खंड/Vol. : 50 अंक/Issue :101 04 /06/2025

जून June 2025

# समाचार पत्रों से चयनित अंश **Newspapers** Clippings

डीआरडीओ समुदाय को डीआरडीओ प्रौदयोगिकियों, रक्षा प्रौदयोगिकियों, रक्षा नीतियों, अंतर्राष्ट्रीय संबंधों और विज्ञान एवं प्रौदयोगिकी की नूतन जानकारी से अवगत कराने हेत् दैनिक सेवा

A Daily service to keep DRDO Fraternity abreast with DRDO Technologies, Defence



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### DRDO News

## BSF taps DRDO for tech to monitor Bangla border stretch in Sundarbans

#### Source: The Indian Express, Dt. 04 Jun 2025

Amid the Centre's crackdown on illegal immigration and cross-border terror networks, the Border Security Force (BSF) has sought the help of the Defence Research and Development Organisation (DRDO) for deployment of advanced surveillance systems — including drones, radars and satellites — along a critical 113-km stretch of the Sundarbans on the India-Bangladesh border.

The request was made during a high-level coastal security review meeting chaired by the Secretary (Border Management) at the Ministry of Home Affairs (MHA) in North Block in the second week of May, shortly after Operation Sindoor.

The focused move to identify and push back illegal Bangladeshi immigrants within 30 days of detention began after the Pahalgam attacks in April, and has gained momentum since Operation Sindoor.

As part of this crackdown, the BSF has stepped up vigilance along the border and is now looking to rely more heavily on high-end surveillance technologies — including drones, radars, satellite imagery and CCTVs — to plug gaps in sensitive areas, especially the Sundarbans, which has long been a known route for illegal crossings.

"The BSF has proposed to bring nearly 113 kms under tech surveillance," said an MHA official. "They've already conducted a feasibility study, in consultation with ISRO and DRDO, and have asked DRDO to carry out field visits to identify the most effective solutions. However, DRDO is expected to take up the Sundarbans site only after it completes its current work on a similar project in Gujarat's creek areas."

The BSF currently monitors about 123 kms of the Sunderbans sector, much of it difficult terrain dotted with creeks and dense mangrove forests.

The demand for a technology-first approach has grown following intelligence inputs that terror outfits are exploring India's riverine and maritime borders — especially through the Sundarbans — to infiltrate. The area, spread across remote islands and crisscrossed by tidal waterways, poses unique challenges for conventional patrolling.

At present, the BSF relies on eight floating Border Outposts (BOPs) and 96 other patrol vessels to maintain vigilance. It has also approached the West Bengal government for land to construct seven observation towers and to allow more forest post co-locations — a model where BSF personnel share infrastructure with forest officials. Three such co-located posts already exist.

However, the MHA official said progress has been uneven. "Despite repeated surveys, officials from the Forest and State Revenue departments did not participate, which has stalled the process," the official said.

At the meeting last month, which was also attended by BSF Director General Daljit Singh Chaudhary, West Bengal government representatives are learnt to have said that they had surveyed seven sites and agreed to provide land at two. "The co-location of three more BSF posts is still awaiting clearance from the Forest Department. Both sides were directed to explore alternate sites if needed and to jointly assess feasibility at each location," the official said.

The Sundarbans push comes amid growing concerns within the security establishment that a porous eastern frontier — unless sealed with urgency — could undermine efforts to curb both illegal immigration and terror infiltration. As part of its wider border strategy, the Centre has already deployed additional forces, stepped up deportation efforts, and expanded intelligence coordination across agencies.

https://indianexpress.com/article/india/bsf-taps-drdo-for-tech-to-monitor-bangla-borderstretch-in-sundarbans-10046827/

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# After Brahmos missiles, India develops another lethal weapon, Pakistan will shiver in fear, tension for China also

#### Source: India.com, Dt. 03 June 2025

After the immense success shown by the indigenous weapons of India during India's Operation Sindoor, the demand for more powerful and dangerous weapons from Defence Research and Development Organisation (DRDO) has only increased. During the recent India-Pakistan conflict, Pakistan reportedly used Chinese-supplied SH-15 Howitzers guns against India. In order to counter Pakistan in the artilleries threat, India's DRDO is preparing to make a blast with another indigenous weapon.

#### DRDO's 155 artillery shell guns

In its recent initiative, DRDO has developed a 155 artillery shell, making India self-reliant in the field of indigenous weapons. For a background information, artillery gun systems are primarily used for indirect fire and can be mounted on different platforms. DRDO's Advanced Towed Artillery Gun System (ATAGS) has a 155 mm/52 calibre gun barrel with a chamber volume of 25 litres as against the newer one with chamber volume of 23 litres. Reports also say that the weight of the shell is around 45 kg and it can be fired up to a distance of 24 to 32 km.

The DRDO initiative is expected to strengthen India's defense capability and also promote 'Make in India' and Atmanirbhar Bharat initiatives. In addition to this, the new development is expected to save India from buying billions of dollars worth foreign artillery shell gun.

#### DRDO's growth after Operation Sindoor

DRDO Chairman Samir V Kamat recently said he was hopeful that defence exports will increase after Operation Sindoor as indigenous military equipment has got "war-tested".

Interacting with reporters on the sidelines of the CII Summit here, he also spoke about the recent clearance given by Defence Minister Rajnath Singh to the "execution model" to

design and produce India's ambitious fifth-generation stealth fighter jet — the advanced medium combat aircraft (AMCA).

"By 2034, the development work should be completed, and after that production should start from 2035. The first prototype flight will be ready by end of 2029," he said.

https://www.india.com/news/india/after-brahmos-missiles-india-develops-another-lethalweapon-155-artillery-shell-guns-pakistan-will-shiver-in-fear-tension-for-china-7859582/

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### **Defence News**

Defence Strategic: National/International

# Six Pakistan fighter jets, one C-130 aircraft, multiple cruise missiles, UAVs destroyed during IAF retaliation in Op Sindoor

#### Source: The Economic Times, Dt. 03 Jun 2025

As per an ongoing analysis of the damage inflicted upon by the Indian Air Force on Pakistan Air Force, it is emerging that 6 PAF fighter jets, two high value aircraft, over 10 UCAVs, one C-130 transport aircraft along with multiple cruise missiles were destroyed by Indian air-launched cruise missiles and surface-to-air missiles.

Sources who were involved in the operations launched against Pakistaggression told ANI that as per the technical analysis of the data available with the IAF, six of the Pakistan Air Force fighter aircraft were shot down in air during operations.

One high value aerial asset, which could either be an electronic counter measures aircraft or an Airborne Early Warning or Control Aircraft, was taken out by a long range strike by the Sudarshan at distances of around 300 km, they said.

The sources said that during the four-day conflict, the strikes at Bholari airbase using air to surface cruise missiles resulted in the loss of another AEWC aircraft of Swedish origin.

There are inputs about presence of fighter jets also in the hangar but since the Pakistanis are not even taking out debris from there, "we are not counting the fighter aircraft losses on ground", they said.

The Pakistani fighter jets were captured by the Indian Air Force radars and air defence missile systems and were seen vanishing after hits were secured by the air defence systems.

The Pakistan Air Force also lost a C-130 transport aircraft during one of the drone strikes by Indian Air Force in the Pakistani Punjab.

The Indian Air Force used only air-launched cruise missiles to attack Pakistani bases and no surface- to-surface BrahMos missiles were used in the attacks, they said. In one of strikes on a hangar by Rafale and Su-30 jets, a significant number of Chinese Wing Loong series medium altitude long endurance drones were destroyed, the sources said.

