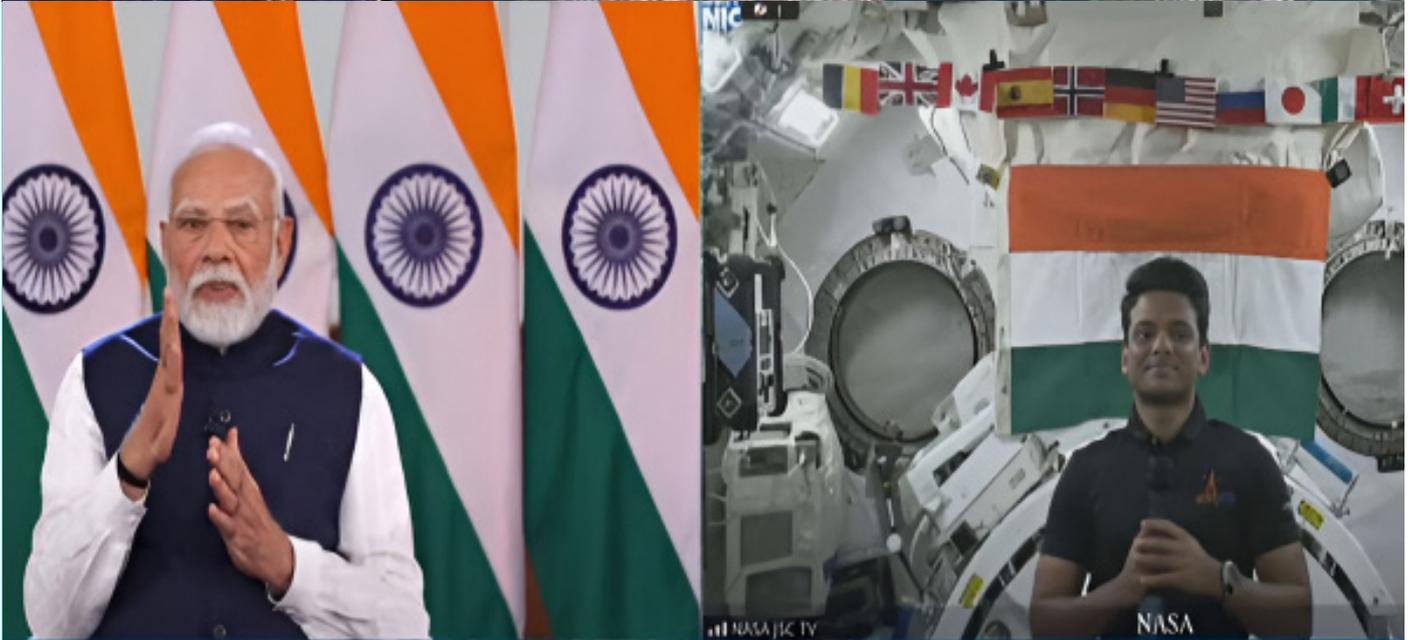




CENTRE FOR AIR POWER STUDIES (CAPS)

Forum for National Security Studies (FNSS)

AEROSPACE NEWSLETTER



PM Narendra Modi Interacts with Astronaut Group Captain Shubhanshu Shukla, Indina Air Force

"India is Going to Open Doors of New Possibilities of Space for the World"

Image Courtesy: ANI

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“What Operation Spider’s Web proved is that brinkmanship is not the sole tool of great powers. A smaller state, with ingenuity, resilience, a mastery of asymmetric and hybrid warfare, and strategic vision, can also walk to the edge and do so responsibly.”

Anonymous Military Analyst (2025, via X)

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Opinions and Analysis

Mission Axiom 4: A Nation Waits with Baited Breath

Dr Martand Jha | 19 June 2025

[Source: CAPS India | https://capsindia.org/mission-axiom-4-a-nation-waits-with-baited-breath/](https://capsindia.org/mission-axiom-4-a-nation-waits-with-baited-breath/)



Outer space is a serious business, and it is also an expensive one. It is, therefore, better to reschedule than to regret it later. The Axiom-4 mission has a new launch date after withstanding five reschedules since its original launch date of May 29, 2025. The primary reason is the cost of the human lives involved. This is true for all space missions. The Axiom-4 mission is special because it marks the return of human spaceflight not only to India but also to Hungary and Poland.

The primary crew for this mission includes Mission Commander Peggy Whitson from Axiom Space, Mission Pilot Shubhashu Shukla from India and two mission specialists, namely Sławosz Uznański-Wiśniewski and Tibor Kapu from Poland and Hungary, respectively. For India, this mission is a precursor to the Mission Gaganyaan– which is India’s inaugural human spaceflight mission.

That is why; apart from Shubhashu Shukla, Group Captain Prashanth Nair is also part of the same mission as a Pilot in the backup crew. In 2027, when India plans to launch its Mission Gaganyaan from Sriharikota, the lessons learnt from the Axiom-4 Mission and the practical experience of being in outer space will hopefully come in handy.

This is precisely why the Indian Space Research Organisation (ISRO) has paid a substantial amount of INR 550 crores to Axiom Space Inc. to secure a seat on this mission. The scheduled duration for this mission is up to 14 days. During this time, the Axiom-4 would be docked to the International Space Station (ISS). Shubhashu Shukla would be the first individual to represent India inside the ISS. Therefore, he is also called ISRO’s first ‘Gaganyatri’-since this mission comes as a precursor to the Mission Gaganyaan. After onboarding the International Space Station (ISS), the Indian astronaut is expected to conduct several microgravity research experiments.

As per the information enlisted on ISRO’s official website, “The field of microgravity research with potential applications in diverse areas such as human health, physical/ life sciences, material research, novel pharmaceutical development and biotechnology offers significant opportunities to the national scientific community. ISRO has shortlisted seven microgravity research experiments proposed by Indian Principal Investigators (PIs) from various national R&D laboratories/ academic institutions for implementation on the International Space

Station (ISS) during the upcoming Axiom-4 mission with ISRO's Gaganyatri".

As mentioned above, these experiments would entail multiple collaborations between the ISRO and India's various scientific institutions. This includes a list of elite institutions like the Indian Institute of Science, International Centre for Genetic Engineering & Biotechnology (ICGEB), National Institute of Plant Genome Research (NIPGR), University of Agricultural Sciences, Dharwad, Indian Institute of Technology, Dharwad, Institute of Stem Cell Science and Regenerative Medicine (InStem), Indian Institute of Space Science and Technology (IIST), Department of Space and College of Agriculture, Vellayani, Kerala Agricultural University.

A total of seven experiments are to be conducted during this mission. These experiments range from gauging the impact of microgravity radiation on edible microalgae to sprouting salad seeds in space- which is relevant to the crew's nutrition. The Indian Institute of Science is collaborating with ISRO on two experiments as part of this mission; one focuses on the survival, revival, reproduction, and transcriptome of the eutardigrade *Paramecium* sp. BLR strain in space, while the other involves analysing human interaction with electronic displays in microgravity.

A few other experiments scheduled for this mission include assessing the effect of metabolic supplements on muscle regeneration under microgravity, analysing the comparative growth and proteomics

responses of cyanobacteria on urea and nitrate in microgravity, and evaluating the impact of microgravity on growth and yield parameters in food crop seeds. These experiments would provide India with an opportunity to utilise the research facilities available on the International Space Station. However, prior to conducting these experiments in outer space, they have undergone rigorous evaluations and reviews on the ground before the scheduled launch of the mission.

The primary objective behind conducting these research experiments is to gain some concrete experience in nurturing a microgravity research ecosystem in India. This would further facilitate the induction of advanced microgravity experiments across various disciplines in the Indian Space Program. However, everything depends on whether the mission is successfully launched on June 22, considering that the launch date has been moved multiple times from the original date, i.e., May 29, 2025.

India is hoping to achieve the desired results from the Axiom-4 mission, as this would provide a valuable template for Mission Gaganyaan. Although this mission is viewed in connection with India's future preparedness for its manned mission to outer space, but every mission is unique on its own and, therefore, should be seen in that light. What India achieves through Axiom-4 can only be discussed at length when this mission concludes.

Ukraine's Operation Spider's Web is a Game-Changer for Modern Drone Warfare. NATO should Pay Attention

Katja Bego | 06 June 2025

Source: *Chatham House* | <https://www.chathamhouse.org/2025/06/ukraines-operation-spiders-web-game-changer-modern-drone-warfare-nato-should-pay-attention>

Ukraine's Operation Spider's Web will undoubtedly enter the history books as one of the most remarkable and best-executed covert operations of the war, with potential consequences for warfare far beyond the current conflict.

According to Ukrainian intelligence, which released information about the 1 June operation, Ukraine used 117 drones to strike several airbases deep within Russia. Ukraine says it damaged or destroyed 41 planes, including bombers that carry strategic cruise-missiles. The drones, which were transported close to the bases hidden in the back of trucks and operated remotely, were reportedly able to inflict damage of up to \$7 billion – at a fraction of the cost.

The operation showed that Kyiv did in fact hold some of the cards ahead of proposed negotiations in Istanbul, temporarily stunned the Kremlin into silence and dealt a blow to Russia's capacity to launch lethal missile strikes against Ukraine.

It also offered a glimpse into the future of warfare, transformed by access to cheap, widely available technology such as small drones, in which anything, anywhere can become a target. While NATO figures will likely have been impressed by Spider's Web's success,

the operation's effectiveness also raises urgent questions about the alliance's own readiness for a future shaped by similar attacks.

Cheap Technology, Drones and AI

The operation was remarkable for its use of relatively cheap, existing technologies. Throughout the war, Ukraine has proven especially adept at using relatively low-cost and lower-tech solutions to counter Russia's larger numbers and deeper resources. It has pushed the envelope on drone innovation to counter Russia's own well-financed drone operations.

Operation Spider's Web is one of the starkest examples yet of just how adept Ukraine has become at gaining an asymmetric advantage – doing more with less. Though the full details are not yet known, Ukraine is believed to have used rigged versions of lower-tech commercially available FPV drones in the operation.

Reports suggest it cleverly used AI solutions to program the drones to hit the Russian planes in their weak spots ahead of time, using museum pieces of the old Russian planes as training data.

The actual navigation of the drones relied on drone autopilot software ArduPilot, an old open-source solution used by drone hobbyists. ArduPilot allowed the drones to autonomously continue their paths, even when the human pilots temporarily lost signal, enabling the strike deep within Russia's heartland.

A new Blueprint for Attacks

While Operation Spider's Web was successful in large part due to its surprise element and creativity, the operation should serve as a stark warning that warfare has changed.

All the technologies used in the operation – or at least versions of them – are available to many other states, as well as non-state actors. They may well take inspiration and copy elements of the operation in different contexts to target both military and civilian infrastructure.

The smuggling of drones on the back of trucks driven unknowingly by Russian drivers is another element that could be emulated. Since the attack, unverified videos have emerged of Russian authorities checking long lines of trucks. NATO's interconnected, open economies are vulnerable to similarly disruptive attacks. It is simply not feasible to look for drones in every container that enters the ports of Rotterdam, Hamburg or Los Angeles.

Drone technology is also rapidly evolving, including improvements in autonomous aspects that will increase the capacity for drone swarming. As the technology becomes more widely accessible, similar drone attack operations will only become more feasible and easier to execute across wider areas.

No Longer out of Reach

The attacks were also revolutionary in their ability to strike targets previously thought to be well out of reach. For Russia, they threaten to undermine a long-standing strategy of relying on its vast size and strategic depth to shield

key military and industrial assets from within striking distance of any front-line on its western border. Operation Spider's Web struck targets well beyond the range of any previous drone incursions, including the Belaya base in Irkutsk in Russia's far-east, almost 5,000 kilometres away from Kyiv.

But Russia is not the only country that has assumed sensitive military sites would be out of reach from hostile drone attacks. NATO states are similarly at risk. Since the Cold War, many NATO members have paid insufficient attention to protecting their strategic infrastructure, whether military bases or commercial ports. They have frequently left expensive assets out in the open and concentrated in a few spots, which could now be vulnerable to potential long-range drone attacks.

The location of much strategic infrastructure is publicly known, or relatively easily discovered through widely available satellite imagery, prompting fears over potential hostile actors conducting reconnaissance at the sites. Washington has voiced concerns over recent years about Chinese companies purchasing land near strategic US military bases; Finland in 2025 banned Russian nationals from doing the same near its sensitive military areas. Recent mysterious drone overflights near bases and airports from Denmark and Germany to the UK and US raise related fears.

How NATO should adapt

Operation Spider's Web highlights how drones, especially those with increasingly

sophisticated autonomous capabilities, are a vital element of increasingly agile and flexible modern warfare.

NATO countries have already recognised this change and made plans to adapt. The UK’s recent Strategic Defence Review refers to drones 28 times, compared to just three mentions of tanks. Across the alliance, members are investing heavily in research and development in drones, though more emphasis should be placed on the development of smaller, more agile UAVs.

NATO has set up new structures, such as a dedicated learning centre in Poland, to rapidly internalise and adapt to the lessons learned from Ukraine’s highly effective drone war. Though innovation should not just be limited to drones, staying at the forefront of drone technology will be critical.

US-Israel-Iran Conflict: List of Key Events

23 June 2025

Source: Aljazeera | <https://www.aljazeera.com/news/2025/6/23/israel-iran-conflict-list-of-key-events-june-23-2025>



Iran's army commander-in-chief General Amir Hatami, centre, accompanied by high-ranking army commanders, speaks in a video call with top commanders of the army, in Zolfaghar central headquarters, Iran, June 23, 2025 [Handout: Iranian Army Press Service via AP Photo]

Fighting

Iran has fired ballistic missiles at the Al Udeid Air Base in Qatar, the United States’ largest military installation in the Middle East. Doha said the attack was intercepted and there were no casualties.

