day air battle. Forty-eight hours later Pakistan responded with a barrage of drone and ballistic missile attacks against Indian airbases, including at least one Fatah-2 ballistic missile fired at the Sirsa airbase in Haryana, 258 km from the national capital. A threshold had been crossed. A nuclear weapons state has never shot a ballistic missile at another N-weapon state, for fear this could be misconstrued as a nuclear weapons launch. This attack was *casus belli* for the IAF to begin Phase 3 of Operation Sindoor -- a ninety-minute predawn rampage on May 10. IAF aircraft blasted Pakistani airbases, installations and radars across a 1600-km distance from the high-altitude deserts of PoK to the Cholistan deserts of Sindh.

In a strategic message to GHQ-Rawalpindi, Chaklala airbase, close to the headquarters of the Strategic Plans Division which handles Pakistan's nuclear weapons and Sargodha airbase, near the Kirana Hills complex where the Pakistan military stores its nuclear weapons, were also targeted. This is likely what prompted Islamabad to reach out for US mediation, a pattern of nuclear sabre-rattling it has followed for nearly four decades. Both India and Pakistan agreed to cease hostilities on May 10.

PM Modi's May 12 statement made it clear that massive mobilisations like Op Parakram were a thing of the past. "Pakistan had prepared

for an attack on the border, but India struck at the heart of Pakistan," he said.

Indian officials say the May 10 strikes by the IAF damaged 20% of the PAF's infrastructure and killed 50 personnel forced the PAF to withdraw to its rear bases and activate its wartime contingencies of operating from highways.

The Pakistan military's accountants would be totalling the losses to military infrastructure over the last 72 hours. The losses to its military infrastructure would possibly be more than the \$1 billion (8,500 crore Indian rupees or 28,000 crore Pakistani rupees) IMF loan disbursed to Islamabad on May 9. GHQ Rawalpindi pursued terrorism as a low-cost option to bleed India. It is now faced with the highest one-week cost since 1971.

The Pakistan Army will have to carefully weigh the costs of NWET, particularly since the Indian response was well below Pakistan's nuclear threshold, the four red lines enunciated by then chief of its Strategic Plans Division (SPD), Lt General Khalid Kidwai in 2001. Pakistan would nuke India if it lost territory, was internally destabilised, economically blockaded or lost its war machinery.

Prime Minister Modi has shown a greater understanding of these red lines than his predecessors. His actions since 2016 have explored the space below the threshold to punish Pakistan's sponsorship of terror. He has expanded the punitive military option in scale over the past decade. From shallow cross-border raids by Indian Army special forces commandos in 2016 to a single strike by the IAF on February

26, 2019. Operation Sindoor is a whole different ball game. It opens up a new 'tri-services escalation ladder mechanism' as mentioned by DG Naval Operations Vice Admiral AN Pramod in the May 11 briefing. The ball is now firmly at the door of Pakistan's Generals in GHQ Rawalpindi. The Generals, who have stealthily usurped all power from behind the curtains, can choose to focus on building up their battered economy, improving the lives of its wretched populace, or use terrorists and risk the wrath of further punitive strikes. But the leopard-like Generals are unlikely to change their spots.

Air Power

India Eyes Partnership with France's Safran to Power Next-Gen Tejas Mk2 Jets

Nalin Mehta | 27 May 2025

Source: Money Control | https://www.moneycontrol.com/news/india/india-eyes-partnership-with-france-s-safran-to-develop-engines-for-powerful-tejas-lca-mk2-jets-13051280.html#google_vignette

The Indian Air Force, which aims to have an optimal



number of 42 fighter squadrons, currently has 31 squadrons.

India is exploring the possibility of a potential partnership with French aerospace and defence major Safran to enhance its engine-making capabilities for Indian Air Force (IAF) fighter aircraft and to develop engines for its next-generation Tejas Light Combat Aircraft (LCA) Mk-2 fighter jets, top defence sources have told Moneycontrol.

US defence major GE Aerospace is currently supplying F404-IN20 engines for Tejas MK-1 fighter jets to Hindustan Aeronautics Ltd (HAL). However, there have been hurdles in the supply, which have delayed timelines for Indian Air Force's plans to augment its fighter

squadrons. In a significant move, India is now looking for all available options to speed up its indigenous fighter production rate. As part of this effort, it is exploring partnering with Safran to enhance indigenous fighter jet engine-making capabilities.

Why New Approach and Safran: Post-Sindoor Effect

The change in approach is because the Indian Air Force needs additional fighter jets in large numbers, according to defence sources. This is especially so in the changed security scenario post-Operation Sindoor, which the government has emphasised is not over. Prime Minister Narendra Modi has stressed the ‘new normal’ and the Sindoor doctrine that any further terrorist attack on Indian soil will result in a heavy response to Pakistan by India and that India will no longer distinguish between state and non-state enemy combatants.

The Indian Air Force, which aims to have an optimal number of 42 fighter squadrons, currently has 31 squadrons. In February, IAF chief Air Chief Marshal A.P. Singh was seen lamenting the delays in the delivery of the Tejas Mk-1 LCA by HAL in a widely watched video that went viral at the Aero India 2025 show in Bengaluru. HAL had, at the time, clarified that delays were due to ‘technical issues’ and were being addressed.

Operation Sindoor has exacerbated concerns over delays in the supply of vital equipment, transfers of technology and the reliability of foreign suppliers. ‘India is looking for all available options,’ said a top

defence source.

Tejas Light Combat Aircraft: The story So Far

IAF ordered its first batch of Tejas Mk-1 fighters in 2009-10. The initial order was for 40 aircraft (32 fighters and eight trainers) to be delivered by 2016. IAF placed its second order for 83 Tejas Mk-1A jets (73 fighters and 10 trainers) in February 2021 as part of a Rs 48,000 crore deal between the Ministry of Defence and HAL. Deliveries for this batch of jets were to start by mid-2024 but have been delayed. The fighter jets were to be built with GE’s F404-IN20, but delays in the delivery of these engines were one of the major reasons for the delay in the on-time delivery of the jets. The deal, as per initial negotiations, also reportedly included 80 percent transfer of technology to India.

In March, GE announced that it had delivered the first of the 99 F404-IJN20 engines that were to be supplied to HAL for the 2021 Tejas Mk-1A deal, in addition to 65 F 404 engines it had supplied earlier by 2016 for the Tejas Mk-1 version. GE’s higher-thrust F414-GE-INS6 afterburning turbofan has also been selected to power the next-gen LCA Mk-2, which has increased range, and for the prototype development, testing, and certification of fifth-generation fighter jets for India’s Advanced Medium Combat Aircraft (AMCA) program.

If the Safran option works, it will be for engines to power Tejas Mk-2.

With India requiring a large number of fighter jet engines in the future — especially in light of recent military tensions with Pakistan — officials are seeking alternatives to diversify sources and enhance the capabilities of its aircraft fleet.

The LCA Mk2 variant (17.5 tonnes) — a 4.5 generation fighter — is expected to replace the Mirage-2000, Jaguar and MiG-29 fighter jets currently deployed by the Indian Air Force.

Safran and India: Background

The French firm has a joint venture with HAL-SAFHAL Helicopter Engines Pvt Ltd to develop new-generation helicopter engines in India.

By way of background, India has long been working to develop indigenous jet engines under its atmanirbhar (self-reliance) push.

In the past, India focused on the afterburner GTX-35VS Kaveri engine, developed by the Gas Turbine Research Establishment (GTRE). The Kaveri engine was deemed inadequate to power the LCA, which resulted in India's turn to GE for LCA engines.

India's Advanced Medium Combat Aircraft Push

The Safran push is being seen as part of a wider push for defence upgradation after Operation Sindoor. In a significant push towards building a robust domestic aerospace industrial ecosystem, Defence Minister Rajnath Singh on Tuesday approved the Advanced Medium Combat Aircraft (AMCA)

Programme Execution Model.

The Aeronautical Development Agency (ADA) is set to execute the programme through industry partnership.

“The Execution Model approach provides equal opportunities to both private and public sectors on a competitive basis. They can bid either independently or as joint ventures or as consortia. The entity/bidder should be an Indian company compliant with the laws and regulations of the country,” the ministry of defence said in a statement. “This is an important step towards harnessing the indigenous expertise, capability and capacity to develop the AMCA prototype, which will be a major milestone towards Aatmanirbharta in the aerospace sector.”

China has been producing large numbers of fifth-generation stealth fighter aircraft -- J20 and J35 -- some of which have been deployed on the LAC and border with India.