More than 10 UCAVs were also destroyed by the different IAF air defence systems over Pakistani air space in the conflict along with large-scale interception of Pakistani air and ground launched cruise and ballistic missiles aimed at different air bases, they said.

The Indian Air Force, the sources said, is still carrying out the analysis of the huge amount of data gathered by it during the conflict. The conflict between India and Pakistan started in May 6-7 night when India retaliated by targeting terrorist universities in the Pakistani Punjab and Pakistan occupied Jammu and Kashmir in response to Pahalgam terror attack.

The conflict lasted till May 10 afternoon when Pakistan side requested for a ceasefire in view of the heavy losses suffered by it in the attacks by the Indian Air Force.

https://economictimes.indiatimes.com/news/defence/six-pakistan-fighter-jets-one-c-130aircraft-multiple-cruise-missiles-uavs-destroyed-during-iaf-retaliation-in-op-sindoor/ articleshow/121601588.cms

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# Pakistani document shows India's extensive strikes during Operation Sindoor; lists 7 new targets

#### Source: The Economic Times, Dt. 03 Jun 2025

A new Pakistani document has shed fresh light on India's precision strikes on Pakistani targets during the four-day clashes last month as it listed at least seven previouslyunknown locations. The document showed India targeting locations in Peshawar in Khyber-Pakhtunkhwa province, Attock, Bahawalnagar, Chhor and Hyderabad in Sindh province and Gujrat and Jhang in Punjab province. These details featured in the document Pakistan released on Operation Bunyan-um-Marsoos which it had launched in response to India's Operation Sindoor.

The document shared with the Pakistani media features graphic details of India's drone strikes targeting Pakistan on May 8, 9 and 10. India launched the operation on May 7, targeting terrorist infrastructure in territories controlled by Pakistan using long-range weapons such as the Brahmos cruise missile in response to the Pahalgam terror attack.

The Indian military targeted nine terror infrastructures that included Markaz Taiba of Lashkar-e-Taiba (LeT) in Muridke, Markaz Subhan Allah of Jaish-e-Mohammad (JeM) in of Bahawalpur and Hizbul Mujahideen's Mehmoona Joya Facility in Sialkot.

It also struck LeT's base in Markaz Ahle Hadith in Barnala and its camp in Muzaffarabad's Shawai Nalla. Following the Indian action, Pakistan attempted to attack Indian military bases on May 8, 9 and 10.

The Pakistani attempts were strongly responded to by the Indian side by inflicting heavy damages to a number of key Pakistani military installations including air bases, air defence systems, command and control centres and radar sites.

Foreign Secretary Vikram Misri on May 10 announced that India and Pakistan reached an understanding to stop all firings and military actions on land, air and sea, with immediate effect. New Delhi has been maintaining that India's fierce attacks on May 10 forced Pakistan to plead for ending the hostilities.

India said Operation Sindoor reflected India's new approach in combating cross-border terrorism from Pakistan and its resolve to not succumb to Islamabad's nuclear blackmail.

https://economictimes.indiatimes.com/news/defence/pakistani-document-shows-indiasextensive-strikes-during-operation-sindoor-lists-7-new-targets/articleshow/ 121603209.cms

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# Russian missiles, Western worries: India's arms map is changing

#### Source: The Economic Times, Dt. 03 Jun 2025

India is strategically and sharply reducing its reliance on Russian defence equipment, marking a significant break from decades of dependence on Moscow's arms. Officials familiar with the matter has earlier told Bloomberg that New Delhi has slashed orders from Russia and turned to Western suppliers, especially the US and France. This shift is a big deal for American defence companies, who are now landing contracts worth billions, and for India, which is diversifying its sources to secure more advanced, reliable technology.

Speaking at the US-India Strategic Partnership Forum, US Commerce Secretary Howard Lutnick said, "You should expect a (trade) deal between the United States and India in the not too distant future." He also noted progress in having the right people involved in the negotiations.

However, one factor that previously strained relations was India's preference for buying military equipment from Russia. Lutnick pointed out that India is now starting to purchase military equipment from the United States, which is a positive step. Lutnick stated, "I think India [is] starting to move towards buying military equipment from the United States, which then goes a long way." But the question remains, what is prompting India's shift away from Russian arms and defence technology.

#### Why India is moving away from Russian arms

India's defence imports from Russia have plummeted from 76% in 2009 to just 36% last year, according to the Stockholm International Peace Research Institute (SIPRI). This is the first time since the 1960s that Russia's share fell below half. The change reflects Prime Minister Narendra Modi's strategy to reduce dependency on Russia, despite India continuing to buy Russian oil and maintain diplomatic ties.

Bloomberg had cited senior Indian officials saying that joint projects with Russia, such as manufacturing helicopters and advanced fighter jets, have been shelved. A proposal to lease a Russian nuclear-powered submarine to train Indian crews is also unlikely to proceed. The only pending Russian deliveries are two warships and anti-missile shield batteries ordered before the Ukraine conflict began.

On the other hand, Russia is all set to deliver the remaining S-400 air defense units to India by 2025-2026, with Roman Babushkin, deputy chief of mission, confirming that the contract is on track with no delays. This is significant especially considering its overwhelming success during the recent conflict between India and Pakistan following the Pahalgam terror attack. This follows India's \$5.43 billion deal signed in 2018 for five squadrons. Three of the five planned squadrons have already been delivered.

#### The Ukraine war accelerates the shift

The war in Ukraine has exposed cracks in Russia's defence manufacturing and delivery capacity. According to Sushant Singh, a lecturer at Yale University, the delay in supplying anti-missile shields "is proof of Russia's strained capacity." Russia's close ties with China, whose electronics it heavily relies on, raise concerns for India's military planners. As told to Bloomberg, Anit Mukherjee, a King's College London expert on Indian military policy, warned, "Russian defense industries' reliance on Chinese electronics is problematic and a red flag for India."

Even so, India still depends on Russia for spare parts to maintain its existing weapons, including rifles, tanks, and fighter jets. Singh explains, "These will remain in service for decades and India will need spare parts and ammunition from Russia for a long time." But the future lies elsewhere.

#### The growing role of US and Western suppliers

Since 2018, India has signed contracts worth nearly \$20 billion for US-made defence equipment, signalling a clear tilt toward Washington. The country recently approved a \$3 billion deal for 31 long-range drones from General Atomics. India's state-owned Hindustan Aeronautics Ltd. (HAL) and General Electric are close to finalising a deal to jointly produce advanced jet engines for India's next generation of fighter aircraft. These agreements began taking shape during Modi's 2023 visit to the US.

A senior Indian official pointed out that while Russian arms are cheaper upfront, their frequent need for repairs makes them more expensive long-term. "India has slowly shifted to Western-origin platforms because the military is increasingly comfortable with such technology," Mukherjee said.

#### Balancing Act: Russia for oil, US for defence

Modi's foreign policy aims to balance relations carefully. While reducing military dependence on Moscow, India continues to buy discounted Russian oil and offers diplomatic backing. Meanwhile, the US provides advanced technology and jobs through defence partnerships. This shift strengthens the US-India defence relationship just as Washington faces tariff challenges and geopolitical tensions.

Nandan Unnikrishnan from the Observer Research Foundation noted, "India doesn't wish to cross any redlines the West may have — particularly the U.S." This cautious approach aims to keep India aligned with Western defence standards without alienating Russia entirely.