Fellow Gulf countries Bahrain and Kuwait – which also host US facilities – joined Qatar in closing their airspace, then reopened them.

Earlier, Israel had struck Tehran’s Evin Prison, notorious for holding political activists. Iranian state television shared surveillance footage of the strike, which reportedly blew the facility’s gate open.

Explosions were heard on the western outskirts of the southwestern Iranian city of Ahvaz, capital of oil-rich Khuzestan province, the Fars news agency reported.

Tasnim news agency reported a strike at an electricity feeder station in the Evin neighbourhood in north Tehran.

Earlier, Israeli Defence Minister Israel Katz said his country had attacked “regime targets and government repression bodies in the heart of Tehran”, including Islamic Revolutionary Guard Corps (IRGC) command centres.

Israel also carried out a strike on the Fordow enrichment facility, a day after the US hit the underground site south of Tehran with so-called “bunker buster” bombs.

The Israeli military issued an evacuation threat to residents of Tehran, telling them to stay away from weapons production centres and military bases.

Iranian state television said on Monday that the country had targeted the Israeli cities of Haifa and Tel Aviv. It claimed the majority of its projectiles fired since the early hours of the day had successfully reached their targets.

Sirens sounded across Israel before noon on Monday, with a large number of impacts recorded in several areas, including the Ashdod area in southern Israel and the Lachish area, south of Jerusalem.

Casualties and Disruptions

Eleven days into the conflict, large

numbers of Tehran’s 10 million population have reportedly fled.

After Israel’s strike on Evin Prison, Iran’s IRIB state broadcaster released video showing rescue workers combing the flattened wreckage of a building at the prison, carrying a wounded man on a stretcher.

Iranian power company Tavanir said there were power cuts in the Iranian capital, Tehran.

In Qatar, prior to Iran’s attack on Al Udeid, the US and the United Kingdom had urged their citizens in the country to “shelter in place”.

Britain said on Monday that a Royal Air Force flight carrying 63 British nationals and their dependents out of Israel had left Tel Aviv.

A number of airlines, including Kuwait Airways, Finnair and Singapore Airlines, have suspended operations in the Middle East. Air India said it was not only halting operations to the region, but also stopping flights to and from the US east coast and Europe.

Politics and Diplomacy

Donald Trump announced on Truth Social that Israel and Iran had “fully agreed” a “Complete and Total Ceasefire” to be phased in over a 24-hour period, after which “The 12 Day War” would be officially over. Iran or Israel have yet to comment on the plan.

His announcement came after Iran’s attack on Al Udeid Air Base in Qatar. Trump thanked Tehran for giving him “early notice” of the

attack, which he described as a "very weak response" to the US attack on Iranian nuclear facilities. In a separate post, he thanked the emir of Qatar for his peace efforts.

A spokesperson for the Qatari Foreign Ministry said that the country considered the Iranian attack to be a "surprise", announcing the situation in the country was safe.

Iran's Supreme Leader Ayatollah Ali Khamenei posted on his Farsi-language X account: "We have not violated anyone's rights, nor will we ever accept anyone violating ours, and we will not surrender to anyone's violation; this is the logic of the Iranian nation."

Iran's Foreign Minister Abbas Araqchi said in a statement posted by his ministry on Telegram that Iran would be ready to respond again in case of further action by the US.

Earlier in the day, Ali Akbar Velayati, an adviser to Khamenei, said bases used by US forces "in the region or elsewhere" could be attacked – that evening, Iran targeted Al Udeid in Qatar.

Abdolrahim Mousavi, Iran's armed forces chief of staff, pledged that the country would take "firm action" in response to US strikes on key nuclear sites the day before. "This crime and desecration will not go unanswered," he said on state television.

Ebrahim Zolfaqari, spokesperson for Iran's Khatam al-Anbiya central military headquarters, addressed US intervention in the war in a video statement, saying: "Mr Trump,

the gambler, you may start this war, but we will be the ones to end it."

Iran's semi-official Tasnim news agency said a parliamentary committee had approved a general plan to suspend cooperation with the International Atomic Energy Agency (IAEA).

Iran's mission to the United Nations said the US, the UK, France, Israel and IAEA chief Rafael Grossi were responsible for the deaths of innocent civilians and the destruction of infrastructure.

Russian President Vladimir Putin slammed attacks on Iran as "unprovoked" and "unjustified" in a Moscow meeting with Tehran's Foreign Minister Abbas Araghchi.

Russian Deputy Foreign Minister Sergei Ryabkov said, "Our strategic partnership with Iran is unbreakable," but was not drawn on the question of whether Iran had requested military help – or whether any help would be forthcoming.

After Israel's attack on Tehran's Evin Prison, Israeli Foreign Minister Gideon Saar wrote "Viva la libertad!", Spanish for "long live liberty", on X.

French Foreign Affairs Minister Jean-Noel Barrot said that the Israeli strike on Tehran's Evin Prison, which holds some French prisoners, was unacceptable.

China's UN ambassador, Fu Cong, said US credibility was "damaged" after its bombing of Iran's nuclear sites, warning the conflict could "go out of control", according to the

state broadcaster.

German Chancellor Friedrich Merz said of Sunday's US strikes on Iranian nuclear sites: "Yes, it is not without risk, but leaving it as it was wasn't an option either."

British Foreign Secretary David Lammy said his country stood ready to "defend our personnel, our assets and those of our allies and partners".

NATO chief Mark Rutte said alliance members had "long agreed that Iran must not develop a nuclear weapon" and called an Iranian atomic bomb his "greatest fear".

US Secretary of State Marco Rubio called on China to help deter Iran from closing the Strait of Hormuz, a chokepoint for one-fifth of the world's oil supply and a potential lever for retaliatory action.

The European Union's foreign policy chief, Kaja Kallas, said closing the strait would be "extremely dangerous".

US President Trump posted an online message on oil production to the US Department of Energy, encouraging it to "drill, baby, drill", and saying, "I mean now."

Reza Pahlavi, the long-exiled son of Iran's toppled shah, but not seen as a player with any real influence in Iran itself, warned the US and Europe not to throw a "lifeline" to Iran's current leadership. "This is our Berlin Wall moment," he said in an interview with the AFP news agency.

Israelis Relieved by US Bombardment of Iran, United Behind War

Group Captain VP Naik VM | 14 May 2025

Source: SCMP | <https://www.scmp.com/news/world/middle-east/article/3315408/israelis-relieved-us-bombardment-iran-united-behind-war>



Israelis expressed relief and optimism on Sunday after US President Donald Trump ordered air strikes on Iran, ten days into a war that has widespread public support.

Despite daily nerve-shredding trips to bomb shelters and growing damage around the country, Israelis appeared united behind Prime Minister Benjamin Netanyahu's move to attack Iran on June 13.

Trump's decision to authorise overnight bombing raids on Iran's nuclear facilities has provided further reassurance after more than a week of sorties by the Israeli air force.

"The war with Iran was inevitable. You knew it would happen sooner or later," Claudio Hazan, a 62-year-old software engineer, said in central Jerusalem on Sunday.

“I hope that it will shorten the war, because otherwise Israel by itself would not stop until they get that Fordo place bombed,” he explained, referring to the deeply buried Iranian nuclear site targeted by heavy US bombers overnight.

Israelis have hunkered down for the last 10 days, with businesses and schools closed and people urged to stay home.

Few have slept a full, uninterrupted night since the conflict erupted due to the screeching missile warnings that flash up on mobile phones at all times of day.

“We woke up to a Sunday morning of alarms and then we saw that the US attacked,” David, a 43-year-old Jerusalem resident, told reporters. “We’re all happy that the US is lending a hand; it has always been lending a hand.”

Israeli President Isaac Herzog told the BBC on Sunday that “now is an opportunity to come to a dialogue of peace, also a dialogue of peace between all nations in the region, including Israelis and Palestinians.”

Israel’s sophisticated air defences have kept Israeli towns and cities relatively safe, shooting down hundreds of Iranian missiles and drones that would otherwise have caused widespread devastation.

Dozens have slipped through, however, with three more impacts reported on Sunday morning in the northern port of Haifa and around the coastal hub of Tel Aviv.

At least 50 strikes have been acknowledged

nationwide and 25 people have died, according to official figures.

When a missile blasted her modern block of flats on Thursday in Ramat Gan, near Tel Aviv, resident Renana said, “It will take a long time until this building recovers.”

But she showed no rancour towards Netanyahu, who has deployed Israeli forces in Gaza, Lebanon, Syria and now Iran since the attack on Israel by Palestinian group Hamas in October 2023.

“The truth is that God is with us and the government should go on with whatever they’re doing, which is exactly what should have been done a long time ago,” Renana, who did not give her surname, said.

Israel’s usually divided political scene has also lined up behind the attack on Iran, a country generations of Israelis have grown up fearing as a threat to their existence.

“Prime Minister Benjamin Netanyahu is my political rival, but his decision to strike Iran at this moment in time is the right one,” opposition leader Yair Lapid wrote in an op-ed last week.

A survey carried out by the Israel Democracy Institute in the days immediately after Israel’s first strikes on June 13 found that 70 per cent of Israelis supported the war, although the results revealed a major divide.

Among Jewish Israelis, there was 82 per cent support, while only 35 per cent of respondents from Israel’s Arab minority, who

mostly identify as Palestinian, were in favour.

Dahlia Scheindlin, an Israeli pollster and political analyst, said that Israelis were much more united behind the Iran campaign than the grinding conflict in Gaza, which many saw as a “dirty war”.

Netanyahu has been criticised for failing to secure the return of Israeli hostages being held by Hamas. He has been accused of prolonging the war for domestic political purposes.

He is also subject to an arrest warrant from the International Criminal Court for alleged war crimes in Gaza, where nearly 56,000 people have been killed, according to the health ministry in the territory.

“There’s a very sharp contrast between how Israelis view the war in Gaza and how they view this war with Iran,” Scheindlin said.

She cautioned, however, that sentiment could change if it turns into a long conflict.

B2 Bombers, Bunker Busters, Tomahawks: The Weapons US Used to Strike Iran

Shiv Aroor and Saikat Kumar Bose | 22 June 2025

Source: NDTV | <https://www.ndtv.com/world-news/b2-bombers-bunker-busters-tomahawks-the-weapons-us-used-to-strike-iran-8729700>



US' B2 bombers carried out precision strikes on three Iran nuclear facilities

The US has joined Israel's war against Iran, bombing Tehran's three key nuclear facilities with precision strikes. Washington, DC has used high-end weaponry, including the dreaded GBU-57 bunker busters and Tomahawk cruise missiles, to target the nuclear installations in Iran's Fordow, Natanz, and Esfahan.

The airstrikes have been followed by a narrative war, with US President Donald Trump claiming that the three nuclear enrichment facilities have been "totally obliterated" and Iran stressing that there were "no signs" of contamination. All eyes are now on how Tehran responds to the situation. While a mega military offensive might lead to further escalation of the conflict, an inadequate response may cause Iran's ruling dispensation to lose popular support.

Here is a look at the high-end military machines the US used

6 B-2 Spirit Stealth Bombers: Among the most advanced strategic weapons in the US inventory, B-2 bombers can counter very sophisticated air defence systems and carry out precision attacks. According to the US Air Force, the B-2 has massive firepower and its "stealth" features threaten heavily defended targets. "The B-2's low observability is derived from a combination of reduced infrared, acoustic, electromagnetic, visual and radar signatures. These signatures make it difficult for the sophisticated defensive systems to detect, track and engage the B-2," it says. Priced at about \$2.1 billion each, B-2 bombers are the most expensive military aircraft ever built.

GBU-57 Bunker Busters: While Trump did not explicitly mention these, the B-2 bombers that struck Iran likely used this heavy ammunition to target Fordow. The GBU-57 is a massive 30,000-pound -- about 13,600 kg -- bomb that can penetrate up to 200 feet underground before exploding, giving it the name "bunker busters". What sets it apart from other missiles or bombs is that it penetrates the earth's surface before detonation, multiplying the impact exponentially.

The GBU-57 is the most powerful bunker buster in the US arsenal. It is about 20 feet in length and has a diameter of 2.6 feet. This sophisticated weapon was developed by the Air Force Research Laboratory's Munitions Directorate, and Boeing conducted its design and testing. Twelve such bombs are reported to have been used as the US struck Iran today.

Tomahawk Cruise Missiles: According to reports, US submarines launched 30 Tomahawk cruise missiles during their strikes on Iranian facilities today. A long-range cruise missile used for deep land attacks, the Tomahawk can be fired from US ships and submarines. What makes these missiles lethal is the option to change targets in-flight through satellite communications. According to the US Navy, these missiles can loiter over a target area to respond to emerging targets and also provide battle damage information. This provides the military control room the flexibility to attack long-range fixed targets or support Special Operations Forces. The first operational use of Tomahawk missiles was in Operation Desert Storm in 1991. They were also used in Operation Odyssey Dawn in Libya and Operation Inherent Resolve in Syria. The US reportedly used submarines from its Virginia and Los Angeles line-up to launch the Tomahawk missiles at its targets in Iran.

F-22 Raptor and F-35A Lightning IIs

The US reportedly used F-22 Raptors and F-35A Lightning fighters to provide air support during the operation. According to the US Air Force, the F-22 Raptor combines stealth, supercruise, manoeuvrability, and integrated avionics and these are coupled with improved supportability. It is designed to project air dominance, rapidly and at great distances and defeat threats trying to intercept the US charge.