HAL Readies Third Tejas Mk1A Line, Targets 24 Jets Yearly Production by 2027, Eyes MoD Nod for New 97-Unit Order

Raghav Patel | 27 May 2025

[Source: Defence.in | https://defence.in/threads/hal-readies-third-tejas-mk1a-line-targets-24-jets-yearly-production-by-2027-eyes-mod-nod-for-new-97-unit-order.14285/](https://defence.in/threads/hal-readies-third-tejas-mk1a-line-targets-24-jets-yearly-production-by-2027-eyes-mod-nod-for-new-97-unit-order.14285/)



State-owned aerospace major Hindustan Aeronautics Limited (HAL) is set to significantly boost its manufacturing capabilities, aiming to produce 24 Tejas Mk1A fighter jets annually from 2027.

This increased output capacity is linked to the anticipated clearance of an additional order for 97 more units of the advanced light combat aircraft by the Indian Air Force (IAF) and the Ministry of Defence (MoD). This prospective order would supplement an existing 2021 contract for 83 Tejas Mk1A jets.

The push to ramp up production highlights HAL's dedication to strengthening India's indigenous defence manufacturing sector, a key goal of the 'Atmanirbhar Bharat' (self-reliant India) initiative.

To facilitate this enhanced production rate,

HAL has operationalised a third assembly line at its facility in Nashik, Maharashtra. This new line is projected to contribute eight aircraft per year, complementing the 16 units annually produced at its two existing facilities in Bangalore. This strategic expansion is designed to ensure HAL can meet the IAF's increasing requirements for the Tejas Mk1A.

Tejas Mk1A is an upgraded version of the indigenous Light Combat Aircraft (LCA), featuring significantly improved avionics, advanced radar systems, and enhanced weapon-carrying capabilities. The addition of the Nashik line is a crucial step in scaling up to meet the demands of the armed forces.

Furthermore, HAL has outlined contingency plans to partner with private sector firms for the assembly of certain aircraft sections. This collaborative approach would be implemented if the IAF necessitates an annual production figure exceeding the planned 24 jets.

Such a strategy indicates HAL's proactive stance on scalability and its intention to harness the capabilities within India's burgeoning private defence industry to ensure accelerated delivery schedules can be met. This public-private partnership model is increasingly being encouraged to build a robust national defence industrial base.

The Tejas Mk1A aircraft is a vital element in the IAF's ongoing modernisation program. It is slated to replace older aircraft fleets, such as the MiG-21s, and augment the force's combat readiness with its versatile multi-role capabilities, suitable for both air-to-air combat and air-to-

ground attack missions.

Should the anticipated order for an additional 97 units receive final approval, the total number of Tejas Mk1A jets on order would reach 180. This would provide a substantial boost to the IAF's operational strength and significantly expand HAL's production portfolio, marking a major milestone for India's indigenous fighter jet program.

As Easy as ABC? How Pakistan Unified Radars, Jets and Warning Aircraft Against India

Zhang Tongin | 13 May 2025

Source: SCMP | <https://www.scmp.com/news/china/science/article/3310134/easy-abc-how-pakistan-unified-radars-jets-and-warning-aircraft-against-india>



Pakistan integrated Awacs aircraft into its air combat system. Photo: AFP

An advanced “ABC” data sharing system made all the difference in Pakistan’s hostilities against Indian forces last week, upending combat conventions, according to a Chinese defence industry newspaper.

In a report on Monday, China Space News said the Pakistan Air Force (PAF) deployed a “locked by A, launched by B, guided by C” combat system, integrating ground radars with fighter jets, and airborne warning aircraft.

Unlike traditional air combat, where a single jet handles detection and missile guidance, Pakistan’s approach shared real-time data.

First, ground systems locked onto targets, then patrol jets launched missiles from safe distances, and finally airborne warning and

control systems (Awacs) seamlessly guided the ordnance to its mark, according to the report.

The system was used against the Indian Air Force, which the Pakistani military said last week led to the loss of five Indian aircraft.

China Space News is published by China Aerospace Science and Technology Corporation and China Aerospace Science and Industry Corporation – key developers of China’s missile and air defence systems.

This “systemic and asymmetric” tactic highlighted the rise of networked, intelligent warfare over mere firepower superiority, it said.

A few countries – such as the United States and Russia – had moved to the “launched by A, guided by B” model, with one aircraft launching the missile, and another able to take over guidance.

In the recent skirmish, however, the PAF went one step further to add “guided by C”, the report said.

“Ground-based air defence systems lock onto enemy aircraft first. Fighter jets on patrol then receive the data and launch air-to-air missiles at safe distances. Subsequently, Awacs and other aircraft continue to provide tracking and guidance to the missiles until they hit the target,” it said.

“This beyond-visual-range combat ability has a game-changing role in the air combat mode.”

The report did not mention any use of

Chinese-made hardware, focusing instead on the PAF’s tactical prowess and India’s failure to unify its data links and combat platforms – which it said could prove fatal in future conflicts.

But Chinese weapons have accounted for more than 80 per cent of Pakistan’s arms imports over the past five years, according to Swedish think tank SIPRI. And some footage of training exercises released by the Pakistani military showed that Pakistan had acquired the HQ-9P air defence missile system and ZDK-03 Awacs from China, in addition to the J-10CE fighter jets and PL-15E missiles credited with bringing down the Indian planes.

India had concentrated on buying equipment rather than integrating systems, the report said, citing Indian statements acknowledging data link compatibility problems between various Awacs, ground radars, and fighter jets, causing delays in threat detection and response.

“In modern air combat, even a one-second delay can be fatal,” the report warned.

Analysts noted that Pakistan’s cost-effective, precision-focused system neutralised India’s numerical air-power advantage.

“If India doesn’t speed up equipment standardisation, data link unification, strengthen training and logistics, it may face more strategic failures in future networked warfare,” the report warned.

It said that analysis of this conflict and others around the world indicated that military

confrontations today had evolved from merely exchanging firepower to systemic, intelligent, and asymmetric warfare.

The article also highlighted the potential for integrating drones into such networked combat systems.

“[Drones] can use low-altitude blind spots in air defence networks to gather real-time intelligence or target ground assets like airbases. They can also serve as missile launch platforms, boosting firepower and strike efficiency.”

Key Questions about the India-Pakistan Aerial Clashes

Justin Bronk | 02 June 2025

Source: RUSI | <https://www.rusi.org/explore-our-research/publications/commentary/key-questions-about-india-pakistan-aerial-clashes>



There is a risk of drawing the wrong conclusions about Chinese and Western air capabilities from the recent clashes if Indian fighter losses are looked at without close examination of the wider operational picture.

The aerial clashes during the recent fighting between India and Pakistan have drawn significant interest from air forces and air power analysts around the world, as well as a barrage of claims and counterclaims from both combatant nations’ governments, militaries and media.

The highly polarised and nationalistic nature of the information space on such topics in both countries means that few official statements can be relied on at face value, and disinformation has been used to flood social media on both sides. It is only in recent days that Indian officials have publicly acknowledged the loss of fighter aircraft, and no explanations have yet been offered for what went wrong.

However, based on analysis of geolocated wreckage, and discussions with officials and military personnel in numerous countries since

the clashes occurred, there a few things that can be stated at this stage, albeit with caveats that they represent analysis based on fragmentary initial data-points.

Initial Outcomes

The first is that during the engagements, Pakistani forces fired a significant number of PL-15 air-to-air missiles from either J-10CE and/or potentially JF-17 fighters, as well as a number of HQ-9 long range surface-to-air missiles.

The second is that the Indian Air Force suffered several fighter losses, including one Dassault Rafale, one Mig-29 and likely a Su-30MKI among one or two additional losses for which no definitive wreckage has been seen in open source.

Third, the Indian Air Force was consistently able to penetrate Pakistani air defences with air-launched standoff munitions to strike a range of terrorist-linked and military sites, despite heavy and well-coordinated defences.

Fourth, the assistance provided by China to Pakistani forces in terms of both technical equipment provision and also intelligence and C2 support enabled the Pakistani forces to perform significantly better against the Indian Air Force than the latter had anticipated.

The specific downing of a relatively newly delivered Rafale has, naturally, led many Pakistani and Chinese sources to proclaim a great victory for Chinese fighter aircraft and missile technology over French (and potentially wider Western) equivalents. Dassault's share price

has fallen significantly since the engagements, while that of Chengdu – the manufacturer of the J-10CE – has risen.

In reality, however, detailed judgements about technical system performance are premature. The simple fact is that reliable information about the engagements themselves is scarce, and so even in the classified space there are still more questions than answers in most countries.

Important Unknowns

One simple set of questions is how many PL-15 air-to-air and HQ-9 surface-to-air missiles were actually fired by Pakistani forces, by what platforms, at what ranges, against what Indian aircraft, and how many actually hit their targets? The conclusions at a technical level will be very different depending on the answers. The recovery of several PL-15 and HQ-9 remnants from unexploded weapons in different locations within Indian-held territory supports the theory that many missiles were fired, at long ranges, with a relatively low probability of kill (Pk). This is also what would be expected given the long ranges resulting from both air forces remaining well on their own side of the line of contact throughout the engagements in question.