#### Quality concerns and manufacturing challenges

India's doubts about Russian equipment quality predate the Ukraine war. Some Russian gear, like the MiG-29K fighter jets, failed to meet expectations. Swasti Rao, of the Manohar Parrikar Institute for Defence Studies, remarked on India's surprise at Russia's poor performance on the battlefield: "How come the Patriots took down the Kinzhal missiles that were touted as invincible? How come Russian ships are becoming such easy targets...?"

Moreover, India's indigenous fighter jet programme has stalled partly because the USbased General Electric struggled to supply jet engines. This highlights challenges in scaling domestic manufacturing and the importance of Western tech transfers.

#### **Nuclear capabilities**

India's reliance on Russia for nuclear-powered submarines remains, as Mukherjee pointed out, "Russia remains the only country which offers its nuclear submarines to India." However, India's broader partnership with Western countries is incomplete until nuclear technology issues are addressed.

India has earmarked \$100 billion for future arms procurement, creating a vast opportunity for Western suppliers willing to co-produce and transfer technology. This opening benefits firms eager to deepen defence ties and help India build a modern, self-reliant military industry.

#### India–US defence ties deepen under 10-year strategic framework

Meanwhile, India and the United States have entered a new phase in their defence relationship under a 10-year framework signed during Prime Minister Narendra Modi's visit to Washington. The agreement, jointly announced with President Donald Trump, positions India as a key defence partner in the 21st century and formalises deeper cooperation in arms procurement, co-development, and regional security.

India has retained its Strategic Trade Authorisation-1 (STA-1) status, reaffirming its position as a trusted partner in sensitive technology transfers. As both countries negotiate

a bilateral trade agreement, a key component of the defence partnership will involve reviewing arms transfer regulations to streamline procurement and technology exchange.

Following Trump's re-election in early 2025, Washington is accelerating defence sales to New Delhi. Talks are set to begin this year on a Reciprocal Defence Procurement (RDP) agreement to align procurement systems and ensure mutual supply of defence goods and services. This will mark a step forward in industrial integration.

Over the last decade, India has significantly expanded its inventory of US-origin platforms. These include strategic airlift and surveillance assets such as the C-130J Super Hercules, C-17 Globemaster III, and P-8I Poseidon, as well as helicopters like the CH-47F Chinook and MH-60R Seahawk. Attack platforms include the AH-64E Apache and Harpoon anti-ship missiles. Artillery systems like the M777 howitzer and the long-endurance MQ-9B drones also feature prominently.

New co-production proposals for the Javelin anti-tank guided missiles and Stryker infantry combat vehicles are under discussion. In addition, the procurement of six more P-8I aircraft is expected to conclude this year, strengthening India's maritime surveillance in the Indian Ocean.

#### Building deterrence in the Indo-Pacific

India and the US are jointly working to counter Chinese assertiveness in the Indo-Pacific. Partnerships between US defence companies and Indian firms are being used to boost local capacity. One such effort is the collaboration between Anduril Industries and Mahindra Group to co-develop autonomous maritime systems and an AI-enabled counter-UAS platform. L3 Harris is also working with Bharat Electronics to develop active towed array sonar systems for anti-submarine warfare.

Earlier this month, the two nations conducted another edition of the "Tiger Triumph" triservice exercise, highlighting growing interoperability across air, land and sea domains.

#### Roadmap for industrial cooperation and technology

A major highlight of PM Modi's visit was the launch of the Autonomous Systems Industry Alliance (ASIA), which will focus on scaling defence production and industrial partnerships in the Indo-Pacific. This comes in addition to ongoing reviews of the International Traffic in Arms Regulations (ITAR), which aim to simplify maintenance, spares, and repair for US-origin platforms operated by Indian forces.

The US is also reviewing its policies on the transfer of fifth-generation fighter jets and undersea technologies to India. This signals a possible shift in export control norms that have long limited high-end technology transfer.

During the recent bilateral meeting in New Delhi, PM Modi and US Vice President JD Vance discussed regional security, military deployments, and intelligence sharing in the Indo-Pacific. Officials described the visit as a key step in elevating defence ties beyond procurement into areas of logistics and emerging threats.

#### Defence Technology and Trade Initiative: Challenges and the road ahead

While the bilateral framework has evolved significantly since 2015, especially with the signing of foundational agreements like LEMOA, COMCASA, and BECA, cooperation in defence technology has been slow to mature. Earlier attempts under the Defence Technology and Trade Initiative (DTTI) suffered from delays in concluding frameworks and limited progress in co-development.

To provide renewed momentum, both sides have been working under the Initiative on Critical and Emerging Technologies (iCET), launched in January 2023. It serves as an umbrella for civil and defence technology cooperation and is linked to the broader strategic trade dialogue.

Despite progress, hurdles remain. Differences in intellectual property rights, commercial terms, and security safeguards continue to limit deeper technological integration. There is also concern over stringent controls placed on black-box components and software by US firms. Even traditional allies have faced constraints in modifying co-developed systems.

#### INDUS-X: accelerating defence innovation

The India-US Defence Acceleration Ecosystem (INDUS-X), launched in 2023, is another important pillar of the defence relationship. It connects India's iDEX and the US Defence Innovation Unit (DIU) to drive joint innovation. The initial rounds under the INDUS-X Mutual Promotion of Advanced Collaborative Technologies (IMPACT) have already targeted areas like undersea communications and oil spill detection.

Meetings between defence investors and start-ups, as well as academic workshops, have laid the groundwork. However, implementation challenges—such as funding and integration of innovations into operational platforms—remain critical.

A protégé-mentor model is also being explored, where US and Indian companies will collaborate on nurturing start-ups. Facilitating this connection with larger manufacturers will be essential to move promising technologies beyond prototypes.

#### Two flagship programmes lead the way

Two projects are set to define this phase of cooperation. The first is the GE–HAL agreement to co-produce the GE-F414 jet engine, with the final contract expected soon. The second is India's acquisition of 31 MQ-9B drones, including plans for local assembly and global maintenance, repair and overhaul (MRO) services in India.

These deals, though not born directly from the roadmap for industrial cooperation signed in June 2023, align closely with its goals of boosting local manufacturing, increasing technology absorption, and diversifying India's defence supply chains.

Several Indian companies are now actively supplying components to US defence manufacturers. This integration has advanced significantly over the past decade, setting the stage for more ambitious industrial cooperation in the years ahead.

Officials on both sides agree: the frameworks are in place, but execution must now take precedence. There is broad consensus on the need to announce new co-development and R&D projects in 2025 and 2026, especially in strategic areas like artificial intelligence, unmanned systems, and cyber defence.

The update of the 2015 Framework for Defence Relations is also due later this year. As the two nations navigate challenges of regulatory compliance, commercial risk, and industrial coordination, India–US defence cooperation in 2025 has reached a pivotal moment—no longer limited to declarations, but geared towards delivery.