Joining F-22 Raptors today were F-35A Lightning fighters. A fifth-generation fighter of the US Air Force, this aircraft has high-end

stealth capabilities and is designed to provide the pilot with unsurpassed situational awareness and the ability to carry out precision strikes in all-weather conditions. The F-35A Lightning IIs have a wingspan of 35 feet, are 51 feet long and can carry a payload of over 8,000 kg.

Former B-2 Pilot Shares Details Behind Iran Nuclear Facility Strikes

Sandeep Doc Louallen | 24 June 2025

Source: ABC News | <https://abcnews.go.com/US/former-2-pilot-shares-details-iran-nuclear-facility/story?id=123121102>



A U.S. Air Force B-2 Spirit lands after supporting Operation Midnight Hammer at Whiteman Air Force Base, Missouri, June 22, 2025.

A decade of planning and complex deception tactics made last weekend's historic B-2 bomber strike on Iran possible, according to retired Gen. Robert Spalding, who said he helped develop the original mission plans.

The operation, named "Operation Midnight Hammer," marked the U.S. military's largest-ever deployment of B-2 stealth bombers

and first use of 30,000 pound bunker-buster bombs in combat, Pentagon officials said. The 30-hour precision strike targeted three Iranian nuclear facilities, making it the longest B-2 mission since 2001, according to officials.

"Everything worked perfectly," Spalding, a former B-2 pilot and senior director at the National Security Council, told ABC News.

Spalding, who said he helped develop the mission plan years ago, told ABC News the operation required more than a decade of preparation, including extensive work on weapons systems and planning.

The mission's success relied heavily on keeping Iran in the dark about the incoming attack. The U.S. military used decoy bombers sent to Guam to throw off potential tracking. Spalding said that hiding such an operation has become more challenging in today's connected world.

"With smartphones and flight tracking nowadays, we have to account for all kinds of data that could tip off the enemy," Spalding said.

The B-2's unique flying wing design makes it ideal for this mission. Its lack of a conventional fuselage and tail allows for a low radar cross-section, making the aircraft difficult for radar to detect.

"The B-2 has two bomb bays that can carry very large weapons, and these bunker-buster bombs were specifically made to fit them," Spalding said.

He added that while Israeli forces had already weakened Iran's air defenses, the B-2's stealth capabilities were crucial to the mission's success.

The extended flight time presented its own challenges. Pilots had to conduct six to seven midair refuelings, each taking about 30 minutes.

"There's a strict schedule of sleep and diet before and during the flight to keep pilots alert during critical moments," Spalding said.

The strikes were aimed at preventing Iran from developing nuclear weapons, U.S. officials said. President Donald Trump called the operation "very successful" in a Truth Social post on Saturday evening.

Israel Strikes Iran Nuclear Plant in Massive Escalation in Middle East

13 June 2025

Source: Defence.in | <https://defence.in/threads/israel-strikes-iran-nuclear-plant-in-massive-escalation-in-middle-east.14500/#post-67576>



Jerusalem: Israel carried out "preemptive" strikes against Iran on Friday, targeting its nuclear plant and military sites, after US President Donald Trump warned of a possible "massive conflict" in the region.

Explosions were heard Friday morning in the Iranian capital, state TV reported, adding that Iran's air defence were at "100 percent operational capacity".

Israel declared a state of emergency, with Defence Minister Israel Katz saying that retaliatory action from Tehran was possible following the operation.

"Following the State of Israel's preemptive strike against Iran, a missile and drone attack against the State of Israel and its civilian population is expected in the immediate future," Katz said.

Oil prices surged as much as 6 percent on the strikes, which came after Trump warned of a possible Iranian attack and said the US was

drawing down staff in the region.

"I don't want to say imminent, but it looks like it's something that could very well happen," Trump told reporters at the White House Thursday when asked if an Israeli attack loomed.

Trump said he believed a "pretty good" deal on Iran's nuclear programme was "fairly close", but said that an Israeli attack on its arch foe could wreck the chances of an agreement.

The US leader did not disclose the details of a conversation on Monday with Israeli Prime Minister Benjamin Netanyahu, but said: "I don't want them going in, because I think it would blow it."

Trump quickly added: "Might help it actually, but it also could blow it."

A US official said there had been no US involvement in the Israeli strikes on Iran.

Extremist

The United States on Wednesday said it was reducing embassy staff in Iraq -- long a zone of proxy conflict with Iran.

Israel, which counts on US military and diplomatic support, sees the cleric-run state in Tehran as an existential threat and hit Iranian air defences last year.

Netanyahu has vowed less restraint since the unprecedented October 7, 2023 attack on Israel by Tehran-backed Hamas, which triggered the massive Israeli offensive in Gaza.

The United States and other Western countries, along with Israel, have repeatedly accused Iran of seeking a nuclear weapon, which it has repeatedly denied.

Israel again called for global action after the UN's International Atomic Energy Agency (IAEA) accused Iran on Wednesday of non-compliance with its obligations.

The resolution could lay the groundwork for European countries to invoke a "snapback" mechanism, which expires in October, that would reinstate UN sanctions eased under a 2015 nuclear deal negotiated by then US president Barack Obama.

Trump pulled out of the deal in his first term and slapped Iran with sweeping sanctions.

Iran's nuclear chief, Mohammad Eslami, slammed the resolution as "extremist" and blamed Israeli influence.

In response to the resolution, Iran said it would launch a new enrichment centre in a secure location.

Iran would also replace "all of these first-generation machines with sixth-generation advanced machines" at the Fordo uranium enrichment plant, said Behrouz Kamalvandi, spokesman of the Atomic Energy Organization of Iran.

Iran currently enriches uranium to 60 percent, far above the 3.67-percent limit set in the 2015 deal and close, though still short, of the 90 percent needed for a nuclear warhead.

Iran to Block Strait of Hormuz after US Strikes. Why it Matters

23 June 2025

Source: India Today | https://www.indiatoday.in/world/story/iran-parliament-approves-closure-of-strait-of-hormuz-a-key-oil-chokepoint-report-2744622-2025-06-22?utm_source=global-search&utm_medium=global-search&utm_campaign=global-search



The Strait of Hormuz is a narrow but vitally important waterway that connects the Persian Gulf to the Gulf of Oman and the Arabian Sea. (Photo: India Today)

Iran's parliament has approved a measure to close the Strait of Hormuz, a strategic global oil choke point, following the US's strikes on the Islamic Republic's three nuclear sites. However, a final decision will be taken by the Supreme National Security Council, Iran's top security authority, said Major General Kowsari, a member of the parliament's National Security Committee.

If Iran goes ahead and shuts down the Strait of Hormuz, through which 20 per cent of daily global oil consumption passes, it would disrupt trade flows, send oil prices shooting up and potentially destabilising the global economy.

Such a move could further create instability in the Middle East, which has been witnessing escalating tensions in the past 20 months,

following Israel's wars with Hamas and Hezbollah in Gaza and Lebanon and the conflict with Iran, and the fall of the long-time autocratic President Bashar al-Assad in Syria.

What is Strait of Hormuz and its Significance?

The Strait of Hormuz is a narrow but vitally important waterway that connects the Persian Gulf to the Gulf of Oman and the Arabian Sea. It lies between Iran on the north coast and the Musandam Peninsula - which belongs to Oman and the United Arab Emirates - on the south.

The strait is approximately 167 km long, narrowing to just about 33 km at its narrowest point, with designated three-kilometre-wide shipping lanes for incoming and outgoing maritime traffic.

The strait serves as the sole maritime passage for oil tankers transporting crude oil from the Persian Gulf, making it one of the world's most critical choke points for global energy security. Roughly 17 million barrels of oil per day - or about 20 to 30 percent of the world's total oil consumption - pass through the Strait of Hormuz.

In fact, about 88 percent of all oil exports from the Persian Gulf must transit this narrow waterway, as alternative pipelines and routes are limited. Beyond oil, about a third of the world's liquefied natural gas also moves through the corridor.

What will Happen if the Strait is Closed?

If Iran were to close or block the Strait of Hormuz, it would disrupt the flow of a significant portion of global oil exports, causing major supply shortages and triggering sharp increases in oil prices.

OPEC members Saudi Arabia, Iran, the United Arab Emirates, Kuwait and Iraq export most of their crude via the strait, mainly to Asia. The UAE and Saudi Arabia have sought to find other routes to bypass the strait.

About 2.6 million barrels per day (bpd) of unused capacity from existing UAE and Saudi pipelines could be available to bypass Hormuz, the U.S. Energy Information Administration said in June last year.

As the strait is so narrow and militarily sensitive, attempts to block it could further inflame regional tensions and potentially provoke international naval responses due to the economic and geopolitical stakes involved.

How India will be Affected if Hormuz Shuts Down?

India has diversified oil and energy supply partners, including Russia and a few Arab nations. A negligible part of its supply also comes from Iran.

Experts believe that the closure of the Strait of Hormuz could impact Indian supplies, which could lead to an increase in oil prices that further influence commodity pricing.

In an interview with India Today TV, Union

Petroleum Minister Hardeep Singh Puri allayed concerns about a spike in oil prices amid the Israel-Iran conflict, saying the situation was manageable and energy rates were under control.

Can Iran Really Block Strait of Hormuz?

Generally, Iran does not have legal authority to stop shipping traffic through the key oil choke point. This needs to be achieved either by force or threat of force, Bloomberg News reported.

If the Iranian navy tried to bar entry to the strait, it could face a strong response from the US Fifth Fleet and other Western navies patrolling the area.

Closing the Hormuz will also impact Iran economically, as it would prevent Tehran from exporting its petroleum. Iran itself depends on transit for its oil exports, with an export terminal present at Jask, located at the eastern end of the strait, according to Bloomberg News.

Such a move will also leave China flustered as it is the biggest buyer of Iranian oil and a key partner that used its veto power at the UN Security Council to protect Iran from facing Western-led sanctions or resolutions.

Air India Crash in Ahmedabad: Safety, Operational and Regulatory Concerns

Vinod Rai | 30 June 2025

[Source: ISAS | https://www.isas.nus.edu.sg/papers/air-india-crash-in-ahmedabad-safety-operational-and-regulatory-concerns/](https://www.isas.nus.edu.sg/papers/air-india-crash-in-ahmedabad-safety-operational-and-regulatory-concerns/)



On 12 June 2025, Air India 171, a scheduled international passenger flight, operated by Air India from Ahmedabad to London, crashed within seconds of take-off. The 11-year-old Boeing 787 Dreamliner aircraft operating the flight crashed approximately 36 seconds after take-off. The aircraft was carrying 230 passengers and 12 crew members. Of these, only one passenger survived. The crash also killed 19 people and injured at least 60 more on the ground.

This was the first fatal accident of the 787 Dreamliner, which entered commercial service in 2011. Initial reports suggest multiple technical issues, including possible engine failure and incorrect flap configuration. India's aviation regulator has ordered urgent checks across Air India's Boeing 787 fleet to verify safety compliance. The crash has also renewed pressure on Boeing, whose aircraft have recently faced scrutiny over safety and manufacturing concerns.

The tragic crash has propelled extensive concern and disquietude in India's aviation sector. It has triggered a chain reaction across regulatory, operational and market landscapes. However, even as the data from the black boxes, recovered from the crash site, has been successfully downloaded and is being analysed, the sector has rallied to reshape fleet strategy, risk management and investor sentiment.

We need to examine how this event has disrupted business, not only in Air India but in the entire aviation ecosystem – from the grounding of aircraft to uncertainty in the stock markets, and the role of compliance and confidence restoration.

Disruptions in Operations

Following the crash, Indian civil aviation regulator, the Directorate General of Civil Aviation (DGCA), announced enhanced safety inspections of Air India's fleet of 33 Boeing 787 Dreamliners. As a consequence, and due to aircrafts being grounded for extensive checks, Air India has announced the cancellation of 15 per cent of its wide-body long-haul flights until mid-July 2025.

While most of the Dreamliners have cleared safety checks, the impact on flight schedules has been significant, as all airlines have had to balance passenger rebooking, fleet readiness and regulatory timelines.

Regulator Advises Stringent Supervision

The DGCA has notified that recent surveillance conducted on Air India's Boeing

787 fleet did not reveal any major safety concerns. However, it has flagged certain maintenance-related issues, urging Air India to ensure better coordination across engineering, operations and ground-handling units, secure the availability of adequate spares to minimise delays and adhere strictly to regulatory timelines and passenger communication protocols.

Turmoil in the Financial Markets

The crash has shaken investor sentiment across aviation-linked stocks. Although Air India is not yet publicly listed, the incident could weigh heavily on its Initial Public Offering plans. Globally, Boeing's stock dropped by nearly five per cent, as the 787 Dreamliner programme came under scrutiny. Share prices of Singapore Airlines (SIA), which has a 25.1 per cent stake in Air India, dropped by 2.1 per cent on the Singapore Exchange after the crash.

Concerns were expressed regarding SIA's engineering company, which plays a critical role in Air India's maintenance, particularly for its wide-body fleet, and supports the development of new base maintenance facilities in Bengaluru. As investigations continue and regulatory scrutiny sharpens, SIA's actions in the coming weeks will be critical in shaping its long-term reputation in India, a market in which it has invested heavily, and one that could very well define the next chapter of its global expansion.

Early estimates also suggest total insurance claims from the crash could range between \$260million and \$600 million. These include full hull loss of the aircraft, passenger liability

under the Montreal Convention and third-party damage, including damage to nearby structures such as the BJ Medical College, onto which the aircraft crashed. Much of this liability may fall on global reinsurers, prompting expectations of higher aviation insurance premiums and tighter renewal conditions in 2026.