Another key question is whether the Indian fighters that were engaged received timely warnings that they had been launched upon from their own sensors or offboard ISR sources, or not? If so, what sort of evasive manoeuvres were they flying, and how many such manoeuvres were successful in defeating

incoming missiles? Linked to the question of what evasive manoeuvres were flown is the question of what level of risk Indian pilots were ordered to accept in conducting their primary strike missions against ground targets in Pakistan? Even very old missiles can achieve kills at long ranges against modern aircraft if the latter are unaware that they have been fired on and/or do not take evasive action. By contrast, if Indian fighters were hit while performing appropriate evasive manoeuvres despite the long ranges at which the engagements took place, then that would be a much more impressive demonstration of terminal lethality for the Chinese missiles and kill-chains in question.

Linked to the question of Indian aircrew situational awareness cues and evasive manoeuvres, is another key unknown at this stage. Did the electronic countermeasures (ECM) systems in the Indian fighters, including the Rafale's vaunted SPECTRA system, have up-to-date threat library data and countermeasure programmes for the specific radars and missile types that they were being engaged by? The technical conclusions from engagements between different systems that have never been used in combat against one another before will depend significantly on what the mission data loads on different Indian fighter aircraft were at the time, but such information is highly classified, so the answers are unlikely to be available in public sources for many years.

Another key question is whether the PL-15 and HQ-9 missiles fired at Indian aircraft during the clashes were cued by the fire

control radar of the fighter or HQ-9 battery launching them, or by Pakistani Saab-2000 'Erieye' Airborne Early Warning and Control (AEW&C) aircraft far from the line of contact? If the latter was being used to provide either launch cueing or mid-course guidance updates to missiles in flight, it would both potentially greatly reduce the warning times that Indian pilots would receive to indicate that they were being engaged, and also indicate a far greater level of sophistication on the part of the Pakistani Air Force than seen in previous clashes.

This aspect is linked to perhaps the most interesting question of all; how significant a role was played by assistance provided to the Pakistani Air Force by Chinese orbital ISR and C2 constellations to provide early warning information, and potentially relay connectivity to missiles in flight? The latter could have greatly enhanced the Pakistani Air Force's ability to provide mid-course guidance updates to weapons in flight from AEW&C aircraft, fighters and ground radars. It would also recast the engagements from the first (and successful) test of Chinese combat aircraft and missiles against Western and Russian equivalents, into a successful combat test of exactly the sort of long range, cross domain kill chains that the PLA would rely on in any clash with American forces in the Indo-Pacific.

The answers to these, and many more details about the tactical and operational picture once that is known, will have a huge impact in shaping the conclusions and lessons that will ultimately be taken by both the Indian and

Pakistani Air Forces, as well as China, Russia, France, the United States and other interested observers.

Role of Air Power in Crossing the Rubicon Again

Air Marshal Diptendu Choudhury Retd | 09 May 2025

Source: Tribune India | <https://www.tribuneindia.com/news/comment/role-of-air-power-in-crossing-the-rubicon-again/>



India's well-coordinated and executed military response against nine targets in Pakistan and PoK is a controlled punitive escalation. Reuters

India's armed forces have upped the ante against Pakistan a day after Operation Sindoor was launched. An air defence system in Lahore has been neutralised. India has targeted air defence radars and systems at a number of locations in Pakistan.

It is clear that there will be no let-up in India's measured but strong military response to the Pahalgam massacre.

The Pakistani media are conceding that Indian drones fell on Lahore, Attock, Gujranwala, Chakwal, Rawalpindi and Bahawalpur in Punjab province, as well as on Sukkur's Miano, Umerkot's Chhor and near Karachi in Sindh.

Peace in India has never been easy, having to live with Pakistan, a neighbour born out of bitterness and an unfulfilled Kashmir aspiration. It is these very aspects which continue to be fostered and leveraged by Pakistan's duplicitous, self-serving military leadership to remain in power.

Having lost all its wars and failed to wrest Kashmir, the use of terror as a strategic instrument of statecraft has been a deliberate choice employed against India for years. Pakistan's cultivated terror groups have taken many innocent Indian civilian lives in the past attacks, but a line was crossed in the targeted Pahalgam killings that uncannily echoed the vitriolic words of its Islamist military chief.

India's enormous patience has been bitterly tested periodically, forcing punitive responses in Uri and Balakot, to drive home the lesson that terror will come at a cost.

The strong, well-deliberated, multi-pronged military response, which has been initiated in concert with all elements of comprehensive national power, underscores India's rise towards great power and the acceptance that it will often come at a cost. Its integrated and escalated controlled kinetic action has for the first time struck deep into the heartland of Pakistan, the home of its power brokers.

The deliberate, selective and simultaneous targeting of nine terror hubs at depths ranging up to 100 km, once again displayed the enormous maturity and restraint in India's response strategy -- we believe that civilian lives matter.

This controlled punitive escalation sends three clear signals — that India will continue to punish acts of terror; that punishment will encompass all instruments of India's growing comprehensive national power and the scale of the punishment will keep increasing in a calibrated manner.

Whether the punishment will spill over into Pakistan's military and the nation as a whole, lies entirely in the hands of its elitist dysfunctional military and political leadership, as India has no intention of making Pakistan's deprived citizens pay the price. But this time around, the messaging is loud and clear: no more terror, period. The large coordinated strike is just the beginning of what is evidently a strategy reset with a long-term approach in India's response matrix.

India's scale of the calm and collected military response has certainly created panic and disarray in Pakistan, triggering a predictable litany of rhetoric and false narratives in a desperate effort to save face.

Predictable also will be the follow-on deliberate show of outrage, riding on threats of being forced into raising the nuclear ante, orchestrated to garner international pressure to get a "belligerent India" to back down from decimating an "innocent Pakistan". Even as the Pakistani establishment plays on international

concerns of a potential "nuclear flashpoint."

Unfortunately for Pakistan, having continued to pursue the use of terror, it is no longer able to generate sympathy and support for being an unwitting victim.

The world has changed and moved on as India's true friends are showing firm support and the rest, concerned with a nuclear escalation and not wanting to pick sides, urge restraint from both sides. Even China, interestingly, has simply expressed concern and urged the return to peace in the neighborhood. For the moment it hasn't come out in open support of Pakistan, its all-weather ally.

India's strategy reset has several unique facets. After having crossed the Rubicon in 2019 when it used offensive air power in conditions of no-war-no-peace to strike the Jaish-e-Mohammed training camp in Balakot, air strikes against terror have evidently become a significant part of the operational repertoire of the Indian Air Force as well as a kinetic response option of the nation.

Equally encouraging is the fresh approach of an integrated military action of this scale, jointly conceived, planned and executed, for the first time since the 1971 war.

The Prime Minister, in his meeting with the Raksha Mantri, the Chief of Defence Staff and the three Service Chiefs, not only provided clear political directions and freedom of action. His message was also a loud strategic signal of things to come.

What followed was a classic multi-domain, multi-mode kinetic action with the core competencies of each Service, that opened page one of the Indian military's new play book.

This is just the beginning. As the kinetic pressure against terror targets continues, Pakistan, with no quid pro quo targets, is left with the only option of continued artillery attacks along the border and indiscriminate firing on forward Indian military and civilian positions.

That raising the ante will definitely trigger an escalated response is no longer in doubt; it has been made very clear in India's response to Pakistan and a message to the world.

However, we must also be clear that all military action when pursued as a deliberate national policy will come with a price. Loss of civilian lives and military setbacks will be inevitable as the scale and duration of the deliberate use of force increases.

The primacy of minimising civilian collateral is evident in the widespread revival of civil defence and passive air defence drills, which India has already initiated.

Military losses, on the other hand, are an acceptable professional hazard, which all warriors accept in their sacred covenant to defend the state and its citizens. This must not deter the nation from continuing on its much-needed chosen path of employing force in its statecraft, having exhausted its strategic patience against a recalcitrant and hostile neighbour.

Militaries are meant to fight and they will until all political objectives are met. After all, they have the strength of the entire nation behind them and the moral ascendancy of just and righteous action. Vengeance is best served cold.

Space

Public-Private Sector Partnerships for Space Systems Innovation and Security

Chuck Brooks | 28 May 2025

Source: *Forbes* | <https://www.forbes.com/sites/chuckbrooks/2025/05/28/public-private-sector-partnerships--for-space-systems-innovation-and-security/>



Spacecraft Launch Into Space. Elements of this image furnished by NASA. getty

Space is a growing commercial critical infrastructure sector dependent on both public and private resources and expertise. Public-private cooperation is essential to the successful growth and secure operations of the space sector.

The components of space systems are focused on the operation of satellites (both information-gathering and backhaul data-processing) and include the systems to launch them. The space ecosystem is also made up of ground station antennas or receptors, flight operations stations, data centers for housing transmitted data, and payload data processing

facilities.