Despite the shift, as of 2025, Russia remains India's largest supplier of military hardware, mostly in spare parts and ammunition. But former Indian defence adviser Amit Cowshish said, "Russia was no longer 'in a position' to meet India's requirements."

https://economictimes.indiatimes.com/news/defence/russian-missiles-western-worriesindias-arms-map-is-changing-s-400-air-defense-unit-howard-lutnick-us-india-tradedeals/articleshow/121588083.cms

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### After drones, a new warfare straight out of science fiction

#### Source: The Economic Times, Dt. 03 Jun 2025

Recent drone warfare has proved that next battlefields are up in the air. After spectacular drone warfare during India-Pakistan conflict, in which India's anti-drone systems were able to intercept wave after wave of Pakistan's attack drones, Ukraine's Operation Spider Web has shocked the world. The audacious drone assault, carried out with first-person-view (FPV) drones hidden inside trucks, targeted nearly 40 strategic Russian bombers thousands of kilometres from Ukraine, dealing what Ukraine claims is a multibillion-dollar blow to Moscow's long-range strike capabilities.

Ukraine's Operation Spider Web has rewritten the rules of combat. Many think drones have become even more important than fighter jets. But this is just one piece of new-age warfare which bridges the gap between reality and fiction.

#### Space is the new battlefield

In March, a startling revelation made by the US pointed at advancements in space warfare -- Chinese defence satellites had practiced "dogfights" in low Earth orbits in 2024. United States Vice Chief of Space Operations General Michael Guetlein said, ""With our commercial assets, we have observed five different objects in space maneuvering in and out and around each other in synchronicity and in control. That's what we call dogfighting in space. They are practicing tactics, techniques and procedures to do on-orbit space operations from one satellite to another."

A dogfight is an aerial battle between fighter aircraft conducted at close range. Now, dogfights have reached space too where satellites fight like fighter jets.

Identifying the satellites involved in the reported military exercise in space, a US military spokesperson confirmed that the "dogfights" took place in 2024. The officer added that there were five satellites involved with three of them Shiyan-24C experimental satellites while the remaining two were experimental spacecraft, the Shijian-605 A and B.

Two months later, in May, it was reported that India too practised a sort of dogfight in space. India quietly pulled off a historic space manoeuvre of its own -- one that married sophisticated scientific finesse with nuanced strategic signalling. On its SPADEX (Space Docking Experiment) mission, the Indian Space Research Organisation (ISRO) successfully executed a high-speed satellite rendezvous in space, showcasing not only technical capability but future preparedness in the new frontier of orbital defence.

The SPADEX mission was first initiated to develop autonomous docking and undocking of two satellites, the manoeuvres which are the backbone of long-duration space missions, space station activities and servicing satellites. When the main mission was accomplished, ISRO engineers observed that the two satellites had almost 50% of fuel left, owing to accurate launch calibration and cautious fuel management. This created the possibility for an unintended but ambitious second phase: testing high-speed coordinated manoeuvres in orbit.

The two satellites were manoeuvred into synchronised, high-speed contact at orbital speeds of 28,800 kmph -- approximately 28 times the speed of a commercial airliner. Flying at such velocities, even the slightest miscalculation can result in disastrous consequences, and hence, this was an accomplishment of gigantic technical sophistication. Similar to fighter jets' aerial combat training, the satellites gradually closed in on each other under controlled conditions, pushing the boundaries of orbital control, real-time communication, and autonomous control systems. Although no weapons were used, the exercise replicates the manoeuvring accuracy that would be required in future space wars.

In 2019, Prime Minister Narendra Modi made a special announcement that India had successfully tested its first anti-satellite missile system, code-named 'Mission Shakti'. "India has entered its name as an elite space power. An anti-satellite weapon ASAT successfully targeted a live satellite on a low Earth orbit," PM Modi said. He also stated that shooting down a LEO satellite is a rare achievement and was completed successfully within three minutes of launch.

India is only the fourth country after the US, Russia and China to have such a space warfare capability. Though it lags the three countries in this domain by far, it is making rapid progress. It is working on a "military space doctrine" that will be brought out in a few months, amid China continuing to develop weapons - direct ascent anti-satellite missiles, co-orbital satellites and electronic warfare - to contest or deny access to space.

#### Space warfare: Fiction becomes reality

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Space warfare has evolved from a theoretical concept, and the stuff found in science fiction, into a critical component of modern military strategy. As of 2025, nations like the United States, Russia, China, and India have developed sophisticated capabilities to leverage, defend, and contest space assets.

Space warfare encompasses military strategies and operations conducted in or through outer space. It involves three key parts: space control, to ensure the freedom of operation in space for one's own forces while denying adversaries the same; space denial, to disrupt or destroy an adversary's space assets to degrade their military capabilities; and space exploitation, to utilize space-based assets for intelligence, surveillance, reconnaissance and communication.

Key domains of space warfare include orbital warfare, engaging in actions to destroy or disable satellites; cyber operations, targeting space-based communication and control systems; electronic warfare, jamming or spoofing satellite signals; and kinetic operations, which means physical destruction of space assets using missiles or other projectiles.

#### America's "Golden Dome" is the next frontier in space warfare

America's proposed "Golden Dome" marks a dramatic shift in space warfare. Projected to cost \$175 billion, the system aims to create a space-based missile defense shield that can detect, track and intercept missiles -- including nuclear ones -- before they reach US soil. If implemented, it would become the world's first active combat infrastructure deployed in orbit, fundamentally altering the nature of space warfare.

Unlike earlier space systems that were passive -- satellites for communication, navigation or surveillance -- the Golden Dome envisions satellites equipped with sensors, interceptors and potentially directed-energy weapons such as lasers. These platforms would neutralize threats in their boost or mid-course phases, forming a constant orbital shield over the US and its allies.

Supporters argue this is the next logical step in deterrence, especially in an age of hypersonic missiles and unpredictable adversaries. However, the plan has triggered intense concern globally, with rivals such as Russia and China warning that it could dangerously destabilize strategic balance. The most serious worry is that the Golden Dome undermines the principle of Mutual Assured Destruction (MAD), a cornerstone of nuclear deterrence. If the US can reliably intercept retaliatory missile strikes, it might be perceived as having a first-strike advantage -- a perception that could provoke an arms race.

Russia has responded with sharp criticism, calling the plan a "dangerous fantasy" that could dismantle existing arms control agreements. Moscow has accelerated the development of hypersonic weapons like the Avangard system, designed to bypass missile defenses. Similarly, China sees the Golden Dome as a direct challenge to its strategic deterrent and is likely to expand its own space and nuclear forces. Beijing has already invested heavily in anti-satellite weapons, maneuverable co-orbital satellites, and electronic warfare systems targeting space assets.

In an increasingly militarized orbital environment, India too is striving to increase its offensive and defensive capabilities in space.

https://economictimes.indiatimes.com/news/defence/after-pakistan-india-drones-fight-anew-warfare-straight-out-of-science-fiction-space-war-drone-battles-to-space-dogfightshow-modern-warfare-is-shifting/articleshow/121594037.cms

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### India-Australia defence ties beyond American shadows

#### Source: The Hindu, Dt. 04 Jun 2025

Donald Trump's return to the White House has sent shockwaves through the global security landscape. With the North Atlantic Treaty Organization (NATO) being put on a burden-sharing timeline and Mr. Trump's cold transactional approach to security commitments worldwide, the Indo-Pacific too faces a pivotal moment. Yet, this represents a strategic opportunity for middle powers such as India and Australia to deepen their defence relationship.

#### An alignment of interests

Australia's strategic geography — bridging the Indian and Pacific Oceans with territories and military presence near Southeast Asia — complements India's maritime ambitions. The Australian Defence Force (ADF) is experienced in coalition operations and can effectively enable Indian military capabilities, as seen in the recently implemented air-toair refuelling arrangement. Australia's established relationships with Pacific Island nations align with India's growing interests. Most importantly, both nations share concerns about China's assertiveness and a common vision for sovereign resilience and regional stability.