Reputational Concerns

The DGCA has sought pilot and dispatcher training records from Air India as part of its probe. Legal experts warn that if negligence is established, liability could exceed the airline's approximately \$2 billion insurance coverage, especially if courts award punitive damages. Internally, the airline will need to reassure stakeholders – ranging from passengers to policymakers – about the robustness of its safety culture and governance framework.

Air India's Safety Record

Led by former SIA executive Campbell Wilson since 2022 (he was the Chief Executive Officer of the airlines' low cost carrier, Scoot), the revamped Air India now operates a fleet of 198 planes, has placed orders for 570 more, and controls about 30 per cent of India's domestic market, positioning it as a key player in a fast-growing aviation sector. It is acknowledged that the airline has made huge strides in safety over the past three years following its takeover by Tata and SIA. In fact, it received its International Air Transport Association's operational safety audit certification last year and has introduced a slew of new crew safety protocols.

Managing the Narrative and Rebuilding Passenger Confidence

While the DGCA's assurance of no systemic safety lapse in Air India's Dreamliner fleet offers some relief, the damage to brand trust and investor confidence is real. For airlines and aviation-linked businesses, this incident reinforces the need for proactive crisis management, stringent internal audits and open communication with all stakeholders.

Air India's future credibility and reliability as a trustworthy airline will depend on how effectively, transparently and swiftly it can restore passenger and shareholder confidence. SIA, which has a benchmark for operational experience, will have to put its technical competence and stakeholder responsibility to restore confidence and long-term stability in the airline's operations. Much will depend on how swiftly remedial and public confidence-building measures are undertaken after the findings from the data from the black boxes emerge.

Indian Authorities Decide to Accord Observer Status to ICAO Expert in AI Plane Crash Probe

27 June 2025

Source: *Decan Herald* | <https://www.deccanherald.com/india/indian-authorities-decide-to-accord-observer-status-to-icao-expert-in-ai-plane-crash-probe-source-3606194>



A tail of an Air India Boeing 787 Dreamliner plane that crashed is seen stuck on a building after the incident in Ahmedabad. Credit: Reuters File Photo

New Delhi: Indian authorities have decided to accord observer status to UN body ICAO's expert in the ongoing probe into the fatal Air India plane crash in Ahmedabad on June 12, a top official source said on Friday.

In a not-so-common move, the International Civil Aviation Organization (ICAO) has sought observer status for its expert in the investigation.

Air India's Boeing 787-8 aircraft operating flight AI 171 en-route to London Gatwick crashed into a medical hostel complex soon after take-off from Ahmedabad on June 12, killing 270 people, including 241 people who were onboard the plane. One passenger survived.

The probe into the crash is in progress.

On Friday, the official source told PTI that after considering the request, it has been decided to accord the observer status to ICAO expert in the investigation.

aviation medicine specialist, an Air Traffic Control (ATC) officer, and representatives from the US National Transportation Safety Board (NTSB), the ministry had said in a statement.

The Indian authorities are approaching the probe in a transparent manner, the official source emphasised.

Further details could not be immediately ascertained.

An aircraft accident investigation is carried out as per Annex 13 of the Chicago Convention.

The International Standards and Recommended Practices (SARPS) contained in the nineteen Technical Annexes to the Convention on International Civil Aviation (also called Chicago Convention) are applied universally and produce a high degree of technical uniformity which has enabled international civil aviation to develop in a safe, orderly and efficient manner, as per ICAO website.

SARPS have been developed by ICAO, which was established in 1944.

On Thursday, the civil aviation ministry said data is being extracted from black boxes, and analysis of cockpit voice recorder and flight data recorder of the crashed aircraft is underway.

AAIB promptly initiated an investigation and constituted a multi-disciplinary team headed by the AAIB chief on June 13 in line with prescribed norms. The team includes an

AIR POWER

Ceasefire or Countdown? India's Strategic DIME Response and the Future of Indo-Pak Air Power

Air Vice Marshal Anil Golani, Director General, Centre for Air Power Studies | 12 May 2025

Source: Economic Times | https://government.economictimes.indiatimes.com/blog/ceasefire-or-countdown-indias-strategic-dime-response-and-the-future-of-indo-pak-air-power/121094424?utm_source=latest_news&utm_medium=homepage



While the IAF managed to achieve its objectives and was a major factor in Pakistan's decision to call for a cease fire, whether a recalcitrant state like Pakistan that harbours terrorists and uses state sponsored terrorism as a means of its policy, turns around or not, the jury is out on the issue.

Ever since the barbaric attack carried out by terrorists at Pahalgam on Apr 22 that led to the loss of 26 innocent lives, the subsequent retaliation by India across the DIME (Diplomatic, Information, Military, Economic) paradigm, the nation has had a tenuous and trying time since the last 19 days that seemed

to stretch like eternity.

Political will, national leadership, diplomatic engagement and the military has been tested like never before since the beginning of this century. The declaration of truce on May 10 from 1700 hrs, after four days of intense fighting across the LoC and the IB, however, was short lived as shelling began a couple of hours after the cease fire.

With the Indian Armed Forces having been given the authority to respond to attacks from across the border, how long the truce would last is anybody's guess. However, with the call for a cease fire coming from Pakistan on May 11 the likelihood of this conflict getting prolonged appears remote.

Whether both nations learn from the conflict to emerge stronger in their pursuit for peace and prosperity of their people, time will tell, but it also gives us an opportunity to take an unbiased and critical look at our military capability, the civil military fusion and the higher defence organisation.

The political message by the leadership, both to its citizens and the world at large, was loud and clear any terror attack on innocent citizens would have a cost across the spectrum of national power including the military option. The messaging to important global leaders, the diplomatic community and the United Nations was also unambiguous and clear terrorism would not be acceptable to India and it is time that the rest of the world understands this.

The information and cyber warriors worked

ceaselessly to stop the spread of disinformation and false propaganda against the Indian Armed Forces. Several other measures taken by the Indian government from closing the border, revoking visas, suspending the Indus Water Treaty, cutting down on the diplomatic staff and the total ban on trade were unprecedented and would pay dividends in the times to come.

The national leadership worked in close coordination with the military, making a concerted effort to strategize and plan the course of action for the military to execute. 'Opera was conceived and executed on the night of 06-07 May with nine targets being struck simultaneously across Pakistan and Pakistan Occupied Kashmir.

This was the first time that the headquarters of the Jaish e Mohammed (JeM) in Bahawalpur and the Lashkar e Taiba (LeT) in Muridke were struck leading to many casualties. Pakistan retaliated by launching 'Operation Bunyan al-Marsous' meaning a 'firm and compact structure' and attempted to carry out strikes across 15 cities in northern India, including military infrastructure.

The IAF responded by carrying out attacks at Nur Khan, Murid and Rafiqi air bases with the tit for tat onslaught continuing for the next four days until the cease fire on May 10. The entire operation was carried out, using air launched long range vectors, surface to surface missiles and kamikaze drones. The attacks by Pakistan were neutralised by the very effective and potent layered air defence system of the IAF comprising the S-400, Barak Medium Range Surface to Air Missiles (MR SAM) Akash, Igla

and the terminal air defence guns.

Drone attacks by the adversary were also effectively countered by the integrated Counter - Unmanned Aerial Systems (C-UAS) system using both kinetic and non kinetic means ensuring that there was no significant damage to Indian targets. A unified command and control for air defence weapon systems is critical and this was successfully demonstrated during the conflict.

The IAF made extensive use of air launched stand off weapons like the SCALP, Brahmos and Hammer with ranges varying between 70 to 400 kms apart from the anti radiation Harpy and the Harop hard kill unmanned aerial systems to strike military targets in Pakistan. No fighter aircraft crossed the Line of Control or the International Border marking this as the first of its kind aerial slugfest between two nuclear armed neighbours. The IAF successfully managed to carry out offensive action along with air defence simultaneously using multi role fighter aircraft. While detailed military lessons from this conflict would take time to unravel and implement professionally through tactics, training and procedures, some takeaways emerge with a fair amount of clarity.

The role of air power as a deterrent force as also for punitive action against an adversary is paramount. The speed, lethality and precision with which the IAF responded and continued to act clearly demonstrated the primacy of this instrument of military power in the given scenario and the political objectives desired.

The inadequacy of Flight Refuelling

Aircraft (FRA) and Airborne Early Warning and Control Aircraft (AEW&C) along with the absence of secure and encrypted communication in the form of Software Designed Radios (SDR) and an Operational Data Link (ODL) have been known for long. These are mandatory requirements in the current aerial warfare domain and there is an urgent need to fill these gaps through fast track acquisition or indigenous production at the earliest.

With an increasing use of UAVs for all roles including terminal attack, these need to be produced by the domestic industry to keep pace with the nation's growing requirements. Long range glide bombs and other weapon systems also need to be produced and stocked in sufficient quantities to meet the requirements of the armed forces.

A major part of 'Operation Sindoor' and 'Operation Bunyan al-Marsous' was carried out through air power with both sides not crossing each other's borders with manned aircraft. Air forces are pivotal to Multi Domain Operations (MDO) being the only force capable of having cross-domain coercion and deterrence capabilities that make it an inescapable necessity for the future.

While the IAF managed to achieve its objectives and was a major factor in Pakistan's decision to call for a cease fire, whether a recalcitrant state like Pakistan that harbours terrorists and uses state sponsored terrorism as a means of its policy, turns around or not, the jury is out on the issue.

The IAF Redefining Rules of Engagement

Air Vice Marshal Anil Golani, Director General, Centre for Air Power Studies | 21 May 2025

Source: Bharat Shakti | <https://bharatshakti.in/the-iaf-redefining-rules-of-engagement/>



Indian Air Force destroyed 20% Pakistan air bases

On Much has been talked about and written about 'Operation Sindoor', which, as per the Indian Government, is still ongoing and has not yet been concluded. However, some important lessons have emerged and must be factored into India's emergence as a resolute, capable, and responsible regional power. The immediate response in the aftermath of the Pahalgam massacre that happened on 22 April 2025 led to a whole of government approach starting with politico-diplomatic actions that included the suspension of the Indus Water Treaty, closing of borders, reducing the strength of the diplomatic missions, including the military attaches' and revoking of visas of Pakistani nationals. It was followed by suspending all trade and preventing Pakistan-registered ships from entering Indian ports and vice versa for Indian ships entering Pakistan ports. The messaging by the political leadership meanwhile conveyed Indian resolve unequivocally to take action to hunt down the perpetrators and the masterminds of the terror attacks.

While the Indian military establishment set its forces into motion, carrying out a careful and calibrated assessment of the options it had been practising, gaming and training for, the Pakistani establishment, fearing the worst, was deployed and ready to defend. The short and intense conflict that was to follow after the political go-ahead signalled a doctrinal shift in India's employment of force to achieve political objectives. The nation was prepared to go up the escalation ladder to achieve its political goals. It was ready to call the nuclear bluff that Pakistan had gotten so used to employing at every opportunity. The attack on the terror camps and infrastructure was executed flawlessly by the IAF on the night of 06-07 May 2025, even as the Pakistan air defence systems were on alert. Taken aback by these strikes, deep inside Pakistan and Pakistan Occupied Kashmir, the PAF was bound to retaliate, and it did by attempting to strike at IAF bases and cities simultaneously on the night of 08-09 May 2025. Having crossed the redlines of attacking Indian military installations, the IAF hit back, targeting thirteen airfields simultaneously on 10 May 2025, inflicting much damage to airfield infrastructure and aircraft.

The physical and psychological impact of the IAF's strike led to capitulation, with Pakistan asking for a ceasefire that was apparently perceived to be at the behest of the United States of America. The truth, however, is now out in the open as the Indian External Affairs Minister, Dr S. Jaishankar, has stated that he had clarified to his counterpart in the United States that the request for a ceasefire must come through the DGMO channel from Pakistan. The IAF started the air campaign on its own terms, defying the

odds of a surprise that wasn't there considering the circumstances and finishing it on its own terms, having met the political objectives. The air defence set-up consisting of the homegrown IACCS network that had integrated sensors and weapon systems across the services ensured that there was no significant damage to Indian military installations, infrastructure and cities despite the Pakistani offensive of drones and missiles. The IAF was not only able to defend but also simultaneously carry out offensive action, taking the fight to Pakistan's heartland and leaving them exposed and vulnerable. This doctrinal shift in the employment of air power by the IAF has successfully busted the myth of air power playing a supporting role in surface forces.

The debate on splitting air power assets between theatre commands must also be laid to rest as centralised planning and decentralised execution during Operation Sindoor clearly demonstrated the efficacy of air power with all its might. While indigenously developed drones, weapon systems like the Akash and Brahmos delivered to telling effect, this should also compel the nation to take a hard look at the limitations of the IAF in terms of capacity, force enablers and secure operational data links that are urgently required to make the IAF more potent. It is in the national interest to keep the sharp edge of the sword of military power ready to strike at all times. The IAF has delivered in a sharp and intense conflict, rewriting the rules of engagement, controlling the escalation matrix on its own terms and delivering upon the political objectives. The synergy between the Indian Army and the IAF was evident in integrating the multi-layered air

defence architecture to make it impregnable to the enemy. The planning and coordination worked with perfection within the existing framework. It is an opportune moment to reflect, learn important lessons and ensure that national effort towards enhancement of military power is prioritised and focused on providing value for money. Efforts towards the enhancement of aerospace power would be in the national interest. In an uncertain, volatile and turbulent neighbourhood, as India’s adversaries would invariably look at taking measures to effectively counter the threat from the IAF in the future, we would do well to not rest on our laurels but continue to innovate, equip and train for the next round.