Satellites are becoming increasingly important to communication needs. For information sharing and monitoring, nations rely more on space as a burgeoning and mission-critical frontier. Many networks are now moving from terrestrial (land-based) communications to cloud-based communications, which use satellites to send data across large distances.

Public Private Partnerships and The High Frontier

A new paradigm for space systems that integrates public and private efforts can be made possible by the government encouraging investment through grants and public-private partnerships (PPPs). Setting space research and development as a top priority will result in a hub for sophisticated manufacturing and new capabilities.

For government operations to successfully deliver necessary services and benefits, public-private partnerships are vital. These collaborations can lower expenses for agencies, streamline operations, and readily scale in response to fluctuations in demand.

Companies can share their R&D expertise to assist in filling the gaps in government funding. For the next generation of scientists and engineers who will lead and succeed, combining public and private sector funding and research pipelines can also create a competitive, long-lasting bridge.

According to Karen L. Jones, a senior project

leader with The Aerospace Corporation's Center for Space Policy and Strategy, for satellite communications, navigation, Earth monitoring, solar system exploration, and other space applications, U.S. government agencies should look to form alliances with the private sector in order to lower expenses and risks. By sharing risk with the private sector in return for performance-based earnings, these public-private partnerships (P3) can take advantage of commercial efficiencies and innovation.

The private sector may significantly contribute to the delivery of satellite communications, navigation, Earth monitoring, solar-system exploration, and other space applications at lower risk and expense, as governments look to enhance their capabilities in these areas. By utilizing commercial economies and innovation, these public-private partnerships can provide government agencies with substantial benefits. The private sector shares risk with the government in exchange for performance-based earnings.

Accelerating the innovation required to address our challenges in space will be made possible by strengthening the public-private relationship through open collaboration, best practices, and shared research and development. Space systems innovation will benefit from a collaboration between public and commercial players that involves information and risk sharing. Combining R&D financing and pipelines from the public and commercial sectors can also create a competitive, long-lasting bridge that will enable the next generation of scientists and engineers to lead and accomplish.

The Defense Innovation Unit (DIU), NASA, the Space Force, and the Air Force Research Laboratory (AFRL) work together to produce the yearly State of the Space Industrial Base report. The four space technology drivers get together to determine the industry's level of maturity and scope in providing essential space technologies and to establish growth priorities. The report concluded that "the greatest investors in the new space economy are not space companies," the authors wrote. "Rather, they are Fortune 500 companies that understand how to turn new space capabilities into products, software, and services that give them a strategic advantage in the global marketplace." (see US Space Agencies Call for Public-Private Partnerships - Payload)

It is encouraging to see the government working with the private sector to develop strategies and programs involving a variety of cutting-edge technologies in crucial fields like robotics, materials science, artificial intelligence, augmented reality, quantum computing, big data & analytics, 5G, energy, and, of course, digital security. With sustained cooperation and investment, innovation will pick up speed and our rapidly evolving technological future will be accelerated.

The manner in which new applications of technology can impact the achievements of our space are still in the initial stages. There is no doubt that public-private collaborations in space systems will propel space exploration along with being the backbone of digital sensing and communications. It will be a journey of discovery and achievement.

The Security Mission:

Because of our increasing reliance on space, and particularly satellites, for communications, security, intelligence, and commerce, as well as the exponential growth of digital transformation, satellite and space systems security is becoming increasingly important.

A higher level of public-private collaboration is needed through PPPs to address the changing cyberthreat scenario for vital space systems infrastructure. The management of satellite and space security risks is a major concern for the public and corporate sectors.

Both national security and the US economy are at risk from cyberattacks that try to interfere with and impair US satellite communications, remote sensing, and imaging capabilities.

There have been more satellite launches in recent years. Due to their low Earth orbit, thousands of satellites are vulnerable to incursions from both above and below. Because satellites can transmit data across vast, worldwide distances, many communication networks are currently moving from terrestrial (land-based) to cloud-based communications. Over 500,000 petabytes of data will be carried by 25,000 satellites launched by 2030.

As the United States expands its communications, sensing, and security mission into the high frontier of space, the systems and networks will face persistent cybersecurity threats. The safety of critical infrastructure will be aided by space cybersecurity, as many platforms are sadly inadequately protected.

Cybersecurity in space systems is related to cybersecurity in all sector verticals. Adversaries can use a variety of tactics to interfere with or take down satellite and ground-based systems. There are several ways for hackers to breach Earth-bound entry points thanks to satellite operations. Long-range telemetry is required for satellite systems to communicate with ground stations, which is one of its disadvantages. Cybercriminals have access to the open protocols that deliver the uplinks and downlinks.

Compromised ground stations can lead to network components that are susceptible to intrusions by threat actors, which in turn causes vulnerabilities in space vehicles. Satellites are the target of ransomware, zero-day, and man-in-the-middle (MitM) attacks. The same software defects that have plagued computer systems for decades can also affect space systems; file upload issues, backdoors, spoofing, remote code execution (RCE), unsecured protocols, spoofing, hijacking, SQL injection, and insecure authentication are of special concern.

These threats have recently increased in size and scope, especially with artificial intelligence-enabled attacks. To combat these threats, our space cyber toolkit must include the newest technological solutions, well-implemented policy free from unfunded mandates, a strong workforce prepared to handle space/cyber issues in the twenty-first century, suitable procurement vehicles to quickly onboard solutions, and a firm grasp of our space cyber supply chain.

Addressing the threats requires

incorporating a robust calculated security strategy of public and private sector partnering based on layered vigilance and protections, readiness, and resilience. To ensure safe and successful operations, cybersecurity risks involving commercial space, including those affecting commercial satellite vehicles, must be understood and managed alongside other types of risks. Preparation and commitment from both government and industry leadership are critical. Industry should collaborate with the government to best utilize risk management models.

The current national security space leadership risk management framework goals of the United States aim to enhance space asset resilience against hostile offensive operations by fostering a safe environment with cybersecurity interoperability in collaboration with U.S. cybersecurity organizations and businesses. In order to encourage the creation and uptake of best practices and risk mitigations, an adaptive framework requires working in conjunction with interaction, allied, partner, and commercial space system operators.

The framework posture also aims to improve the comprehension of cybersecurity and incorporate space equities and goals into U.S. postures at cybersecurity and other international forums. It also encourages proper physical security measures in addition to comprehensive, risk-based cybersecurity techniques for threats to ground- and space-based systems.

The security of space systems can be improved in a number of ways. These consist of multi-check log-in procedures for Internet-

of-Things devices, robust identity and access management, security by design, and the deployment of an extensive Zero Trust supply chain risk management program for all software users and vendors who interact with the satellite systems.

A strong intrusion detection system (IDS) should serve as the foundation of a cyber-resilient satellite. Telemetry, command sequences, command receiver status, shared bus traffic, and flight software settings should all be continuously monitored by the IDS.

An increasing awareness of space cyber and kinetic threats is shown in the establishment of the United States Space Force and United States SpaceCom in 2019. SpaceCom carries out operations while the Space Force hires, develops, and equips personnel.

An intelligence-sharing initiative was recently established by the U.S. Space Force's procurement arm to alert commercial satellite operators to any dangers to their orbiting assets. Cyberattacks, electronic jamming, physical anti-satellite weapons, and ground-based directed energy weapons are examples of space-based dangers.

More than 900 space enterprises registered through the Space Systems Command's "Front Door" portal will receive unclassified threat data under the new initiative, "Orbital Watch," regardless of whether they have security clearances or government contracts.

During its beta stage, the program will be implemented progressively, starting with quarterly threat information dissemination. The

goal of Orbital Watch, according to Front Door initiative head Victor Vigliotti, is to "increase collective situational awareness and strengthen collaboration with commercial space providers." Establishing a safe "commercial portal" that facilitates the exchange of threat intelligence between government and private entities is the ultimate goal. (see Space Force announces 'Orbital Watch' program to share intelligence with commercial sector - SpaceNews)

NASA also plays a significant role in securing the High Frontier and published the first edition of its Space Security Best Practices Guide in December 2023 with the goal of bolstering mission cybersecurity efforts for space activities in the public and private sectors. The guide is in line with the Space System Protection Standard, which summarizes NASA's continuous dedication to supporting the creation of exact cybersecurity standards for its space systems. The manual was developed by the agency to support the goals of Space Policy Directive 5, Cybersecurity Principles for Space Systems.

Space systems are also part of the public-private partnership homeland security mission. A couple of years back, the Cybersecurity and Infrastructure Security Agency of the Department of Homeland Security formed a Space Systems Critical Infrastructure Working Group. The group, which brings together stakeholders in the key infrastructure of the space system, is composed of industry and government officials and operates under the direction of the Key Infrastructure Partnership Advisory Council. It was an honor for me to be a part of that working group and recommendations

and actions on cybersecurity for space systems.