While Japan, South Korea, and Europe are all valuable partners for India, the New Delhi-Canberra defence relationship has quietly built bureaucratic muscles, which are skeletal in other relationships. Over the past decade, successive Australian Prime Ministers and India's Prime Minister Narendra Modi have elevated this partnership, with Canberra viewing New Delhi as a "top-tier security partner". This foundation now provides the perfect launch pad to navigate a world where American security guarantees appear increasingly conditional.

The bureaucratic muscles of the New Delhi-Canberra relationship include the Comprehensive Strategic Partnership (CSP) 2020 and the 2+2 ministerial dialogue launched in 2021 for high-level strategic coordination. Practical cooperation has advanced through arrangements such as the Mutual Logistics Support Agreement (MLSA), which streamlines logistical support during joint exercises and humanitarian missions, and the November 2024 Air-to-Air refuelling arrangement allowing the Royal Australian Air Force to extend the operational reach of Indian aircraft. Further, key military exercises—AUSTRAHIND (Army), AUSINDEX (Navy), and participation in multilateral

exercises such as Pitch Black and Malabar, demonstrate a decade of careful relationshipbuilding.

Neither New Delhi nor Canberra can be expected to fill the gap left by the United States alone. India remains tied to its continental predicament, with an active border dispute with China and both conventional and sub-conventional challenges from Pakistan. Similarly, Australia is undergoing substantive churn in the strategic imagination of its regional role, which involves a complete overhaul of its armed forces, acquisitions of new technologies under the AUKUS (Australia, the United Kingdom, and the U.S.), and increased outreach to smaller island states in its maritime geography.

Given all this, how can both sides ensure that they rise up to face challenges in the regional security architecture? Five aspects need immediate attention:

#### The focus areas

First, it is time to rebalance defence engagement beyond comfortable silos. While Navyto-Navy cooperation has flourished, there is a need to break down service barriers. This could be achieved through joint military exercises that reflect real world operations, and moving towards a dedicated forum for joint staff talks. Further, both sides should work towards a major joint, combined exercise within the next decade — one that truly tests their collective capabilities.

Second, India's defence footprints in Canberra need to reflect the strategic importance of this relationship. It should consider upgrading its Defence Adviser (DA) position in Canberra to a one-star rank. Since this position has always been held by a Navy official, the addition of dedicated Army and Air Force personnel as assistants could help balance the service participation. Further, it needs to have dedicated people for its engagement with the Pacific Islands — work that is currently handled by the very efficient DA in Canberra.

Third, India needs to elevate ground-up ideas from working-level personnel. Too often, strategic dialogues become exercises in diplomatic niceties rather than forums for hard truths. Including more uniformed professionals with operational insights and creating spaces for classified discussions can generate fresh thinking that both nations need. Simple initiatives such as fellowships for staff college graduates or regular war-gaming exchanges would build the mutual understanding that underpins genuine cooperation.

Fourth, India should explore cooperation with Australia in the Maintenance, Repair and Overhaul (MRO) of naval vessels. New Delhi has successfully displayed its capabilities in this sector with active contracts with the U.S. and British navies. Further, exploring joint manufacturing and provision of patrol boats for small island security forces in the Indian Ocean Region and in the Pacific would again showcase the joint intentions and capabilities of the two sides. These aspects of cooperation in MRO and patrol boats may seem small, but their second and third-order impacts on exposure to each other's technologies and platforms can be immense.

#### An opportunity for MSMEs

Finally, defence industry collaboration demands a reset. Given that most of the bigger Original Equipment Manufacturers (OEM)s in Australia are field offices of European, East Asian, or American firms, Indian OEMs have preferred to deal directly with their main offices in these countries. Cooperation in the Micro, Small and Medium Enterprises (MSME) sector has been a missed opportunity. Defence and aerospace startups in both countries are at the forefront of cutting-edge technologies. Their outputs in components and dual-use technologies make them ideal to work with each other. Just like New Delhi, Canberra is also implementing an indigenisation programme in the defence sector. Therefore, there is potential to align the MSME sectors in both countries. To enable this, they could explore something similar to the U.S.-India INDUS X model.

https://www.thehindu.com/opinion/op-ed/india-australia-defence-ties-beyond-americanshadows/article69653663.ece

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# US balks at India-Russia defence ties: What's delaying Washington's deals?

#### Source: Business Standard, Dt. 03 Jun 2025

On Tuesday (June 3), US Secretary of Commerce Howard Lutnick delivered a message that many in New Delhi may have long suspected but seldom heard in such stark terms. Speaking at the US-India Strategic Partnership Forum (USISPF) Leadership Summit, Lutnick said past Indian decisions, like defence purchases from Russia and participation in Brics, have "rubbed the United States the wrong way".

"That's a way to kind of get under the skin of America," he said, singling out India's military ties with Moscow and its presence in groupings like Brics, which is perceived to challenge the dollar's global dominance. The message was blunt, but it revealed a deeper truth, despite a loud strategic and diplomatic embrace - the India-US defence partnership remains affected by mistrust, mismatched expectations, and mounting delays.

#### Why India-US defence partnership has not taken off

Over the last two decades, India has procured nearly \$20 billion worth of US-origin military hardware, ranging from C-17 Globemaster and C-130J aircraft to Apache helicopters and M777 howitzers. More recently, India signed agreements for 31 MQ-9B SeaGuardian drones, GE jet engines for fighter aircraft, and joint production of Javelin anti-tank missiles and Stryker infantry vehicles.

But in reality, these headlines hide a growing frustration in New Delhi. Nearly all major US-origin defence deals announced in recent years are yet to materialise. Deliveries of GE-404 jet engines, which are critical to India's indigenous Tejas fighter jet programme, have been delayed, setting the project back by at least two years. Additionally, the long-touted Indo-Pacific maritime awareness package, including the SeaVision surveillance

system approved in May 2025, is yet to be delivered. Even the high-profile MQ-9B drone deal remains tangled in a web, with final assembly and maintenance arrangements still being ironed out.

These delays have cast a shadow over the defence relationship, particularly when juxtaposed with India's parallel defence partnership with Russia. Despite geopolitical turbulence, India and Russia continue to co-develop and manufacture systems like the BrahMos missile and AK-203 rifles under the Make in India programme. Their long-standing cooperation is institutionalised through the Inter-Governmental Commission on Military Technical Cooperation (IRIGC-MTC).

#### US' hesitancy in providing defence equipment and India's 'Aatmanirbhar' push

At the heart of the India-US defence dilemma lies a fundamental misalignment of priorities. India seeks co-development, joint production, and above all, meaningful technology transfer to boost its self-reliance (Aatmanirbhar Bharat). The US, on the other hand, largely views India as a lucrative arms market, offering equipment but rarely the underlying know-how.

Even when co-production is agreed upon, the technologies involved are dated and old. The Javelin missile, developed in 1989 and inducted in 1996, and the Stryker vehicle from the early 2000s, are far from cutting-edge. While still effective, they represent a bygone era of warfare. In contrast, the future battlefield is increasingly being shaped by AI-enabled systems, autonomous drones, and electromagnetic weapons, domains where US-India collaboration has seen little progress.

The contrast is not just technological but economic. A single Javelin missile costs \$216,717 (roughly ₹1.9 crore), while a Ukrainian anti-tank drone capable of the same battlefield effect costs just \$500 (₹43,685). For India, reliant on cost-effective solutions, the Javelin is a white elephant.