How Ukraine’s Operation “Spider’s Web” Redefines Asymmetric Warfare

Kateryna Bondar | 02 June 2025

Source: CSIS | <https://www.csis.org/analysis/how-ukraines-spider-web-operation-redefines-asymmetric-warfare>



Photo: Security Service of Ukraine/via Telegram

On June 1, Russia’s Military Transport Aviation Day, a significant holiday for the Russian armed forces, the Security Service of Ukraine (SSU) carried out a bold and unprecedented coordinated drone strike deep inside Russian territory. The operation targeted four strategic air bases and delivered a major blow to Moscow’s long-range bomber fleet. Codenamed “Spider’s Web”—or simply “Web”—the operation was named for its wide geographic coverage across remote Russian locations previously thought to be beyond the reach of Ukraine’s long-range drone capabilities.

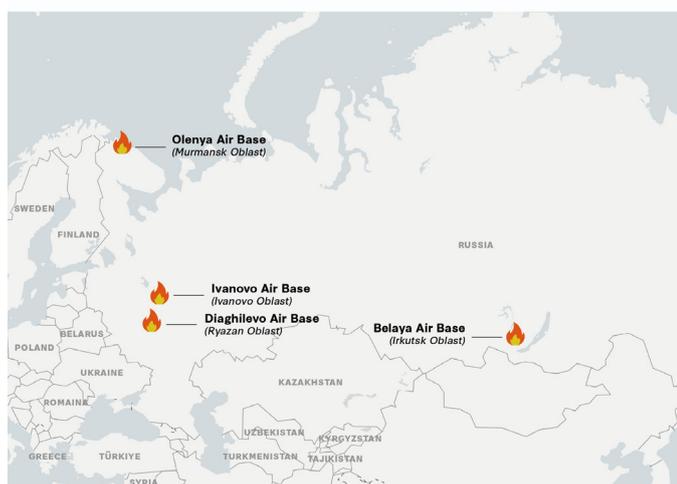
Using small striking drones covertly smuggled into Russia and launched from hidden compartments inside cargo trucks, the operation struck more than 40 high-value aircraft—including strategic bombers Tu-95MS, Tu-22M3, and A-50 planes used for launching and coordinating missile attacks on Ukrainian cities. The meticulously planned operation marks a significant milestone in Ukraine’s evolving asymmetric warfare capabilities and signals a

major vulnerability in Russia’s rear defenses.

What were the key targets of Ukraine’s Operation Spider’s Web?

Operation Spider’s Web targeted four key Russian military air bases that play pivotal roles in Russia’s strategic aviation infrastructure. Notably, their locations span the entire breadth of Russian territory, as shown in Figure 1—an aspect that likely inspired the codename of the operation.

FIGURE 1
Targeted Russian Airbases During Ukrainian Drone Operation



Source: CSIS analysis.

CSIS | WADHWANI AI CENTER

1. Olenya Air Base (Murmansk Oblast)

Olenya air base is located on the Kola Peninsula and approximately 1,900 km north of Ukraine. It is home to the 40th Composite Aviation Regiment, which includes a squadron of Tu-22M3 bombers. In addition, a significant number of Tu-95MS strategic bombers—previously stationed elsewhere—have been relocated to this base, making it a vital launch point for long-range missile strikes against Ukraine. The base’s remote Arctic location was previously considered sufficient protection

against Ukrainian attacks.

2. Diaghilevo Air Base (Ryazan Oblast)

Diaghilevo serves as Russia’s central hub for the combat training of strategic aviation crews. It is located approximately 470 km from the Ukrainian border. The base also houses a major aircraft repair facility for all types of Russian strategic bombers, including the Tu-95, Tu-160, and Tu-22M3. Damage to this base not only affects active bomber units but also disrupts both pilot training pipelines and maintenance operations for Russia’s long-range aviation fleet.

3. Belaya Air Base (Irkutsk Oblast)

Located deep in Siberia, more than 4,000 km from Ukraine, the Belaya air base was previously thought to be well beyond the reach of Ukrainian strikes—until now. The airfield hosts the 220th Heavy Bomber Aviation Regiment, which operates Tu-22M3 bombers capable of launching Kh-22 supersonic cruise missiles. The drone strike here marks the first documented Ukrainian attack on a military target in this region, demonstrating the unprecedented operational range and tactical ingenuity of the SSU’s campaign.

4. Ivanovo Air Base (Ivanovo Oblast)

Located about 700 km from the Ukrainian border, Ivanovo air base is the primary station for Russia’s A-50 AWACS (airborne warning

and control system) aircraft, which are crucial to Russian air operations. These aircraft perform key functions such as detecting air defense systems, tracking airborne threats, and coordinating fighter jet activity. With Russia possessing fewer than ten A-50s in total, the loss or damage of even one significantly degrades its situational awareness and command-and-control capabilities.

The Russian Ministry of Defence also mentioned attacks in Amur Oblast, but no confirmed damage was reported.

Together, these four bases form the backbone of Russia’s long-range strike and aerial surveillance capabilities. Their simultaneous targeting reflects a sophisticated and coordinated Ukrainian effort to undermine Russia’s ability to project air power and sustain missile attacks across Ukraine.

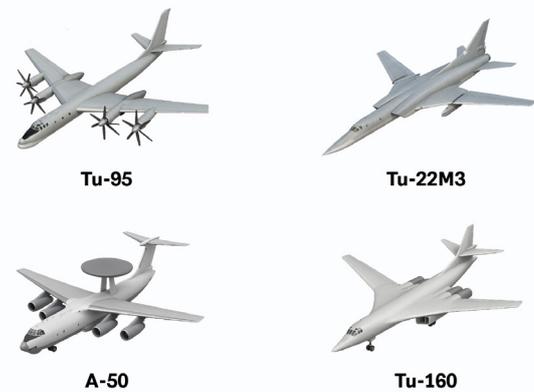
What were the types of aviation destroyed?

During the SSU’s special operation, Spider’s Web, Ukraine targeted and destroyed more than 40 Russian aircraft stationed at four key air bases across Russian territory. As shown in Figure 2, the major losses include strategic bombing, aviation, and airborne early warning and control aircraft.

1. Tu-9: A Soviet-era strategic bomber equipped with turboprop engines, used by Russia to launch long-range cruise missiles such as the Kh-55, Kh-555, and the newer Kh-101/102.

Each aircraft can carry up to 16 cruise missiles. Despite its age, the Tu-95 remains a critical asset in Russia’s long-range strike capability.

FIGURE 2
Aircraft Types Representing Key Losses in Ukraine’s Operation "Spider's Web"



Note: These images are AI-generated representations of the aircraft, created using reference imagery and descriptions from [Airliners.net](#) and guided by CSIS analysis, using GPT-4o.
Source: CSIS analysis.

CSIS | WADHWANI AI CENTER

2. Tu-22M3: A supersonic long-range bomber capable of carrying Kh-22 cruise missiles, which pose a severe challenge for Ukrainian air defenses due to their high speed. The Tu-22M3 forms part of Russia’s conventional and nuclear strike forces.

3. A-50: An AWACS aircraft used by Russia to detect air defense systems, coordinate missile strikes, and guide fighter aircraft. Russia has fewer than ten operational A-50s, and each is estimated to cost around \$350 million. Their loss severely limits Russia’s situational awareness and air command capabilities.

4. Tu-160: A supersonic, variable-sweep wing strategic bomber and the largest combat aircraft in the world. Capable of carrying both nuclear and conventional cruise missiles, including the Kh-101 and Kh-102, the Tu-160 serves as a key component of Russia’s long-range strike and

nuclear deterrent force.

The majority of aircraft confirmed damaged or destroyed belong to the core platforms used by Russia for strategic bombing and battlefield coordination.

How was the operation conducted?

Planning for the operation reportedly began over 18 months prior to its execution. Ukrainian operatives smuggled around 150 small strike drones, modular launch systems, and 300 explosive payloads into Russia through covert logistical routes. The drones were concealed inside wooden modular cabins, which were then loaded onto standard cargo trucks.

An integral component of the operation was its use of covert logistics conducted through Russian territory, involving unwitting Russian civilian participants. As part of the operation's deception strategy, the SSU reportedly recruited Russian truck drivers to deliver the mobile drone launchers camouflaged as standard cargo loads. These drivers were instructed to arrive at specific times and park at predesignated locations in the vicinity of Russian strategic air bases, including fuel stations and isolated roadside areas.

At the designated time, the roofs of the cabins were remotely opened, and the drones launched directly from within the trucks. This minimized the distance between launch and impact, allowing the drones to bypass Russia's

layered air defense systems—including Pantsir and S-300 units—before they could react. Notably, Russian sources confirmed the drones were launched from positions just outside the airfields, including from fuel stations and roadside laybys. After all the drones were launched, the trucks exploded, indicating that they were equipped with a self-destruction mechanism.

Altogether, 117 drones were launched, with over 40 aircraft struck, amounting to what Ukrainian sources estimate as 34 percent of Russia's strategic cruise missile delivery platforms. This includes some of the few remaining A-50 airborne early warning and control aircraft, which are vital to Russia's airspace surveillance and targeting operations.

Importantly, all personnel involved in the operation were successfully moved from Russian territory to Ukraine prior to drone launch. Ukrainian leadership, including President Zelensky and SSU chief Vasyl Maliuk, was reportedly closely involved in the planning and real-time coordination of the strike.

The success of Spider's Web highlights a dramatic shift in the balance of initiative. Ukraine demonstrated the ability to execute a coordinated, multi-theater deep-strike operation, far beyond its borders, using fully indigenous systems and asymmetric tactics—blending deception, precision, and strategic surprise.

What role did AI play in Ukraine's Spider's Web drone operation?

In Operation Spider's Web, Ukraine demonstrated a hybrid approach to drone warfare that combined remote human control with elements of autonomy and potentially AI-assisted functionality. While the operation was not fully autonomous, the available evidence suggests that artificial intelligence likely played a supporting role in both flight stability and targeting, particularly in enabling precise strikes on vulnerable components of high-value aircraft.

The first-person-view (FPV) drones used in the operation were remotely controlled through Russian mobile telecommunications networks, including 4G and LTE connections. These networks provided sufficient bandwidth to support real-time video transmission and command inputs across vast distances, allowing Ukrainian operators to manage drone flights from outside Russian territory. This setup avoided the need for any physical ground control stations or nearby operators.

To enable stable long-distance control over mobile networks, the drones relied on a software-hardware system built around ArduPilot—a widely used, open-source autopilot framework designed for unmanned aerial vehicles. ArduPilot provides advanced flight stabilization, waypoint navigation, failsafe routines, and programmable mission profiles. In this case, each drone was integrated

with a compact onboard computer (such as a Raspberry Pi), connected to a webcam and an LTE modem via Ethernet. The camera feed was used for visual navigation, while control signals were routed through ArduPilot's UART interface, allowing operators to pilot the drone remotely with stabilized, responsive input—even when faced with significant signal latency.

ArduPilot's flexibility makes it well-suited for missions operating over unstable or high-latency links, such as mobile internet, as it can independently manage the drone's orientation, heading, and altitude, ensuring flight stability while awaiting operator commands. This made it the ideal choice for long-range, internet-based FPV control—especially when using improvised mobile launch platforms deep inside Russian territory.

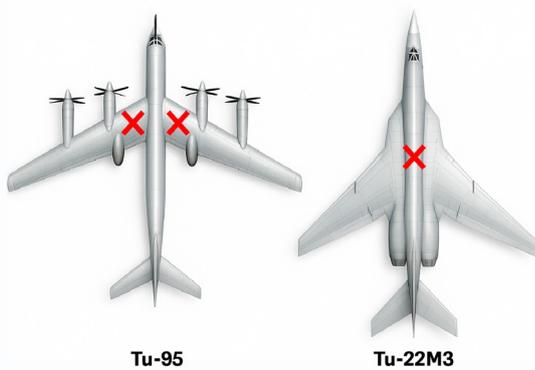
In addition to manual control, AI-assisted targeting appears to have been integrated into the drones' attack logic. According to open-source intelligence and reporting, SSU teams studied construction and visual profiles of the targeted aircraft—including Tu-95MS, Tu-22M3, and A-50 models, which are preserved in Ukrainian aviation museums like the Poltava Museum of Long-Range and Strategic Aviation—to identify precise weak points.

These profiles likely served as training data for machine vision models that were then embedded into the drones' onboard computers. Such models could assist operators by identifying key structural weak points,

such as underwing missile pylons and fuel tank seams, enabling rapid and precise final-stage maneuvering during the dive attack. The images released by the SSU confirm that the specific structural points, as shown in Figure 3, were identified as targets during the preparation phase, and later, official footage shows drones striking precisely at those designated areas.

FIGURE 3

Identified Structural Weak Points Targeted During Operation "Spider's Web"



Note: These images are AI-generated representations of the aircraft, created using reference imagery and descriptions from [Airliners.net](#) and guided by CSIS analysis, using GPT-4o.
Source: CSIS analysis based on information shared by the SSU.

CSIS | WADHWANI AI CENTER

While there is no public confirmation that the drones executed AI-assisted autonomous strikes, the integration of AI-based object recognition into the control architecture likely augmented the operators' ability to strike specific aircraft vulnerabilities. In effect, the drones acted as precision weapons—remotely flown, but potentially capable of executing final targeting actions with computational assistance.

The operation leveraged a combination of software enabling remote control, 4G/LTE communications, and likely AI-assisted targeting, built on open-source platforms and Ukrainian-developed tools. The success of

the mission did not hinge on technological novelty alone, but rather on the organizational ingenuity, deep reconnaissance, and logistical mastery that enabled Ukraine to strike at the core of Russia's strategic aviation assets—far beyond the frontline.

What strategic lessons can be learned from Ukraine's Operation Spider's Web?