Information Sharing and Analysis Centers (ISACs) are now facilitating a number of industry-specific public/private partnerships that assist critical infrastructure owners and operators (in collaboration with the government) in safeguarding their facilities, employees, and clients against physical and cybersecurity threats, among other dangers. This includes the space realm.

In order to improve our capacity to anticipate and address vulnerabilities, incidents, and threats, the Space ISAC helps the global space industry collaborate. It also disseminates timely and actionable information among its member entities and acts as the sector's main communications channel for this information.

The only source of all-threats security information for the public and private space sectors is Space ISAC. For information, facts, and analysis on space security and risks to space assets, it will be the most complete, one-stop shop. Additionally, Space ISAC will support response, mitigation, and resilience programs with resources and analysis. (see About Us - Space ISAC)

It is obvious that safeguarding space-based assets from cyberattacks is a national security necessity that both business and government must address. Security must be an afterthought while we develop and continue to construct the satellite backbone that will direct our economic prosperity and safety for the ensuing decades.

This will be a remarkably interesting and revolutionary decade for science and innovative technology, including for space. Strategic collaboration between government and industry stakeholders is a proven model that makes good sense. The public and private sectors must keep funding and extending collaboration in the rapidly changing landscape with research and development and exploration in order to solve the numerous issues that lie ahead and enhance our quality of life and safety. Securing space needs to be a forward-thinking priority as the industry develops further.

China Launches Classified Shijian-26 Satellite with Long March 4B Rocket

Andrew Jones | 29 May 2025

Source: Space News | <https://spacenews.com/china-launches-classified-shijian-26-satellite-with-long-march-4b-rocket/>



Liftoff of a Long March 4B rocket from Jiuquan spaceport, May 29, 2025, carrying the Shijian-26 satellite. Credit: Ourspace

HELSINKI — China carried out its ninth launch of the month early Thursday, sending the secretive Shijian-26 spacecraft into orbit.

A Long March 4B rocket lifted off at 12:12 a.m. Eastern (0412 UTC) May 29 from Jiuquan Satellite Launch Center, northwest China. Insulation tiles fell away from the rocket's payload fairing as it climbed into a cloudy sky.

The Shanghai Academy of Spaceflight Technology (SAST), which provided the Long March 4B for the mission, declared success of the launch within an hour of liftoff.

SAST revealed the previously-unknown payload for the mission to be the experimental Shijian-26. No images or details of the spacecraft were provided.

The satellite is mainly used for national land surveys, environmental management, and other fields, providing information services to support national economic development, according to Chinese state media.

Shijian-26 was jointly developed by the Dongfanghong Satellite company under the China Academy of Space Technology (CAST), the Harbin Institute of Technology (HIT), and the Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP) under the Chinese Academy of Sciences (CAS).

The involvement of the latter suggests remote sensing capabilities, while the absence of imagery and specific capabilities, along with the involvement of institutions with dual-use technology expertise, suggests possible classified or military-related applications.

Shijian is a series of satellites used to conduct experiments and test new technologies. The previous mission, Shijian-25, launched in January to test on-orbit refueling and mission extension technologies, following on from the Shijian-21 mission which towed a defunct satellite into a graveyard orbit.

Other notable missions include the retrievable Shijian-19 science satellite, the 8,000-kilogram Shijian-20, and Shijian-17, which demonstrated maneuverability around the geostationary belt and conducted proximity operations.

Accelerating launch activity

The Shijian-26 mission followed just hours after a vertical takeoff and splashdown test

by Sepoch, and the launch of the Tianwen-2 near Earth asteroid sample return and comet rendezvous mission from Xichang.

The Tianwen-2 spacecraft was successfully sent into a heliocentric orbit and began a roughly year-long voyage to asteroid Kamo‘oalewa, a quasi-satellite of the Earth.

The mission was performed under a deal of secrecy, despite being an exploration mission. The launch was not broadcast live, and no images of the spacecraft itself have been published, suggesting a potentially sensitive aspect to the sampling mission.

China’s previous mission saw the return-to-flight of the Kinetica-1 (Lijian-1) solid propellant rocket from CAS Space, a commercial launch arm of CAS, following a launch failure late last year. The rocket lifted off from Jiuquan at 12:05 a.m. Eastern (0405 UTC) May 21.

The launch carried six satellites—the optical Taijing-3 (04) and synthetic aperture radar Taijing-4 (02A) satellites for Minospace, along with the multispectral imaging satellite Xingrui-11, Xingjiyuan-1 intelligent satellite for Shanghai Guoyu Zhilian Aerospace Technology Co., Ltd, the 12U Cube-108-001 with a GNSS occultation detector payload for Beijing FutureSpace Space Technology Institute, and Xiguang-1 (02) for Xiopm Space, carrying a multispectral payload.

The trio of launches takes China to a total of 32 orbital launch attempts for the year. It was the ninth orbital launch of the month, indicating an acceleration in Chinese launch

cadence. China has not publicly released its launch plans for 2025, but could be targeting around 100 launches.

Mars by 2026? Elon Musk Shares Critical Updates on Starship Launch, 2029 Human Landing Goal

31 May 2025

Source: Business Today | <https://www.businesstoday.in/latest/trends/story/mars-by-2026-elon-musk-shares-critical-updates-on-starship-launch-2029-human-landing-goal-478538-2025-05-31>



The first missions would carry only a handful of early settlers tasked with setting up infrastructure and solving challenges on the Martian surface.

Elon Musk is swiftly refocussing his aim from Washington to colonising Mars. Less than a day after stepping down from his role at the Department of Government Efficiency, the SpaceX founder laid out a sweeping vision for interplanetary colonisation. At an event on May 29, Musk detailed the company’s roadmap for launching its first crewed Starship mission to Mars by 2026, starting with a Tesla Optimus robot. If all goes well, human missions could

follow just two years later.

In a 42-minute video posted to X (formally Twitter), Musk laid out a plan to launch the mammoth spacecraft to Mars for the first time as early as next year. The ship would arrive seven to nine months later in 2027. Musk considers the odds of launching in that upcoming window to be about 50-50. If SpaceX misses it, the next opportunity wouldn't come for another two years.

The first missions would carry only a handful of early settlers tasked with setting up infrastructure and solving challenges on the Martian surface. These efforts rest on the next generation of Starships — each equipped with nine engines, upgraded heat shields, and higher payload capacity.

Musk revealed that SpaceX's Texas facility, billed as “the biggest structure in the world,” is designed to churn out 1,000 Starships annually to support the migration of millions to Mars.

He also shared plans to scale production of Starlink satellites to 5,000 units a year, many intended for Martian deployment. “Ideally, we'll be able to take anyone who wants to go to Mars,” Musk said. “And bring all the equipment needed to make it self-sustaining, to let it grow on its own.” He stressed the need to stockpile resources in case Earth-based support abruptly stops. “Having two strong, self-sustaining planets will be critical for the long-term survival of civilization.”

SpaceX has set its sights on Arcadia Planitia for its landing site — chosen for its access to ice, flat terrain, and favorable latitude. The first

uncrewed mission is planned for 2027, with humans potentially following in 2029. “Maybe to just be safe, we might do two landing episodes with Optimus and the third one with humans. We will see,” Musk said.

To make Mars self-reliant, Musk estimates that at least one million tons of cargo will be required, necessitating up to 2,000 Starships per transfer window. Long-term, he envisions Martian independence from Earth and the expansion of missions beyond the Red Planet — to the Asteroid Belt, Jupiter’s moons, and eventually, other star systems.

“This is an opportunity for the Martians to rethink how they want civilization to be,” Musk concluded. “So you can rethink what form of government you want, what new rules you should have. There’s a lot of freedom and opportunity in Mars to do a recompile on civilization, which will be up to the Martians.”

Aerospace Industry

Embraer Deepens India Commitment with New Subsidiary, Eyeing Aerospace Growth and Enhanced Bilateral Brazil-India Ties

Anjana Basu | 31 May 2025

[Source: Defense.in | https://defence.in/threads/embraer-deepens-india-commitment-with-new-subsidiary-eyeing-aerospace-growth-and-enhanced-bilateral-brazil-india-ties.14331/](https://defence.in/threads/embraer-deepens-india-commitment-with-new-subsidiary-eyeing-aerospace-growth-and-enhanced-bilateral-brazil-india-ties.14331/)



Brazilian aerospace and defense major Embraer today announced a significant reinforcement of its commitment to India with the establishment of a fully owned Indian subsidiary which will have its corporate office in AeroCity, New Delhi. This strategic move underscores Embraer's long-term vision for growth and potential collaboration with India's rapidly evolving aerospace and defense landscape.