#### What are the regulatory barriers hindering India-US defence partnership?

India's quest for deeper military-technical collaboration with the US is hindered by a thicket of regulatory and legal barriers in the latter nation. US laws like the Arms Export Control Act (AECA) and International Traffic in Arms Regulations (ITAR) severely restrict technology transfers, especially for systems involving nuclear propulsion or fifth-generation fighter capabilities.

Conversely, India's defence procurement system, marked by sluggish approvals, budget mismatches, and delayed offset clearances, discourages even the most well-meaning US defence firms. Structural misalignments and unresolved intellectual property concerns further hinder joint ventures.

The Defence Technology and Trade Initiative (DTTI), once hailed as a breakthrough framework for co-development, has largely under-delivered.

#### India's geopolitical diplomacy a thorn in US' eyes

India's insistence on strategic autonomy and refusal to enter formal alliances remains a sticking point. While Washington expects alignment in Indo-Pacific military postures, New Delhi walks a tightrope, maintaining ties with the US, Russia, and France in equal measure.

This balancing act has drawn flak in Washington. India's purchase of the Russian S-400 missile system exposed it to potential US sanctions under the CAATSA (Countering America's Adversaries Through Sanctions Act) law. While the Biden administration held back, the unpredictability of US foreign policy under the Trump administration makes long-term defence planning increasingly difficult for India.

#### What is the size of India's arms import?

According to the Stockholm International Peace Research Institute (SIPRI), India was the world's largest arms importer between 2019 and 2023, accounting for 9.8 per cent of global imports. In value terms, India's arms imports in 2023 stood at \$1.43 billion (in constant 1990 dollars), with Russia still being the largest supplier, although its share has declined from 76 per cent (2009–13) to 36 per cent (2019–23). France and the US have been the biggest gainers.

Therefore, as Lutnick's remarks make clear, the India-US defence relationship may be moving forward, but it is still dragging its feet.

https://www.business-standard.com/external-affairs-defence-security/news/india-usdefence-ties-russia-howard-lutnick-javelin-stryker-125060300846 1.html

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### "Let's make defence sector a role model for other sectors": French Foreign Trade Minister Laurent Saint-Martin on India-France bilateral ties

#### Source: The Tribune, Dt. 03 Jun 2025

France and India should make the "major success" of the defence sector in bilateral ties a "role model" for other sectors, French Foreign Trade Minister Laurent Saint-Martin said after the high-level discussions with Union Commerce and Industry Minister Piyush Goyal.

Goyal commenced his three-day official visit to France on Sunday. This visit is part of his ongoing visit to France and Italy from June 1 to 5. During his engagements in France, Goyal held bilateral meetings with key French Ministers, including Laurent Saint-Martin and Minister of Economy Eric Lombard. These discussions are focused on strengthening the Indo-French economic partnership and exploring new avenues for enhancing trade and investment cooperation.

"The defence sector is one of the major success stories in India-France bilateral ties. Let's make this defence sector a role model, an example for other sectors," Saint-Martin told reporters after the bilateral meeting in Paris.

The French minister expressed optimism about the stalled European Union-India free trade agreement, suggesting a breakthrough could come in weeks or months, as "we believe in freer trade, and not in trade wars."

"I am pretty optimistic that we can have an agreement in the coming weeks or months, because we have to showcase the world that we believe in trade, in freer trade, and not in trade wars," he told reporters.

Saint-Martin emphasised that demonstrating commitment to multilateral trade cooperation carries special significance amid current global tensions. "It means a lot for us, because we are living in very troubled times in terms of global trade," he said, adding that both India and France must strengthen their economic and cultural ties.

The minister highlighted India's importance in European trade strategy, noting strong backing from Brussels. "India is one of our priorities and I know that the European Commission really wants to fast-track the talks for the pact," Saint-Martin said.

France seeks to reduce both tariff and non-tariff barriers while addressing sensitive sectors.

"We have to take care of, for example, our agriculture, and some norms that we have in terms of environment and sanitary standards," he explained. "A deal at the end is a consensus - both sides have to understand each other's concerns and sensitivities."

Saint-Martin acknowledged that Europe-India trade relations remain below their potential, calling for increased exports, investments, and joint ventures between the regions. The 27-nation European Union represents one of India's largest trading partners, yet both sides see room for significant expansion.

"The FTA is a way of facilitating trade. This is why we need to lower barriers, but on the other hand, you have to protect sometimes some sectors, and I'm talking about agriculture," he said, outlining the delicate balance required in negotiations.

The minister's comments come as global supply chains face disruption and countries seek to diversify trade partnerships beyond traditional routes. The France-India defence cooperation, which includes joint manufacturing and technology transfer agreements, serves as a successful model for deeper economic integration across multiple sectors.

https://www.tribuneindia.com/news/business/lets-make-defence-sector-a-role-model-forother-sectors-french-foreign-trade-minister-laurent-saint-martin-on-india-france-bilateralties/

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### Clear evidence of China's support to Pakistan during India-Pakistan conflict revealed as Pak delegation thanks Beijing

#### Source: The Week, Dt. 03 Jun 2025

The recent India-Pakistan conflict has revealed that China's support for Pakistan is overt and operational, moving beyond the supply of military hardware, which includes fighter jets and submarines. In a further testament to the help Pakistan received during the military confrontation following the Pahalgam attack, Pakistan thanked China for the "unequivocal support" it received.

According to media reports, former Pakistan foreign minister Bilawal Bhutto-Zardari, who is in the US along with a nine-member Pakistan Parliamentary delegation to present Islamabad's version of the recent India-Pakistan conflict, met China's Permanent Representative to the UN, Fu Cong.

While the discussion between the two sides revolved around the security situation in South Asia in the wake of the India-Pakistan conflict, Bilawal thanked Beijing for the "unequivocal support extended by China" and claimed that Pakistan's response to India's Operation Sindoor was "responsible and restrained," reported Geo News. Further, he urged China to help in resolving the Kashmir dispute. Earlier, taking to X, Bilawal had claimed that he was in the US to "convey Pakistan's message—that Pakistan seeks peace with dignity and equality at the UN."

Tensions between India and Pakistan escalated after the Pahalgam terror attack, with India carrying out precision strikes on terror infrastructure in Pakistan and Pakistanoccupied Kashmir in the early hours of May 7. Pakistan attempted to attack Indian military bases on May 8, 9, and 10. India strongly responded to the Pakistani attempts by inflicting heavy damage to a number of key Pakistani military installations, including air bases, air defence systems, command and control centres and radar sites.

https://www.theweek.in/news/defence/2025/06/03/clear-evidence-of-chinas-support-to-pakistan-during-india-pakistan-conflict-revealed-as-pak-delegation-thanks-beijing.html

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### Can India afford to wait for a decade for fifthgeneration fighter jet AMCA while Pakistan gets Chinese stealth jets?

#### Source: The Week, Dt. 03 Jun 2025

In the wake of the recent conflict between India and Pakistan following the Pahalgam attacks, discussions on India's fifth-generation fighter jet programme, Advanced Medium

Combat Aircraft (AMCA), and the possible stopgap alternatives have gained further momentum.

While Pakistan is reportedly considering the purchase of J-35 fifth-generation stealth fighters from China and exploring the possibility of setting up a joint production line of combat aircraft KAAN with Turkish Aerospace Industries, India's homegrown fifth-gen fighter is expected to be inducted into the Indian Air Force only by 2035.