Operation Spider's Web marks a turning point in how low-cost, improvised unmanned systems can be employed with strategic impact deep behind enemy lines. By combining accessible technology, creative logistics, and targeted precision, Ukraine demonstrated a new paradigm in drone warfare—one that challenges conventional assumptions about scale, cost, and vulnerability.

The following lessons emerge from this operation and highlight key takeaways for the future of warfare and defense planning.

1. Low-cost, open-source drone systems can effectively destroy high-value military platforms.

Operation Spider's Web proved once again that FPV drones, built with inexpensive components and controlled via open-source autopilot systems like ArduPilot, can destroy strategic aircraft worth billions. These drones, costing \$600–1,000, successfully struck aircraft such as the Tu-95MS and Tu-22M3—bombers worth billions that Russia uses to launch Kh-

101 and Kh-22 missiles, respectively. This case shows a growing trend in modern warfare: Mass-produced, attritable systems with limited range or payload can inflict disproportionate strategic damage when combined with creativity and intelligent targeting.

2. Russia's losses include irreplaceable strategic bombers with no clear path to restoration.

Among the more than 40 aircraft damaged or destroyed were Soviet-era platforms that are no longer in production, such as Tu-95 bombers. Because the original supply chain for components was spread across the Soviet Union, Russia now lacks the industrial base to quickly replenish such losses. Even if some airframes could be repaired, replacing avionics, engines, or airframe parts may be prohibitively difficult. The long-term degradation of Russia's long-range strike fleet, which forms part of its nuclear triad, represents a rare and costly strategic vulnerability.

3. Strategic infrastructure remains highly vulnerable without dedicated counter-UAV defense measures.

Despite being stationed thousands of kilometers from Ukraine—in places like Murmansk and Irkutsk—Russia's key air bases were successfully struck. The attacks exposed critical gaps in Russian perimeter defense. Conventional systems like Pantsir and S-300 were unable to detect or intercept the low-flying

small drones, which were launched from cargo trucks parked nearby. This shows the need for a layered defense that includes simple measures such as hangar fortification and electronic warfare, along with broader efforts to deny enemy use of mobile networks and implement continuous surveillance of infrastructure near military sites.

4. Autonomy is essential for unmanned operations conducted beyond reliable communication range.

The drones used in Operation Spider's Web operated via 4G/LTE networks using ArduPilot autopilot software—a widely used open-source platform that allows flight stability and control even under signal delay or loss. These systems were installed on single-board computers (like Raspberry Pi), connected to LTE modems and standard webcams for operator vision. In such long-range missions, where human operators might face latency or disconnection, autonomy in navigation and stabilization becomes critical. This is particularly important for cheap, expendable platforms where high-end comms infrastructure like Starlink is either unavailable or economically unjustified.

6. AI-enabled targeting allows low-cost drones to strike with surgical precision.

Ukrainian planners reportedly used decommissioned Soviet aircraft—on display at the museum—to train AI systems in recognizing structural weak points, such as

underwing pylons or fuel tank locations. The SSU's released photos confirm these spots were identified in advance and later targeted in the strikes by pilots or potentially with AI-enabled targeting assistance. This precision allowed even lightweight FPV drones to cause catastrophic damage by hitting the most vulnerable and flammable parts of each aircraft, further amplifying the cost-effectiveness of the attack.

7. The operation reflected strategic planning aimed at disabling the entire ecosystem of Russian long-range aviation.

Beyond aircraft destruction, the SSU deliberately targeted facilities like the Dyagilevo air base, which functions as both a training hub and an aircraft repair center. By simultaneously degrading platforms, logistics, and crew readiness, Ukraine attacked the entire operational backbone of Russia's strategic bomber fleet. This approach shows a deep understanding of strategic aviation as a system—not just as a collection of airframes.

Ukraine prioritizes operational and technical secrecy by ensuring its technologies cannot be reverse-engineered.

One of the key elements of the operation's success was the denial of forensic access to the assets used. After all, FPV drones were launched from disguised wooden cabins mounted on trucks, the trucks self-destructed—likely through embedded explosive charges.

Just as long-range drones often explode after a certain period of time after launch, this tactic prevents Russia from analyzing or copying the technology used.

Conclusion

Operation Spider's Web not only showcased Ukraine's tactical ingenuity but also illuminated the broader technological and strategic shifts reshaping modern warfare. As unmanned systems become more sophisticated, accessible, and effective, there are three critical trends that military and political leaders around the world can no longer afford to ignore.

First, the proliferation of cheap, attritable technologies—both in hardware and software—is accelerating. Cheap off-the-shelf FPV drones, open-source software platforms, and AI models, once designed for hobbyists, are now weaponized with devastating results. The accessibility and adaptability of such systems make them an attractive tool for state and non-state actors alike, demanding urgent efforts to anticipate, regulate, and counter their militarized use in both conflict zones and domestic settings.

Second, the steady advance of autonomy is reshaping how these systems operate. While current drones often separate navigation, targeting, and execution into distinct semiautonomous functions, future iterations will likely merge them into unified, fully autonomous platforms capable of conducting

missions independently, across vast distances, and with minimal human oversight. This progression will challenge existing doctrines, oversight mechanisms, and ethical boundaries.

Third, the operation demonstrated the growing need for robust physical protection and dedicated countermeasures against drone threats. From critical military infrastructure to civilian sites, the vulnerability to small, precise, and hard-to-detect systems is growing. Conventional air defenses are often ill-suited for this new threat landscape, prompting an urgent call for innovation in early detection, electronic warfare, and layered physical defenses.

Together, these trends point to a future where technological agility, not just industrial scale, determines strategic advantage. The militaries that adapt early—by investing in resilience, countermeasures, and adaptive doctrine—will be best positioned to meet the challenges of a rapidly evolving battlefield.

Operation Midnight Hammer 3 Questions from an Air Power Perspective

Wg Cdr A Pichipoo Raja | 27 June 2025

Source: CAPS India | <https://capsindia.org/operation-midnight-hammer-3-questions-from-an-air-power-perspective/>



On June 21, 2025, the US conducted strikes on three nuclear facilities in Iran under the operation codename “Midnight Hammer”. A total of 14 Massive Ordnance Penetrators (MOP), GBU 57 bombs, weighing 30,000 pounds each, were dropped from B-2 bombers that flew from the mainland US. One hour and forty minutes before the B-2 dropped their weapons, two dozen Tomahawk Land Attack Missiles (TLAM) were fired from a US submarine. Consequently, Iran has admitted to severe damage to its nuclear infrastructure. However, from an air power perspective, there

are still some questions that remain unanswered. **Hypothesis 1 – It was an Ad Hoc Decision**

Firstly, Israel has comparable weapons in its arsenal that can offer the same destruction as a TLAM So, the first question is, “Why were TLAMs from the submarine employed when Israel is capable of doing the same damage with other weapons?”

Secondly, Israel had declared air superiority over the region several days before the US attacked Iran. Israel did not lose any aircraft in this operation (other than drones), implying the validity of this claim. There is no evidence that any Iranian aircraft took off during this operation. However, General Dan Caine, during the press briefing, said, “The U.S. employed several deception tactics, including decoys as the fourth and fifth generation aircraft pushed out in front of the strike package at high altitude and high speed, sweeping in front of the package for enemy fighters and surface to air missile.”

Why were fighter sweeps used when there was no aerial opposition? So, the second question is, “Over an area with air superiority, why such textbook tactics were employed?”

Thirdly, B-2 is a stealth aircraft. Stealth aircraft are not supposed to be seen or detected. Decoys are meant to draw attention to themselves. Why were B-2s sent to the Pacific as decoys?

This article will offer three hypotheses on why the attack was planned in this manner.

This was an ad hoc attack put together at short notice. It is likely that President Donald Trump changed his mind and ordered to attack. No one informed him that there was not enough time to prepare. US Secretary of Defense Pete Hegseth, US Vice President JD Vance, and US Secretary of State Marco Rubio are all significantly younger than President Trump. The implications of this were evident in the case of the leaked Signal chat of the Houthi operation in March 2025, as it made it clear that no one in the US Security decision-making process contradicted the President, despite having personal reservations against the operation. In this case, since time was short, they possibly pulled out an existing plan to attack Iran’s nuclear programme that had already been wargamed in the past. The plan was executed without significant modifications to adjust to the current situation, given the time constraints. This is evident from the use of submarine-launched TLAMs, the employment of sweep aircraft against zero air opposition, and other measures- all designed for a situation of initial wave against a well-defended adversary.

The ad hoc plan can also be inferred from the contradictions that arose during the press briefing. Secretary Pete Hegseth said, “This is a plan that took months and weeks of positioning and preparation.” In contrast, only minutes later, General Caine said, “In just a matter of weeks, this went from strategic planning to global execution.” While Secretary Hegseth sought to convey a long-term perspective on the decision, General Caine aimed to demonstrate the swift response of his forces.

Hypothesis 2 – Inter-Service Competition

The US Navy lost three F/A-18 aircraft in its operations against the Houthis, with two of those losses occurring within a week in May 2025. Additionally, the United States Central Command (US CENTCOM) is believed to have lost 15 to 22 MQ-9 Reaper drones. The operation cost over a billion dollars but failed to achieve any visible objectives. Losing so many assets to a non-state actor with no air force is a tremendous loss of credibility for any military.

The situation with Iran provided an opportunity for US CENTCOM to improve its image. Therefore, the use of TLAM, a low-risk option, was primarily intended to restore the Navy's reputation and convey a sense of jointness, even when tactically unnecessary. Considering that, throughout the operation, Israel had been effectively targeting these facilities.

Hypothesis 3 – Risk Averse Behaviour

The US's prolonged involvement in the global war on terror has possibly degraded some conventional war-fighting capabilities, especially the mindset. The US military has been engaging weak adversaries like terrorists in uncontested airspace for decades. This has provided them with the freedom to employ any asset in whatever manner they deem fit. Low-risk options like drone strikes and stand-off attacks have become the norm. This has progressively lowered the institutional threshold for risk. To compare, during the Gulf War of 1991, the F-117 (stealth aircraft) was the only aircraft to operate over the densely air-defended areas

of Iraq right from the beginning, when Iraqi air defences were still intact. Whereas, in this operation multiple fourth and fifth-generation fighter aircraft were used to protect the B-2 stealth aircraft during this operation over an area where air superiority was already established. This has significant connotations. Any future operation against a peer adversary could be abandoned at the planning stage, as the risk appetite is low.

Finally, Secretary Hegseth claimed that the US military capabilities are “nearly unlimited.” In that case, this kind of planning might be perfectly rational from their perspective, and all the above hypotheses could be incorrect. However, this defies one of the principles of war, “economy of effort.” Therefore, drawing the correct lessons from the application of air power in this operation needs to be congruent with the principles of war.

How the US Bombarded Iranian Nuclear Sites Without Detection

Farnoush Amiri and Meg Kinnard | 23 June 2025

Source: AP News | <https://apnews.com/article/iran-fordo-us-strike-trump-israel-nuclear-sites-320a85327f94ed7496f09564261f3148>



The stealth bombers that dropped massive bunker-buster bombs on Iranian nuclear facilities have begun returning to a U.S. base in Missouri. (AP video: Nicholas Ingram)

DUBAI, United Arab Emirates (AP) — It was an unprecedented attack years in the making, with some last-minute misdirection meant to give the operation a powerful element of surprise.

U.S. pilots dropped 30,000-pound bombs early Sunday on two key underground uranium enrichment plants in Iran, delivering what American military leaders believe is a knockout blow to a nuclear program that Israel views as an existential threat and has been pummeling for more than a week. American sailors bolstered the surprise mission by firing dozens of cruise missiles from a submarine toward at least one other site.

Dubbed Operation Midnight Hammer, U.S. officials say the plan was characterized by a “precision strike” that “devastated the Iranian

nuclear program,” even as they acknowledged an assessment was ongoing. For its part, Iran denied that any significant damage had been done, and the Islamic Republic pledged to retaliate.

Taking off from the U.S. heartland, B-2 stealth bombers delivered a total of 420,000 pounds of explosives, aided by an armada of refueling tankers and fighter jets — some of which launched their own weapons. U.S. officials said Iran neither detected the inbound fusillade, nor mustered a shot at the stealthy American jets.

The operation relied on a series of deceptive tactics and decoys to maintain the secrecy, U.S. officials said hours after the attack, which was preceded by nine days of Israeli attacks that debilitated Iran’s military leadership and air defenses.

A Decoy Plan

Even before the planes took off, elements of misdirection were already in play. After setting parts of the plan in motion, Trump publicly announced Thursday that he’d make a decision within two weeks on whether to strike Iran — ostensibly to allow additional time for negotiations, but in actuality masking the impending attack.

One group of B-2 stealth bombers traveled west from Missouri on Saturday as decoys, drawing the attention of amateur plane spotters, government officials and some media as they headed toward a U.S. air base in the Pacific. At the same time, seven other B-2s carrying two

“bunker buster” bombs apiece flew eastward, keeping communications to a minimum so as not to draw any attention.

Air Force Gen. Dan Caine, the chairman of the Joint Chiefs of Staff, said at Sunday’s briefing that it was all “part of a plan to maintain tactical surprise” and that only “an extremely small number of planners and key leaders” knew about it in Washington and Florida, where U.S. Central Command is based.

After 18 hours of furtive flying that required aerial refueling, the armed B-2 Spirit bombers, each with two crew members, arrived on time and without detection in the Eastern Mediterranean, from where they launched their attack runs. Before crossing into Iran, the B-2s were escorted by stealthy U.S. fighter jets and reconnaissance aircraft.

A graphic released by the Pentagon showed the flight route as passing over Lebanon, Syria and Iraq. It was unclear whether those countries were notified of the U.S. overflight in advance. Most U.S. lawmakers were also kept in the dark, with some Republicans saying they were provided a brief heads-up by the White House before the strike.