The establishment of a subsidiary in India aims at strengthening its interests across defense, commercial aviation, business aviation, services & support and the burgeoning urban air mobility sector. Embraer is working on growing its team in the country, building capacity to capitalize

on the opportunities within the country's ever-evolving aerospace and defense industry. This includes establishing teams across corporate functions and specialized cells focused on procurement, supply chain and engineering.

"India is a key market for Embraer, and this expansion demonstrates our unwavering commitment to the country," said Francisco Gomes Neto, President & CEO of Embraer. "We are excited to deepen our collaboration with the Indian aerospace and defense industry, leveraging our expertise and technology to contribute to the nation's growth and Make in India efforts. We see significant opportunities across defense, commercial aviation, business aviation, services & support, and the emerging urban air mobility sector."

Embraer is significantly deepening its engagement in India. The company has a substantial footprint with nearly 50 Embraer aircraft and 11 aircraft types currently operating in the country - from commercial aviation, defense and business aviation, all supported by Embraer's service and support network in the country.

Embraer's growth in the country also underscores the strengthening of ties between Brazil and India, with Embraer's expansion in the region reflecting a shared commitment to deeper collaboration and mutual growth. Embraer's involvement in India, including participating at the upcoming IATA AGM 2025 in New Delhi, highlights the company's strategic focus on the Indian market and ongoing efforts to engage with key stakeholders across the aviation ecosystem.

This announcement builds upon recent strategic moves Embraer has made in India, including an MoU signed in February 2024 between Embraer Defense & Security and Mahindra Defence Systems to evaluate the opportunity to jointly pursue the Indian Air Force's Medium Transport Aircraft (MTA) program with the C-390 Millennium.

The C-390 is a new generation multi-mission aircraft designed and built to take on the demands of the 21st century operating environment. The aircraft is the most advanced in its class and flies faster (470kts) and further on a standard crew duty day. It also carries more cargo (26 tons) compared to other medium sized military cargo aircraft. The C-390 has been in operation for many years at Full Operational Capability and can perform a wide range of missions such as transporting and dropping cargo and troops, medical evacuation, search and rescue, humanitarian missions, firefighting and air-to-air refueling both as a tanker and a receiver.

On the commercial aviation front, the E-Jets family of regional and small narrowbody aircraft brings significant benefits to India's air connectivity by unlocking 'blue ocean' opportunities found in tier two and tier three cities and contributing to India's aspirations of becoming a leading global aviation hub.

The E-Jets have transformed and enhanced regional connectivity as proven with Star Air - an all-Embraer operator of E175 and ERJ145 aircraft. With a range beyond the turboprop and capacity below the 180-seat narrowbody, the E-Jets are empowering airlines to tap on

the next frontier of growth through enhanced regional connectivity and optimization of capacity to demand on thin routes.

Embraer aircraft that are operated by Indian Forces include the Legacy 600 aircraft used for the transportation of government officials and VIPs by the Indian Air Force (IAF) and Border Security Force (BSF) and the 'Netra' AEW&C aircraft based on the Embraer ERJ145 platform operated by the IAF.

Starting 2026, HAL to Overhaul Tejas Mk1 Jets with Mk1A's AESA Radar, Improved Displays, and EW Suites

Raghav Patel | 30 May 2025

Source: [Defence.in](https://defence.in/threads/starting-2026-hal-to-overhaul-tejas-mk1-jets-with-mk1as-aesa-radar-improved-displays-and-ew-suites.14325/) | <https://defence.in/threads/starting-2026-hal-to-overhaul-tejas-mk1-jets-with-mk1as-aesa-radar-improved-displays-and-ew-suites.14325/>



State-owned aerospace and defence company Hindustan Aeronautics Limited (HAL) has announced plans to commence a significant upgrade and overhaul programme for the Indian Air Force's (IAF) fleet of Tejas Mk1 fighter jets, beginning in 2026.

This initiative aims to bolster the operational capabilities of the earlier Initial Operational Clearance (IOC) and Final Operational Clearance (FOC) versions of the Tejas Mk1. The upgrades will be implemented in stages, bringing these aircraft closer to the more advanced standards of the Tejas Mk1A variant.

The Tejas Mk1, a critical asset in India's aerial defence, has been serving the IAF since its first squadron was formed in 2016. The initial IOC and subsequent FOC versions, while effective, do not possess some of the sophisticated systems found in the newer Tejas Mk1A.

The Mk1A features superior avionics, an advanced Active Electronically Scanned Array (AESA) radar for improved target detection and tracking, enhanced electronic warfare (EW) systems for better self-protection and disruption of enemy systems, and the capability to integrate cutting-edge weaponry such as the Beyond Visual Range (BVR) Astra missile.

To address this technological difference, HAL's upgrade strategy will primarily focus on enhancing the aircraft's electronic systems rather than undertaking extensive structural changes, like modifying the air intake, which would involve considerable redesign and testing efforts.

The upgrade process will be carried out in phases, concentrating on integrating modern avionics packages. This includes fitting advanced AESA radar systems, improved cockpit displays for better situational awareness for pilots, and more capable electronic warfare

suites.

Such enhancements will significantly elevate the Mk1 fleet's performance to levels comparable with the Tejas Mk1A. This approach is designed to be cost-effective and aims to keep the aircraft out of service for the shortest possible time, thereby maintaining the IAF's operational readiness.

The overhaul, set to start in 2026, will also address the routine wear and tear on the aircraft, ensuring the airframes remain fully operational and mission-capable for an extended service life.

HAL's decision to prioritise avionics upgrades over major structural modifications, such as those seen in the latest Tejas Mk1A related to its air intake, is a strategic one. The company intends to maximise the combat effectiveness of the existing Mk1 fleet through these critical electronic enhancements.

Advanced avionics are vital for success in contemporary air warfare, enabling the Tejas Mk1 to operate effectively in complex, networked battle environments and contested airspaces.

This upgrade programme aligns with India's broader goal of modernising its armed forces and strengthening its indigenous defence manufacturing capabilities.

GE Pledges Doubled F404 Engine Output for India's Tejas Mk1A, Promise to Deliver 24 Engines Annually from 2027

Raghav Patel | 31 May 2025

[Source: Defence.in | https://defence.in/threads/ge-pledges-doubled-f404-engine-output-for-indias-tejas-mk1a-promise-to-deliver-24-engines-annually-from-2027.14326/](https://defence.in/threads/ge-pledges-doubled-f404-engine-output-for-indias-tejas-mk1a-promise-to-deliver-24-engines-annually-from-2027.14326/)



GE Aerospace has provided a significant assurance to Hindustan Aeronautics Limited (HAL) regarding India's indigenous Tejas Light Combat Aircraft (LCA) Mk1A programme.

The American aviation giant has committed to doubling the production of its F404-IN20 engines from the current rate of 12 units per year to 24 units annually, starting in 2027.

This development follows a challenging 14-month period of delays in engine deliveries which had previously affected HAL's manufacturing schedule for the advanced fighter jets.

Sources have confirmed that GE has recently delivered the first F404 engine of the current batch and is actively working to meet HAL's complete engine requirements, addressing earlier production line difficulties.

The F404-IN20 engine is a specially adapted, high-thrust version of GE's globally recognised F404 engine family, engineered specifically for the single-engine Tejas Mk1A aircraft, providing 84 kilonewtons (kN) of thrust.

This enhanced power is achieved through advanced features such as a higher-flow fan and single-crystal turbine blades, establishing it as the most powerful variant in the F404 series.

These engines are vital for the Indian Air Force (IAF), which is looking to bolster its fleet and address a shortage of fighter squadrons. The IAF has an existing order for 83 LCA Mk1A jets, a deal valued at approximately 48,000-crore from February 2021. An additional procurement of 97 jets is also under consideration, potentially bringing the total order to 180 aircraft.

To meet this substantial demand, HAL plans to manufacture 24 Tejas Mk1A jets each year, a production rate that is heavily reliant on a consistent supply of engines from GE.

The interruption in F404 engine deliveries, which lasted for 14 months beyond the originally planned schedule of March 2024, was attributed to the reactivation of GE's production line. This line had been inactive for five years due to an order gap between 2016 and 2021.

Restarting production was further complicated by widespread global supply chain disruptions and the necessity to re-certify vendors, an issue GE has reportedly

encountered across its aerospace operations.

The first engine from the revised schedule was successfully delivered on March 25, 2025. GE has also committed to supplying another 11 engines by the close of 2025, making a total of 12 for the year.

This initial delivery has enabled HAL to move forward with critical testing and integration processes. Currently, three LCA Mk1A airframes are complete, with another 11 in advanced stages of assembly at HAL facilities in Bengaluru and Nashik.

GE Aerospace's commitment to increase engine production to 24 units annually by 2027 is in step with HAL's objective of delivering between 16 and 24 Tejas Mk1A jets to the IAF each year.