If the J-35 deal is finalised, China will start delivering the stealth fighters in the next two years, shifting the regional balance as the jets will significantly enhance Pakistan's airpower.

Writing for the American think tank The Heritage Foundation, policy expert Kriti Upadhyaya argues that fifth-generation aircraft is both "a strategic imperative and an operational necessity" for India as China's fifth-generation Chengdu J-20 Mighty Dragon is now operational and Pakistan continues to co-develop the JF-17 jets with China.

She points out that India's frontline aircraft Su-30MKIs, Mirage 2000s, and MiG-29s are fourth or 4.5 generation. It is also important to note that the Indian Air Force has a combat fleet strength of 31 squadrons against a minimal requirement of 42.

India's fifth-gen ambitions had suffered a setback when a joint Indo-Russian initiative Sukhoi/HAL Fifth Generation Fighter Aircraft (FGFA) project was stalled due to various reasons. However, India came up with the domestic alternative—AMCA or Advanced Medium Combat Aircraft.

The twin-engine multi-role fighter AMCA is expected to incorporate radar-absorbing materials, specialised coatings, and exhaust technologies to increase stealth. Designed for sustained supersonic flight without afterburners, AMCA is likely to be equipped with sensor fusion, AI-assisted electronic piloting, Net-centric warfare systems, and integrated vehicle health management.

As Defence Minister Rajnath Singh approved industry partnership, which equal opportunities to both private and public sectors on a competitive basis for the AMCA execution model, the Aeronautical Development Agency (ADA) of Defence Research and Development Organisation (DRDO) is expected to issue an expression of interest soon. If timelines are met, the first prototype is expected to be rolled out between 2026 and 2027 and is expected to be inducted into the Indian Air Force by 2035.

However, given the geopolitical scenario and Pakistan's increasing air power capabilities, a 10-year wait for the fifth-generation fighter seems to be a long one. According to Upadhyaya, in the meantime, India has two options to bridge the gap—US F-35 and the Russian Su-57. Although the Su-57 is cheaper and Russia also promises the transfer of technology, the analyst notes that it lacks proven operational history and the maintenance ecosystem is uncertain.

Meanwhile, the F-35 is the most widely deployed fifth-gen fighter in the world, despite the "kill switch" myth. The analyst points out that in order for the F-35 deal to happen, "India

would need to undertake credible reforms to safeguard sensitive US defence technologies while also maintaining interoperability" as the US has been hesitant to offer the platform to countries that operate equipment of Russian origin.

For the US, equipping India with its fifth-generation fighter, helps it to advance its strategic objective of having a credible deterrent to Chinese military adventurism in the Indo-Pacific region.

According to the analyst, in order to bridge India's fifth-generation power gap, India could acquire a limited number of F-35s even as it accelerates the AMCA development. India should also build collaboration with like-minded countries like the US in areas like stealth coatings, electronic warfare systems, and manned-unmanned teaming (MUM-T). Besides, it should also start investing in sixth-generation technologies.

However, not everyone seems to agree. A few days ago, former Indian Air Force chief R.K.S. Bhadauria said as the government put its faith in AMCA, we as a country needs to do everything to expedite the AMCA. "That cause of concern in terms of what Pakistan is going to get from China in the interim - be it J20 or J-35 - let them get these. That will be studied. What is important is in the interim how do you handle these threats and there are ways and means of tackling this threat that they will have," he was quoted as saying.

https://www.theweek.in/news/defence/2025/06/03/can-india-afford-to-wait-for-a-decadefor-fifth-generation-fighter-jet-amca-while-pakistan-gets-chinese-stealth-jets.html

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# Pakistan's Türkiye-made highly advanced warship begins sea trials in Istanbul. Should India be worried?

#### Source: The Week, Dt. 03 Jun 2025

The sea trials for the Babur-class corvette PNS Khaibar (F-282), built under the Pakistan-Türkiye MILGEM programme, started sea trials at Istanbul Naval Shipyard, in what comes as a major milestone in the bilateral defence relationship between the two countries. The sea trials come even as there is a major erosion in the relationsip between India and Türkiye amid the latter's strong diplomatic and material support for Pakistan, especially on the Kashmir issue.

PNS Khaibar—reportedly the most important defence initiative between the two countries —was seen being accompanied by the Turkish offshore patrol vessel Akhisar. "At Istanbul Naval Shipyard Command, following the completion of outfitting and harbor tests on PN Khaibar being built for Pakistan Naval Forces Command under ASFAT main contractorship, the vessel conducted its first sea trial and began the 'Sea Acceptance Test Process," a statement from the Turkish defence ministry stated.

The multi-mission corvette PNS Khaibar, with a displacement capacity of nearly 3,000 tonnes, has combined diesel and gas turbine, and can speed up to 29–30+ knots. It is

equipped wih SMART-S Mk2 3D radar, Aselsan's Hizir torpedo countermeasure suite, SeaEye-AHTAPOT electro-optical sensors, and ALBATROS NG air defense system.

The integration of advanced sensors, multinational weapon systems including P-282 hypersonic surface-to-surface missiles and a Leonardo 76mm Super Rapido main gun, and hypersonic missiles positions the class among the most capable corvettes in the world.

Under the MILGEM programme, two of these warships are being built in Türkiye, and two in Karachi Shipyard & Engineering Works under the technology transfer scheme. Türkiye is a major arms supplier to Pakistan. The two countries have a strong defence tie-up spanning air, naval, land, and cyber domains, with regular military training exercises, joint defence projects, technology transfers and arms sales.

"Through joint ventures in defense technology, co-production of military equipment, and collaborative training and exercises, Türkiye and Pakistan are committed to supporting each other in achieving self-sufficiency in arms manufacturing," a statement in Defence Turkey reads.

While India should view Pakistan's acquisition of advanced Turkish-built warships part of the country's naval modernisation efforts a major step regional naval competition as it shows an incressed Pakistan-Türkiye defense ties, the Indian Navy remains significantly larger and technologically advanced, with a broader fleet of destroyers, frigates, aircraft carriers, and submarines.

https://www.theweek.in/news/defence/2025/06/03/pakistans-turkiye-made-highlyadvanced-warship-begins-sea-trials-in-istanbul-should-india-be-worried.html

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### Science & Technology News

### IISc researchers develop novel nanozyme which prevents excess clotting

#### Source: The Hindu, Dt. 03 Jun 2025

Researchers at the Indian Institute of Science (IISc.) have developed an artificial metalbased nanozyme that can potentially be used to clamp down on abnormal blood clotting caused by conditions like pulmonary thromboembolism (PTE).

According to IISc., under normal circumstances, when a blood vessel is injured, specialised blood cells called platelets get activated, and cluster together around the vessel to form protective blood clots. This process, known as the blood clotting cascade (haemostasis), involves a complex series of protein interactions triggered by signals from physiological agonists (chemicals), such as collagen and thrombin.

However, when these signals go haywire in conditions like PTE or diseases like COVID-19, oxidative stress and levels of toxic Reactive Oxygen Species (ROS) increase, leading to over-activation of platelets. This triggers the formation of excess clots in the blood vessel, contributing to thrombosis, a major cause of morbidity and mortality.

To tackle this challenge, researchers led by G. Mugesh, professor in the Department of Inorganic and Physical Chemistry, have developed nanomaterials that mimic the activity of natural antioxidant enzymes, which scavenge reactive oxidative molecules. These nanozymes work by controlling ROS levels, thereby preventing the over-activation of platelets that leads to excess clot formation or thrombosis.