“Our B-2s went in and out and back without the world knowing at all,” Secretary of Defense Pete Hegseth told reporters Sunday.

A Multifaceted Attack

About an hour before the B-2s entered Iran, Caine said that a U.S. submarine in the region launched more than two dozen Tomahawk

cruise missiles against key targets, including a site in Isfahan where uranium is prepared for enrichment.

As the U.S. bombers approached their targets, they watched out for Iranian fighter jets and surface-to-air missiles, but encountered none.

At 6:40 p.m. in Washington and 2:10 a.m. in Tehran, the first B-2 bomber dropped its pair of GBU-57 massive ordnance penetrators on the deeply buried Fordo uranium enrichment plant. It was the first time these so-called “bunker busters” had ever been used in combat. Each 30,000-pound bomb is designed to burrow into the ground before detonating a massive warhead.

The Fordo site received the bulk of the bombardment, though a couple of the enormous bombs were also dropped on a uranium enrichment site at Natanz.

The U.S. bombs fell for about half an hour, with cruise missiles fired from submarines being the last American weapons to hit their targets, which included a third nuclear site at Isfahan, Caine said.

Both Iran and the U.N. nuclear watchdog said there were no immediate signs of radioactive contamination around the sites.

A Look at the Numbers

The mission included:

- 75 precision-guided weapons: these included 14 GBU-57 “bunker buster” bombs deployed

by the seven B-2 Spirit stealth bombers, and more than two-dozen Tomahawk cruise missiles launched from a U.S. submarine.

- 125 aircraft, including the B-2 bombers, fighter jets and refueling planes.

Tejas Mk1A Doubles Close-Combat Air-to-Air Firepower with Dual ASRAAM Missile Pylons, Promising Superior Dogfight Performance

Raghav Patel | 23 June 2025

Source: [Defense.in](https://defence.in/threads/tejas-mk1a-doubles-close-combat-air-to-air-firepower-with-dual-asraam-missile-pylons-promising-superior-dogfight-performance.14641/) | <https://defence.in/threads/tejas-mk1a-doubles-close-combat-air-to-air-firepower-with-dual-asraam-missile-pylons-promising-superior-dogfight-performance.14641/>



In a major boost to India's indigenous military aviation program, the Tejas Mk1A Light Combat Aircraft (LCA) has been showcased with a newly integrated dual-pylon system, effectively doubling its capacity for

close-combat missiles.

The new configuration, featuring the Advanced Short-Range Air-to-Air Missile (ASRAAM), was a highlight at the Aero India 2025 exposition, signalling a substantial enhancement of the fighter jet's combat effectiveness.

Developed by Hindustan Aeronautics Limited (HAL), the innovative dual-pylon adapter allows two missiles to be mounted on a single hardpoint, or weapon station, on the aircraft. This upgrade immediately doubles the Tejas Mk1A's arsenal of air-to-air missiles for dogfights.

More importantly, it frees up other hardpoints to carry a versatile mix of additional weapons, including precision-guided bombs or long-range missiles, thereby enhancing the aircraft's flexibility for diverse mission roles.

The weapon at the centre of this upgrade is the ASRAAM, a formidable missile developed by European manufacturer MBDA.

Known for its high speed, which is in excess of Mach 3, and an advanced imaging infrared seeker, the ASRAAM provides a "first shot, first kill" capability.

Its "Lock-On After Launch" (LOAL) feature allows the pilot to fire the missile and have it acquire a target afterwards, making it exceptionally deadly in close-quarter aerial combat against enemy fighters and drones.

The Tejas Mk1A is a significantly improved version of India's homegrown light combat

fighter.

It incorporates critical upgrades over the initial Tejas Mk1, including an Active Electronically Scanned Array (AESA) radar for superior target detection, an advanced mission computer, a modern electronic warfare suite for enhanced self-protection, and improved maintainability.

These features are designed to meet the rigorous demands of the Indian Air Force (IAF) for a modern multi-role aircraft capable of operating in heavily contested airspace.

The static display of the enhanced aircraft at Aero India in Bengaluru drew considerable interest from military officials and defence analysts.

It served as a clear demonstration of HAL's progress in advancing the Tejas platform, a cornerstone of India's national policy of self-reliance in defence manufacturing, known as 'Aatmanirbhar Bharat'.

Furthering its firepower, HAL is also developing a similar dual-pylon configuration for India's indigenous Astra series of Beyond Visual Range (BVR) air-to-air missiles.

Integrating a dual rack for the Astra Mk1 and the in-development Mk2 missiles, which have a reported range of over 160 km, will grant the Tejas Mk1A superior capability to engage enemy aircraft from extended distances, complementing its enhanced dogfighting prowess.

This upgrade is a critical development for

the Indian Air Force, which is working to overcome a shortfall in its fighter fleet. With a current strength of approximately 31 squadrons against a sanctioned requirement of 42, the IAF is phasing out its ageing MiG-21 fleets.

The timely induction of the modernised and more lethal Tejas Mk1A is pivotal to bridging this capability gap and maintaining a credible defence posture.

The ability to carry a larger and more diverse weapons load makes the Tejas Mk1A a more versatile asset for a range of military operations, from air defence to ground strikes. This enhanced combat potential is crucial for countering advanced aircraft operated by regional adversaries.

By integrating both foreign and indigenous weapon systems, the Tejas Mk1A program not only strengthens national security but also significantly reduces India's dependence on international suppliers.

India to Extend Two-Tiered BMD Shield to Key South Indian Hubs, Countering Pak's Long-Range HATF-1 and Fatah-2 Threats

Raghav Patel | 25 June 2025

[Source: Defence.in | https://defence.in/threads/india-to-extend-two-tiered-bmd-shield-to-key-south-indian-hubs-countering-paks-long-range-hatf-1-and-fatah-2-threats.14655/](https://defence.in/threads/india-to-extend-two-tiered-bmd-shield-to-key-south-indian-hubs-countering-paks-long-range-hatf-1-and-fatah-2-threats.14655/)



In a significant move to enhance its strategic defence capabilities, India is set to expand its indigenous Ballistic Missile Defence (BMD) shield to cover major cities in southern India.

This decision comes as the first phase of the programme, designed to protect Delhi and Mumbai, approaches full operational status, addressing the evolving threat landscape marked by Pakistan's deployment of advanced rocket systems.

Developed by the Defence Research and Development Organisation (DRDO), India's BMD system is a multi-layered network designed to intercept and destroy hostile ballistic missiles.

Phase-I employs a two-tiered approach, featuring the Prithvi Air Defence (PAD) and

Prithvi Defence Vehicle (PDV) for high-altitude exo-atmospheric interception (outside the Earth's atmosphere at altitudes up to 80 km) and the Advanced Air Defence (AAD), also known as Ashwin, for endo-atmospheric interception at lower altitudes of up to 30 km.

This layered architecture ensures a higher probability of successfully neutralising incoming threats.

The initial deployment of the BMD shield has been focused on safeguarding the National Capital Region (NCR) and the financial hub of Mumbai. This placement was prioritised to counter potential threats from Pakistan's missile arsenal, particularly the nuclear-capable Shaheen series.

According to official sources, the protective umbrella of the Phase-I BMD system is now being extended to include the vital southern cities of Bangalore, Chennai, and Hyderabad.

The expansion acknowledges the increasing strategic and economic importance of these urban centres. Hyderabad, in particular, has grown into a critical hub for the nation's defence and aerospace sectors, hosting key facilities for DRDO, Hindustan Aeronautics Limited (HAL), and Bharat Electronics Limited (BEL), alongside numerous private defence firms.

To implement this southern shield efficiently, a single BMD site is reportedly being planned in a central state. This strategic positioning would allow its long-range tracking radars and interceptors to provide effective coverage for all three cities simultaneously.

Such a centralised deployment model is designed to optimise resource allocation, reduce operational costs, and streamline command and control structures.

This expansion is part of India's broader strategy to create a robust defence against a range of aerial threats, including Pakistan's recently tested Fatah-II guided multiple-launch rocket system, which has a reported range of up to 400 kilometres.

Meanwhile, work on Phase-II of the BMD programme is advancing. This next stage aims to develop interceptors capable of neutralising Intermediate-Range Ballistic Missiles (IRBMs) and Intercontinental Ballistic Missiles (ICBMs).

The DRDO is actively conducting trials for its next-generation interceptors, the AD-1 and AD-2 missiles. The AD-1, a long-range interceptor, has already undergone successful flight tests and is designed to engage targets in both high and low atmospheric layers, significantly enhancing the reach and versatility of India's missile defence capabilities.

Op Sindoor: IAF Achieved its Aim and Validated Weapon Systems

Colonel Vinayak Bhat (Retd) | 13 June 2025

Source: CAPS India | <https://capsindia.org/op-sindoor-iaf-achieved-its-aim-and-validated-weapon-systems/>



Operation Sindoor has proven to be another feather in India's cap after the Balakot strikes in February 2019. India's Air Defence (AD) and the Indian Air Force demonstrated their professional acumen and technological prowess, with the Indian Navy and Army playing a decisive and supportive role.

The planning for Op Sindoor was initiated following the unrestricted authorisation to use air power. Comprehensive intelligence was gathered regarding the status of terrorists at 21 identified locations. Ultimately, only nine of these locations were selected based on specific information indicating the presence of terrorists. Preparations were made for a plan to dismantle terrorist infrastructure in Pakistan and Pakistan-occupied Kashmir (PoK). The plan included various contingencies following an escalatory ladder disproportionate to Pakistan's actions in a carefully coordinated use of India's air power.

Some members of the Indian media had started to question the preparedness of Indian forces,

showing a lack of understanding regarding the complexities involved in preparing for military conflict with a determined, nuclear-armed, and religiously motivated adversary. One commentator even suggested, “India could stop short of an escalatory military assault similar to the Balakot air strike of 2019.” [1] Everyone thought Jabba Top attack was the highest point of India and any such strikes would breach the nuclear threshold for Pakistan and India was unlikely to take military measures and would be content with only abrogating the Indus Waters Treaty (IWT).

Precisely 14 days after the terrorist attack, the Indian government passed orders to all states to practice civil defence and blackouts on the evening of May 07, 2025. Blinded by the love for their terrorists, the adversary could never have assessed or even guessed the D-Day for Indian forces to be the same.

Pakistan tried in vain to clarify its position with regards to the Indian strikes on May 07, 2025, following a call from the Indian DGMO (Director General of Military Operations) to explain that India’s fight was against terrorist activities targeting innocent tourists and that no civilian, military, or intelligence infrastructure was attacked.

Pakistan military and intelligence nexus which had become a collusive, all powerful front, superior to the Pakistani government, decided to attack Indian military installations and air bases in response to the Indian strike on terrorist infrastructure/ camps on May 07, 2025. They even dared to attack India with ballistic missiles creating a nuclear bogey but

in vain. All Pakistani attacks, big or small were thwarted with professionalism keeping our men safe and systems operationally ready.

IAF’s perfect and accurate attacks on Nur Khan and Murid Air Bases’ C2 AD (Command and Control, Active Duty) facilities [2] rendered Pakistan Air Force’s capability to launch any air operations untenable bringing Pakistan to its knees.

This paper looks at Op Sindoor through the kaleidoscope of satellite imagery to explain India’s intent of launching escalatory strikes to achieve its aim.

Revisiting Balakot

Pakistan has typically obfuscated evidence whenever it has been presented, especially in the form of dossiers. When the Pulwama attack happened, India decided to attack one of the terrorists’ training camps, masquerading as a madrassa.

On February 26, 2019, the attack on Jaba Top took the PAF by surprise. The Indian Air Force (IAF), for the first time after the 1971 war, had crossed the International Boundary (IB) to hit a target inside Pakistan. Even before India announced it, Pakistan’s Director General ISPR (Inter-Services Public Relations) had already tweeted about the attack. The aim of the early and quick tweets by DG ISPR was to ensure that India did not deny crossing the IB. However, on the contrary, India claimed the attack across the IB within minutes.

The Pakistan Army, which excels in cleaning operations, was more than ready that day. It ensured a cleanup and minor repairs before 10 am so that satellites wouldn't be able to notice anything unusual.

However, a lot was observed on satellite images despite Pakistan Army's efforts to hide the damages. The peculiar small holes of SPICE 2000 were covered up in no time but the job obviously was done very unprofessionally leaving behind telltale signs.

The Corrugated Galvanised Iron (CGI) sheets are very pliable and have a tendency to try to regain their original shape. The penetrating power of the SPICE 2000 missiles is so strong at those high speeds (>Mach 2) that the holes created in CGI sheets look much smaller than even the size of the missile on satellite imagery. This makes it difficult for an untrained eye to believe if any attack had taken place.

The change in CGI sheets is visible in the images of Google Earth dated February 27, 2019, which is not a particularly difficult thing to do. The comparison of before and after images provides more clarity on the changes to the CGI sheets that occurred after the IAF attack.

A similar comparison with images from Op Sindoor illustrates how challenging it is for an untrained eye to discern from satellite imagery that the IAF has indeed hit buildings, unless ground photos are made available. The size of the impact point is tiny (less than a meter), which is barely equal to two or three pixels on the satellite image with a 30 cm resolution.

The buildings in the Muridke headquarters of Lashkar-e-Taiba (LeT) were hit with precision and possibly with similar weapons used during the Balakot strike. This time, the cleaning operation by the Pakistan Army and Inter-Services Intelligence (ISI) was caught on satellite images.

The second building at Muridke, located next to the hospital, was used by terrorists as a storage facility for their small arms and was destroyed. However, the changes visible in satellite imagery were quite subtle, even to a trained eye. The distorted walls and roof suggest that the building had collapsed, and the dome had fallen below ground level.