This enhanced engine supply rate is intended to support the timely completion of the existing order for 83 jets, anticipated by 2029, as well as the potential additional order of 97 jets, which are targeted for delivery by the 2031-2032 financial year.

However, the prior delays have already affected the IAF's modernization timeline, with concerns that its fighter squadron strength could decrease to 27 by 2032 if production schedules face further setbacks.

Some analysts have pointed out that GE's earlier difficulties in foreseeing and managing supply chain challenges, especially after a \$716-million contract was signed in August 2021, were concerning given the strategic importance of the Tejas programme for India's

national defence, particularly in light of regional security dynamics with China and Pakistan.

The F404-IN20 engine is part of a long-standing relationship; its predecessor, the standard F404 engine, has been the powerplant for the earlier Tejas Mk1 variant since the 1980s, with 65 such engines delivered by 2016.

The renewed and ongoing partnership between GE and HAL, which now extends over four decades, also includes ambitious plans for the future. This includes the co-production of the more powerful F414 engine, which is slated for the upcoming LCA Mk2 and India's fifth-generation Advanced Medium Combat Aircraft (AMCA).

A significant agreement for 80% technology transfer for the F414 engines was signed in 2023, underscoring the depth of this strategic collaboration.

Aatmanirbhar Bharat: Raksha Mantri approves Advanced Medium Combat Aircraft Programme Execution Model through Industry Partnership

27 May 2025

Source: [PIB | https://www.pib.gov.in/PressReleasePage.aspx?PRID=2131528](https://www.pib.gov.in/PressReleasePage.aspx?PRID=2131528)



In a significant push towards enhancing India's indigenous defence capabilities and fostering a robust domestic aerospace industrial ecosystem, Raksha Mantri Shri Rajnath Singh has approved the Advanced Medium Combat Aircraft (AMCA) Programme Execution Model. The Aeronautical Development Agency (ADA) is set to execute the programme through Industry partnership.

The Execution Model approach provides equal opportunities to both private and public sectors on competitive basis. They can bid either independently or as joint venture or as consortia. The entity/bidder should be an Indian company compliant with the laws and regulations of the country.

This is an important step towards harnessing the indigenous expertise, capability and capacity to develop the AMCA prototype, which will be a major milestone towards Aatmanirbharta in the aerospace sector.

ADA will shortly issue an Expression of Interest (EoI) for the AMCA Development Phase.

F-15E Spotted Packing Big Laser-Guided Rocket Arsenal Ideal for Drone Hunting

Joseph Trevithick | 23 May 2025

Source: *TWZ* | <https://www.twz.com/air/f-15e-spotted-packing-big-laser-guided-rocket-arsenal-ideal-for-drone-hunting>



Unattributed via *The Merge*

A picture has emerged showing a U.S. Air Force F-15E Strike Eagle loaded with at least three seven-shot 70mm rocket pods under its left wing. If the jet had three more pods on the right side, this would amount to a whopping 42 rockets, which could be carried together with eight traditional air-to-air missiles. Such a loadout would turn the F-15E into a flying counter-drone and cruise missile arsenal ship capable of an incredible 50 engagement opportunities, minus the gun.

The Air Force has already proven the extreme value of laser-guided 70mm Advanced Precision Kill Weapon System II (APKWS II) rockets in the air-to-air role in combat on

the F-16, news TWZ first broke earlier this year and has continued to follow very closely. Integrating APKWS II into the F-15E's arsenal isn't surprising, especially considering how active these aircraft have been in countering lower-performing aerial threats.

The picture of the rocket-armed F-15E, seen below, first appeared on social media accounts for *The Merge*, a military aviation podcast and associated newsletter, yesterday. "An Air Force F-15E Strike Eagle testing laser-guided rockets was spotted with a 6-pod 42-rocket loadout in flight test," *The Merge* wrote in an accompanying post on Instagram.

Though *The Merge* says the aircraft was carrying six rocket pods at the time, only three are clearly visible in the image on the jet's left underwing pylon, but a symmetric load makes perfect sense. Pods full of laser-guided APKWS II rockets are relatively easy to spot since the weapons are longer than unguided 70mm types and their noses protrude noticeably from the front as a result. As it exists now, APKWS II consists primarily of a laser guidance section sandwiched between one of a variety of warhead types and a standard 70mm rocket motor.

In addition to the rocket pods, the Strike Eagle has an inert AIM-120 Advanced Medium-Range Air-to-Air Missile (AMRAAM) without control fins and a flight test data pod under its left wing. An AN/AAQ-33 Sniper Advanced Targeting Pod (ATP) and an AN/AAQ-13 navigation pod (which incorporates a forward-looking infrared sensor and a terrain-following radar) are seen loaded on the stations under the jet's left and right air intakes, respectively.

The F-15E seen in the picture also has an “ET” tail code, reflecting an aircraft assigned to the 96th Test Wing headquartered at Eglin Air Force Base in Florida.

“I can confirm the pic was taken here at Eglin AFB,” Gabriel Myers, a spokesperson for the 96th Test Wing, told TWZ when asked for more information about the image of the rocket-toting F-15E. “The Eglin AFB test community through strong partnerships have aggressively conducted integrated test of the Advanced Precision Kill Weapon System. By working at speed to ensure advanced capabilities have the intended effects, we increase warfighter readiness and lethality to meet the global demands of the joint force.”

When the F-15E might be cleared to operationally employ APKWS II rockets is unclear.

“Unfortunately, we can’t speak to specific timelines [for the test work], but we can say it was done rapidly,” Myers continued.

In U.S. service, on the fixed-wing side, the precision-guided rockets have been integrated onto Marine Corps AV-8B Harriers and F/A-18C/D Hornets and U.S. Air Force F-16C/D Vipers and A-10 Warthogs. Marine AH-1Z Viper and UH-1Y Venom helicopters, as well as U.S. Navy MH-60R/S Seahawks and U.S. Army AH-64D/E Apaches, can also employ APKWS II.

A full air-to-air loadout for the F-15E currently consists of eight missiles. Four missiles – either short-range AIM-9 Sidewinders or AIM-120 Advanced Medium-

Range Air-to-Air Missiles (AMRAAM) – can be loaded on launch rails on either side of the Strike Eagle’s two underwing pylons. Two more AIM-120s can be carried on pylons on each of the conformal fuel tanks (CFT) attached to the sides of the fuselage. The jets can also carry a wide array of air-to-ground munitions and other stores on the pylons under their wings, on the CFTs, and on their ventral centerline hardpoint.

Adding APKWS II to the F-15E’s already very expansive arsenal would give the jet an additional lower-cost tool for precisely engaging a variety of ground targets, as well. These can include light armored vehicles. As the newly-emerged picture highlights in showing 21 engagement opportunities on a single pylon, the laser-guided rockets offer significant benefits when it comes to magazine depth.

But it’s the Strike Eagle and APKWS II combo’s potential in the air-to-air role that is perhaps most exciting. As we noted earlier, Air Force F-16s first began employing the laser-guided rockets in an anti-air optimized configuration to shoot down Houthi drones during operations over and around the Red Sea last year, which TWZ was first to report. The Air Force had announced back in 2019 that it had demonstrated APKWS II’s ability to be used as an air-to-air weapon in a test wherein an F-16 downed a surrogate for a subsonic cruise missile, something we were also first to report on. APKWS II is also combat-proven in the surface-to-air role against drones, as well as in air-ground modes and surface-to-surface modes.

Since January, F-16s have been observed flying the Middle East carrying air-to-air loadouts that include one or two seven-shot 70mm rocket pods, as well as traditional air-to-air missiles and LITENING targeting pods. This had already underscored the magazine depth benefits of APKWS II. A typical air-to-air for the Viper consists of six air-to-air missiles. Just having a pair of rocket pods on one pylon effectively triples the number of anti-air engagement opportunities per sortie. The F-15E with six seven-shot rocket pods, along with eight air-to-air missiles, goes far beyond that capacity.

APKWS II is also a significantly lower-cost anti-air weapon than traditional air-to-air missiles in U.S. military inventory today. The APKWS II guidance kit, which is the most expensive part of the munition, has a unit cost of around \$15,000 to \$20,000. The warhead and motor add a few thousand dollars more to the total unit price. Current generation AIM-9X Sidewinders each cost in the region of \$450,000, while the latest AIM-120 variants are \$1 million or more apiece.

Even with the air-to-air specific upgrades developed for APKWS II, it does still have limitations when employed against aerial threats, as TWZ has noted in the past in the context of F-16 counter-drone missions:

“In an air-to-air engagement, the laser designator in the LITENING pod could be used to ‘laze’ or designate the target. LITENING’s sensor turret can be slaved to the radar on the aircraft carrying it, or vice versa. So-called buddy lasing, where one aircraft designates the target

for another, could also be useful in this case, especially given the speed differential between typical Houthi drones and F-16s. One jet could keep the target steadily lazed while the other makes its attack run.”