The team synthesised redox active nanomaterials of different sizes, shapes, and morphologies via a series of controlled chemical reactions starting from small building blocks. They then isolated platelets from human blood, activated them using physiological agonists, and tested how effectively the different nanozymes could prevent excess platelet aggregation.

The team found that spherical-shaped vanadium pentoxide (V2O5) nanozymes were the most efficient. These materials mimic a natural antioxidant enzyme called glutathione peroxidase to reduce oxidative stress. "The unique chemistry of the vanadium metal is crucial because the redox reactions that reduce ROS levels are happening on the surface of the vanadium nanomaterial," said Prof. Mugesh.

The team injected the nanozyme in a mouse model of PTE. They found that it significantly reduced thrombosis and increased the animals' survival rates. They also observed the weight, behaviour, and blood parameters of the animal for up to five days after injecting the nanozyme, and did not find any toxic effects.

The team now plans to explore the efficacy of the nanozyme in preventing ischemic stroke, which is also caused by clogging of blood vessels. "We are hopeful about clinical studies in humans because we have done our experiments with human platelets, and they worked," said Prof. Mugesh.

https://www.thehindu.com/sci-tech/science/iisc-researchers-develop-novel-nanozyme-which-prevents-excess-clotting/article69651814.ece

# Indian astronaut Shubhanshu Shukla's mission to International Space Station postponed to June 10

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#### Source: The Hindu, Dt. 03 Jun 2025

Axiom Space's mission to the International Space Station (ISS), carrying Indian astronaut Shubhanshu Shukla and three others, has been postponed to June 10 at 5:52 pm IST, onboard SpaceX's Falcon-9 rocket from the Kennedy Space Centre in Florida. File.

Axiom Space's mission to the International Space Station (ISS), carrying Indian astronaut Shubhanshu Shukla and three others, has been postponed to June 10 at 5:52 pm IST, onboard SpaceX's Falcon-9 rocket from the Kennedy Space Centre in Florida. Indian astronaut Group Captain Shubhanshu Shukla's mission to the International Space Station (ISS), which was scheduled to be launched on June 8, has now been postponed to June 10.

At a press conference held virtually from the Axiom Mission 4 (Ax-4) crew's quarantine location in Florida, Axiom Space announced that the crew is scheduled to launch to the ISS on June 10 at 8.22 am Eastern Time (ET) from Launch Complex 39A at the National Aeronautics and Space Administration's (NASA) Kennedy Space Center in Florida.

#### **Inclement weather**

"This shift allows teams to account for predicted inclement weather during the SpaceX Falcon 9 rocket and Dragon spacecraft transport in addition to completing final processing of the spacecraft ahead of launch," NASA said. Following the launch on June 10, and after around 28 hours in orbit, the crew is scheduled to dock at the ISS at approximately 12.30 p.m. ET on Wednesday, June 11.

Group Captain Shukla will be the pilot of the Ax-4, and former NASA astronaut Peggy Whitson will command the commercial mission. European Space Agency project astronauts Sławosz Uznański-Wiśniewski from Poland, and Tibor Kapu from Hungary, are also part of the crew. The Ax-4 crew, which is currently in quarantine, shared insights into their final preparations.

#### Busy preparing

Group Captain Shukla said that he and his team have been very busy preparing for the mission. "The best part is yet to come, which is when we launch to space, but I think we have been very fortunate with the combination of people sitting in these four chairs (referring to fellow crew members)," Group Captain Shukla said. He called upon fellow Indians to be curious about the mission. "I would just urge everybody back home to be excited about this mission and participate wholeheartedly. Be curious, be excited. I think we are going to do some really amazing things during our 14 days in the ISS," he said.

"We have certain live events from orbit and we will be doing live interactions, including one with a VIP. We will have interactions with students, academia and also with the space industry so that I can share not just my story but also my experience on orbit with people in our country," he said in response to a question on whether he would be interacting with Prime Minister Narendra Modi from space.

https://www.thehindu.com/news/national/axiom-4-mission-carrying-indian-astronautshukla-to-international-space-station-postponed-to-june-10/article69653967.ece

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## Garden Reach inks pact with Norway firm, India to build its first polar research vehicle

Shows commitment to India's capabilities in polar and ocean research: Sonowal

#### Source: The Indian Express, Dt. 03 Jun 2025

Kolkata-based Garden Reach Shipbuilders and Engineers Limited (GRSE), a Government of India undertaking, signed an MoU with Norwegian firm Kongsberg on Tuesday to co-design and build India's first-ever polar research vehicle (PRV) indigenously.



The MoU was signed in Oslo in the presence of Union Minister of Ports, Shipping and Waterways Sarbananda Sonowal, who termed it "a commitment to fostering scientific discovery, advancing India's capabilities in polar and ocean research, and contributing to global efforts to address pressing challenges like climate change."

"Let this MoU signing be a beacon of hope and progress, signalling India's unwavering commitment to scientific advancement and sustainable development. Together, we are building not just a vessel but a legacy — a legacy of innovation, exploration and international cooperation that will inspire generations to come," Sonowal said.

A PRV is a ship which serves a platform for research in the polar regions (areas surrounding the North and South Poles). It can also help scientists undertake research in the ocean realm.

India currently operates three research base stations in the polar regions — Bharati and Maitri in Antarctica, and Himadri in the Arctic region — and had been planning to have its own PRV for a while now. In 2023, Union Minister Kiren Rijiju informed the Rajya Sabha

that the country would have its first PRV within five years at an estimated cost of Rs. 2,600 crore.

According to the Ministry, the MoU marks an important milestone for India's shipbuilding sector as it will receive design expertise for developing the PRV "while taking into account the requirement of National Centre for Polar and Ocean Research, which will use it for research activities in the polar and southern ocean realms".

The PRV will be equipped with the latest scientific equipment, enabling researchers to explore the oceans' depths and study marine ecosystems, Sonowal said. It will be a testament to India's critical shipbuilding capabilities, boosting the Government's 'Make In India' initiative, he added. GRSE, which has built warships, survey and research vessels, will build the PRV in its yard in Kolkata.

Meanwhile, Sonowal, who embarked on a five-day official visit to Norway and Denmark on Monday, also represented India in a ministerial meeting on the role of shipping in shaping the future. The meet emphasised the need for the industry to seek out a stable, long-term, regulatory environment supporting inclusive and decarbonised ocean-based trade. Ministers from Brazil, Japan, UN, US, China and Norway also attended the meet.

Underlining PM Narendra Modi's vision of SAGAR – Security and Growth for All in the Region – Sonowal said it "leverages India's vast coastline, strategic location, and maritime heritage to drive economic prosperity, enhance regional security, and ensure sustainable development for all stakeholders".

"This entails economic cooperation, capacity building, disaster management, information sharing and environmental stewardship. Upgrading from the SAGAR initiative, India's PM Narendra Modi ji announced MAHASAGAR — which is Mutual and Holistic Advancement for Security Across the Regions, signalling further consolidation," he added.

He also said the MInistry's Sagarmala 2.0 programme "focuses on bridging critical infrastructure gaps, boosting shipbuilding, ship repair, and recycling, and positioning India as a global maritime leader". Sonowal also held a roundtable meeting with Norwegian shipowners, and invited investment in India's maritime sector.

https://indianexpress.com/article/india/garden-reach-inks-pact-with-norway-firm-india-tobuild-its-first-polar-research-vehicle-10046884/

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