“APKWS IIs are usable against drones, as well as subsonic cruise missiles, in the first place because those are relatively steady, non-reactionary, low-performance targets. The rockets are not dogfighting weapons.”

BAE Systems, the prime contractor for the APKWS II, is now developing a dual-mode guidance package that adds a passive infrared seeker to give the rocket a quasi-fire-and-forget capability. A laser designator would still be needed to provide initial cueing, but the launch platform would be able to move much more rapidly from engaging one target to the next with the addition of the infrared guidance mode, as you can read more about here.

Pairing F-15E with APKWS II, even just with the guided rocket’s existing capabilities, would offer additional advantages in the air-to-air role given the range and endurance of the Strike Eagle, as well as its substantial overall payload capacity. The F-15E is also a two-seat aircraft, which allows the pilot to remain fully focused on flying the aircraft while the back-seater handles targeting duties.

Together with aerial refueling support, an F-15E armed with APKWS II rockets and traditional air-to-air missiles could provide a far more persistent counter-air screen with a huge magazine depth against drones and some cruise missile types. This kind of general

scenario is what Air Force Strike Eagle crews found themselves in on multiple occasions while defending Israel from Iranian attacks last year, during which, running out of missiles became the limiting factor.

Specifically, while responding to Iran's drone and missile attacks on Israel in April 2024, F-15Es had to land to rearm while threats were still flying overhead. At least one Strike Eagle crew switched to their aircraft's 20mm M61 Vulcan cannon after running out of missiles, but was unable to shoot anything down.

"The drone war is kind of like a video game. You just gotta get the jets up in the air and position them correctly for an intercept. The radar will easily see them after they're launched and then it's just how many missiles you have versus how many drones are launched. The technical aspect of detecting them and downing them is easy," Daren "Shotgun" Sorenson, a retired Air Force lieutenant colonel who flew F-15Es, told TWZ in an interview last summer. "It's easy work. You can do it all day long until you run out of missiles."

The Air Force also recently sent a detachment of F-15Es to the highly strategic island of Diego Garcia in the Indian Ocean, explicitly to provide force protection for forces currently there, including B-52 bombers, a deployment TWZ was first to report. This only further underscores the key role Strike Eagles are already playing in shielding high-value assets, especially from drones and cruise missiles.

All of this also applies at least equally, if not more so, to the Air Force's incoming F-15EX Eagle II aircraft. The F-15EX is the latest and most capable variant to emerge in the extended Strike Eagle family, and is expected to be used primarily in the homeland air defense role in U.S. service, at least initially. Last year, TWZ laid out in detail how the Strike Eagle's performance in the anti-air role in the Middle East had bolstered the case for the EX in U.S. and Israeli service. Indonesia also plans to buy F-15s derived from the EX variant, and other foreign customers, including Poland.

"The proliferation of one-way attack drones is driving a massive demand signal for counter-UAS capabilities," The Merge also told TWZ directly when asked about the picture of the rocket-armed Strike Eagle. "The cost exchange afforded by APKWS rockets—and the flexibility and magazine depth by putting them on the F-15E/X—should make a meaningful difference."

Adding APKWS II to the F-15E's arsenal, especially for air-to-air use, could be a factor in ongoing debates about the future of the Air Force's Strike Eagles, as well. Congress recently blocked the service, at least until 2027, from pursuing plans to retire more than half of the heavily in-demand Strike Eagle fleet.

It would also not be surprising at all to see APKWS II join already growing air-to-air loadouts available to U.S. Navy F/A-18E/F Super Hornets. A year ago, Houthi drone threats in and around the Red Sea had already prompted that service to launch a crash program to increase the number of AIM-9Xs a Super Hornet could carry on a single sortie.

The Navy has since officially dubbed F/A-18E/Fs armed with five AIM-120s and four AIM-9Xs as “Murder Hornets.”

Regardless of the threat of partial retirement, many F-15Es remain in Air Force service in the coming years, there are clear signs the jets are now in line to get an important firepower boost, including when it comes to shooting down drones, in the form of APKWS II.

Karnataka wins Tata-Airbus Helicopter Manufacturing Unit

Arindam Majumder | 26 May 2025

Source: *Economic Times* | <https://economictimes.indiatimes.com/news/defence/karnataka-wins-tata-airbus-helicopter-manufacturing-unit/articleshow/121419379.cms?from=mdr>



European aviation major Airbus and Tata Advanced Systems (TASL), the aerospace arm of the Tata group, will set up the Final Assembly Line (FAL) for the H125 helicopters for the Indian Air Force (IAF) in Kolar, Karnataka, people aware of the development said.

The facility is India’s first privately-led helicopter assembly facility and is a shot in the

arm of the government’s Make in India campaign as part of which the government is trying to build self-reliance in aerospace manufacturing.

The factory will produce Airbus’ best-selling H125 helicopter from its civil range for India and the neighbouring countries and will be the fourth such facility in the world after France, US and Brazil. It will start with a production capacity of 10 helicopters per year but will see expansion as Airbus has projected a demand for 500 light helicopters of the H125 class in the country and south Asia in the next 20 years.

The people quoted above said that the plant will be set up in the Vemgal Industrial area which is around two hours from Bengaluru and already houses other facilities of TASL including a satellite manufacturing plant.

Spokespersons of Airbus and TASL didn’t reply to queries. Gunjan Krishna, commissioner for industrial development and director, industries department of Karnataka refused to speak on the topic as the discussions were confidential.

Karnataka, they said, was chosen among multiple other locations in Andhra Pradesh, Uttar Pradesh and Gujarat due to the state’s established ecosystem in aerospace manufacturing.

While Anantapur in Andhra Pradesh which gained international recognition after becoming home to Kia Motors’ manufacturing unit was a strong contender, Karnataka was chosen due to its strong ancillary support ecosystem besides being a hub for TASL which will build the plant.

The Tata-owned company recently acquired 7.4 lakh sq. ft. plot in Karnataka’s Vemgal

Industrial Area for the establishment of an aircraft manufacturing and final assembly line, including Maintenance, Repair, and Overhaul (MRO) facilities.

“The locations were appraised based on their logistics facility, expansion potential, availability of skilled workforce and promises of the state government like fast track approval of permissions,” a person involved in the project said.

He said that Vemgal has potential of expansion including setting up of helipads which is a must for a final assembly line for testing of aircraft before delivery.

Besides that the state as part of its aerospace and defence policy has also promised subsidy on land including capital investment, stamp duty, incentives in electricity charges and production linked incentives of 1% of annual turnover for a period of 5 years.

“This will not only strengthen indigenous manufacturing capabilities but also act as a catalyst for developing advanced industrial clusters,” said Aravind Melligeri, executive chairman & CEO, Aequus a major aerospace manufacturer which counts Airbus as a customer.

Initiatives like this drive skill development, attract supply chain investments, and create high-value employment, accelerating the transformation of India into a globally competitive and strategic node in global aerospace manufacturing,”

Tata and Airbus are also setting up a final assembly line for the C295 aircraft in Vadodara, Gujarat. Gujarat has recently bagged multiple

high-ticket investment projects including multiple semiconductor plants, C295 aircraft and the international diamond bourse leading to accusations from opposition political leaders that the state was being favoured by the central government.

Further Reading

1. China’s Tianwen-2 Lifts off on Mission to Bring Asteroid Samples Back to Earth - <https://spacenews.com/china-launches-tianwen-2-mission-to-sample-near-earth-asteroid/#:~:text=Liftoff%20of%20the%20Long%20March%203B%20Y110%20from,asteroid%20and%20lat-er%20survey%20a%20main%20belt%20comet.>
2. China Plans to Arm Tiangong Space Station with Self-Defence Bots, Scientist Says - <https://www.scmp.com/news/china/science/article/3312063/china-plans-arm-tiangong-space-station-self-defence-bots-scientist-says>
3. DeepSeek’s AI Model Being Used to Design New Chinese Warplanes, Leading Engineer Says - <https://www.scmp.com/news/china/military/article/3308934/deepseeks-ai-model-being-used-design-new-chinese-warplanes-says-leading-engineer>

"The insentient ocean does not heed my humble request, even after three days have passed. Then Lord Ram, angered, said 'No love without fear.' "Our job is to hit the targets, not to count the body bags."

Air Marshal AK Bharti



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Centre for Air Power Studies

P-284 Arjan Path, Subroto Park, New Delhi - 110010

Tel.: +91 - 11 - 25699131/32 Fax: +91 - 11 - 25682533

Email: capsnetdroff@gmail.com

Website: www.capsindia.org

Advisor : AVM Ashish Vohra VSM (Retd)

Editor, Concept & Content : Col Amit Bedi

Composed by Mr Rohit Singh

Tel.: +91 9716511091

Email: rohit_singh.1990@hotmail.com