These changes can be proved with ground photos. Still, Jaba Top being heavily guarded (Image-3 above), no one could access the site until the Pakistan Army opened it for the Defence Attaches 43 days after the attack. By then, all evidence of a terrorist camp being run under the garb of Madrassa Taleem-Ul-Quran at the site was removed.

Misinformation and disinformation campaigns by Pakistan were marred by the DG ISPR Twitter handle and his press conference, which claimed that two Indian pilots caught by them were being treated at Combined Military Hospital (CMH). Whatever escapades Pakistan was trying to make proved to be false, and their face of a pathological liar was exposed to the entire world then in 2019 and also now in 2025.

Jittery Pakistan

Pakistan's armed forces are the most jittery in the world and at the slightest hint

of danger, they begin firing indiscriminately. The nighttime can be pretty entertaining. The troops of the Pakistan Army are so fearful of a potential attack from the Indian Army that they continuously launch flares throughout the night during tense periods.

In the aftermath of the Balakot strikes, Pakistan remained jittery throughout the month of March 2019.[3] The airport in Multan suddenly shut down for all flights one day. The reports emanating from Multan city indicated an IAF attack on the airport, claiming Pakistan lost an F-16B, and later, some reports suggested the JF-17 was shot down by their own LY-80 Surface-to-Air Missiles (SAM). Chinese SAM systems identified their own aircraft. These were skylarking by PAF to somehow make good their losses of an F-16B during the episode with Wing Commander Abhinandan Varthaman.

Battlefield Testing of Indian Armed Forces Weapons and C2 Systems

In the early morning of May 10, 2025, Indian armed forces lit up Pakistan, covering its entire land border with India from Karachi to Skardu. The Indian Navy was already operationally deployed in the Arabian Sea to ensure that the Pakistani Navy was stalled in their ports and did not interfere in the actions of the IAF and the Indian Army. The aim was to disproportionately escalate to counter Pakistan's response of attacking Indian air bases and military installations, despite India successfully repelling the attacks; kudos to the latest IACCS (Integrated Air Command and Control System) supporting the air defence of Indian airspace.

To remind readers, the Mian Channu episode of the Indian BrahMos was a fluke firing of the missile in March 2022. The entire team was later punished adequately by the IAF for negligent firing, taking cognisance of the possible devastating consequences. It was reported that the missile was launched from Ambala and crossed into Pakistan through the Suratgarh border. When plotted on Google Earth, the missile's trajectory shows that it made a sharp 90° turn and reached Mian Channu without causing any damage. It possibly travelled around 124 kilometres within Pakistan for 3 minutes and 44 seconds, moving at a speed of approximately Mach 1.6. However, Pakistan's Center for International Strategic Studies (CISS) produced a report [4] more than two years later, claiming that the firing was not inadvertent but a test in which Pakistan's radars failed miserably.

The BrahMos is notable for being the first cruise missile tested at supersonic speeds in a steep dive mode, which necessitated thorough validation, especially in the unpredictable conditions of a battlefield. The successful neutralisation of targets by the Indian armed forces, with significant impact, is no small achievement. However, a closer examination of the chosen targets along the entire land border with Pakistan reveals that India was not acting indiscriminately. Instead, it was testing its missiles and their variants, as well as the crucial Integrated Air Command and Control System (IACCS), across the entire country using live targets.

The plotted targets on the maps indicate that the chosen ranges were between 350 km and 500

km. This strongly suggests that the BrahMos was tested at its maximum ranges at night, against a live enemy who was at full alert. This information also indicates significant success in our radar systems, communications, and Navigation with Indian Constellation (NavIC), as well as the exceptional integration achieved by the Integrated Air Command and Control System (IACCS).

The complete cooperation, jointness and synergy between not only the various uniformed services but also branches of the Ministry of Defence (MoD) and other government departments was tested during Op Sindoor and proved to be outstanding.

Conclusion

Pakistan, after the Op Sindoor attacks, was in no position to claim that only a single crowd died. The enormous devastation was a stark reminder for everyone to see. The damage was so extensive that Pakistan could not hide any of the targets, even for a short time. Pakistan had no choice but to wave the white flag and request for a ceasefire. The considered decision by India to accept the ceasefire, when requested, should not be construed as a lack of Indian political or military will to escalate the situation.

India remains vigilant, with Operation Sindoor becoming the new normal. India has been prepared and continues to be willing to ensure that its adversary faces disproportionate consequences for its terrorist misadventures. This operation would undoubtedly go down in history as one of the best examples of the shortest war on terror with a stubborn nuclear

neighbour called Pakistan.

Space

International Space Station welcomes its first astronauts from India, Poland and Hungary

Marcia Dunn | 26 June 2025

Source: The Journal | <https://www.the-journal.com/articles/international-space-station-welcomes-its-first-astronauts-from-india-poland-and-hungary/>



This image provided by NASA shows visiting crew in dark blue, Axiom Space's Peggy Whitson, left, Hungary's Tibor Kapu, 2nd left, India's Shubhanshu Shukla, center, and Poland's Slawosz Uznanski-Wisniewski, center right, aboard the International Space Station, Thursday June 26, 2025. (NASA via AP)

CAPE CANAVERAL, Fla. (AP) — The first astronauts in more than 40 years from India, Poland and Hungary arrived at the International Space Station on Thursday, ferried there by SpaceX on a private flight.

The crew of four will spend two weeks at the orbiting lab, performing dozens of experiments. They launched Wednesday from NASA's Kennedy Space Center.

America's most experienced astronaut, Peggy Whitson, is the commander of the visiting crew. She works for Axiom Space, the Houston company that arranged the chartered flight.

Besides Whitson, the crew includes India's Shubhanshu Shukla, a pilot in the Indian Air Force; Hungary's Tibor Kapu, a mechanical engineer; and Poland's Slawosz Uznanski-Wisniewski, a radiation expert and one of the European Space Agency's project astronauts on temporary flight duty.

No one has ever visited the International Space Station from those countries before. The time anyone rocketed into orbit from those countries was in the late 1970s and 1980s, traveling with the Soviets.

Speaking in both English and their native languages, the new arrivals shared hugs and handshakes with the space station's seven full-time residents, celebrating with drink pouches sipped through straws. Six nations were represented: four from the U.S., three from Russia and one each from Japan, India, Poland and Hungary.

"We have so many countries at the same time on the space station," Kapu said, adding that seven of the 11 astronauts are first-time space fliers "which also tells me how much space is expanding."

Added Uznanski-Wisniewski: "We will all

try to do the best representing our countries." Shukla rated the experience so far as "fantastic ... wonderful."

The space station's commander, Japan's Takuya Onishi, said he was happy to finally see their smiling faces after "waiting for you guys so long." Whitson also made note of the lengthy delay and preflight quarantine.

To stay healthy, the four newcomers went into quarantine on May 25, stuck in it as their launch kept getting delayed. The latest postponement was for space station leak monitoring, NASA wanted to make sure everything was safe following repairs to a longtime leak on the Russian side of the outpost.

It's the fourth Axiom-sponsored flight to the space station since 2022. The company is one of several that are developing their own space stations due to launch in the coming years. NASA plans to abandon the International Space Station in 2030 after more than three decades of operation, and is encouraging private ventures to replace it.

Shubhanshu Shukla's Historic Space Mission: India's Leap into Commercial Human Spaceflight

28 June 2025

Source: *Vision IAS* | <https://www.visionias.in/blog/current-affairs/shubhanshu-shuklas-historic-space-mission-indias-leap-into-commercial-human-spaceflight>



On June 25, 2025, Shubhanshu Shukla became the first Indian astronaut to reach the International Space Station through a commercial mission.

India's space program has achieved a historic milestone with Group Captain Shubhanshu Shukla becoming the first Indian astronaut to visit the International Space Station through the Axiom 4 mission. This groundbreaking achievement marks a new chapter in India's space exploration journey, demonstrating the nation's growing capabilities in human spaceflight and its strategic approach to leveraging commercial space opportunities.

Breaking Barriers: Shubhanshu Shukla's Historic Achievement

Shubhanshu Shukla, a distinguished Group Captain in the Indian Air Force, made history on June 25, 2025, when he crossed the Karman Line as part of the Axiom Mission 4 crew. This achievement is particularly significant as he

became the second Indian to venture beyond Earth's atmosphere, following Wing Commander Rakesh Sharma's pioneering flight in 1984 – a gap of over 40 years.

Serving as the mission pilot aboard the SpaceX Dragon spacecraft 'Grace', Shukla's role extends far beyond symbolic representation. His participation provides India with invaluable operational experience that directly benefits the country's indigenous Gaganyaan mission scheduled for 2027.

Understanding Axiom 4: A Commercial Space Revolution

Axiom 4 represents the fourth private astronaut mission jointly conducted by NASA and Axiom Space, a leading commercial space company. This mission exemplifies the evolving landscape of space exploration, where commercial entities are increasingly playing crucial roles in human spaceflight operations.

The four-member international crew includes Commander Peggy Whitson from the United States, Pilot Shubhanshu Shukla from India, and Mission Specialists from Poland and Hungary. This diverse composition highlights the mission's significance in fostering international collaboration and marking the return of these nations to human spaceflight after decades of absence.

SpaceX, serving as the launch provider, successfully launched the mission from Launch Complex 39A at NASA's Kennedy Space Centre. The spacecraft docked with the International Space Station approximately 16 hours later, beginning a planned 14-day scientific mission.

Strategic Importance for India's Space Program

India's participation in Axiom 4 marks a strategic shift in the country's space exploration strategy. With NASA no longer conducting government-sponsored foreign astronaut missions, India proactively embraced commercial space services to accelerate its national human spaceflight goals.

This pragmatic approach reflects India's sophisticated understanding of the evolving global space landscape. By leveraging commercial platforms, India can acquire essential experience, conduct vital research, and validate operational protocols without relying solely on traditional bilateral government agreements.

Former ISRO Chairman Sreedhara Somanath emphasised the mission's profound significance, stating it represents "more than a milestone for India" and symbolises "India's ascent into the league of spacefaring nations."

Scientific Experiments and Gaganyaan Connection

During his 14-day mission aboard the International Space Station, the mission is set to conduct approximately 60 different scientific studies representing 31 countries. The experiments specifically designed by ISRO provide crucial insights for India's Gaganyaan mission:

- **Microgravity Crop Growth:** Cultivating Indian superfoods like moong and methi in zero gravity through germination and growth studies related to crop seeds on ISS.

Analyzing genetics, microbial load, and nutritional profiles to develop India-specific space food systems and identify "space-hardy genes" with preferred traits for future long-duration missions.

- **Human Physiology Studies:** Examining skeletal muscle dysfunction pathways, myogenesis and cellular responses in microgravity to identify molecular mechanisms and therapeutic targeting strategies for maintaining astronaut health during Gaganyaan missions, with implications for muscle-related diseases and aging conditions on Earth.
- **Mental Health Research:** Exploring the physical and cognitive impact of computer screen utilization in microgravity, and stress-wellbeing interactions to inform spacecraft computer design and improve psychological support systems for astronauts.
- **Life Support System Development:** Studying cyanobacteria photosynthesis, biochemical activity, and space microalgae growth rates, metabolism, and genetic activity in microgravity, investigating their potential as foods, fuel, and integration into spacecraft environmental control systems to directly support Gaganyaan's life support requirements and future spacecraft life support systems.

International Space Station: A Platform for Collaboration

The International Space Station, orbiting approximately 250 miles above Earth, serves as humanity's premier scientific laboratory in

space. Operating since 1998, this marvel of international cooperation involves five principal partner agencies: NASA (USA), Roscosmos (Russia), ESA (Europe), JAXA (Japan), and CSA (Canada).

However, the ISS is approaching its operational conclusion, with plans for controlled deorbiting by 2030-2031. This transition creates opportunities for commercial space stations like Axiom Station, which will initially attach to the ISS before becoming an independent platform.

For India, accessing the ISS through commercial missions like Axiom 4 provides essential experience that cannot be replicated on Earth, preparing the nation for its ambitious space station plans.

India's Gaganyaan Mission: Building Indigenous Capabilities

The Indian space program has strategically designed Gaganyaan as a comprehensive demonstration of indigenous human spaceflight capability. This mission aims to send three astronauts to a 400-kilometre Low Earth Orbit for three days, establishing India among the exclusive group of nations with independent human spaceflight capabilities.

Shubhanshu Shukla's experience on Axiom 4 will directly contribute to Gaganyaan's success by providing hands-on knowledge of:

- Pre-launch quarantine procedures
- International collaboration protocols
- Spacecraft ingress and egress procedures
- Medical diagnostics in microgravity

- Health readiness protocols
- Future Implications and Long-term Vision

India's strategic approach to human spaceflight extends far beyond individual missions. The country envisions establishing the Bharatiya Antariksh Station (BAS) by 2035, with the first module planned for launch in 2028. Additionally, India aims for a crewed lunar mission by 2040.

The Karman Line crossing by Shubhanshu Shukla represents a foundational step in this ambitious roadmap. The operational experience gained, combined with scientific data collected during the mission, directly informs and de-risks future complex missions.

Economic and Technological Benefits

India's human spaceflight program serves as a powerful catalyst for technological innovation and economic growth. The Gaganyaan mission actively engages over 500 Micro, Small, and Medium Enterprises (MSMEs) and private players, fostering a vibrant domestic space-tech ecosystem.

The government's strategic vision aims for India to capture 8% of the global space market by 2033, growing its space economy to \$44 billion. This growth stimulates employment generation across numerous sectors while driving innovation in areas like life support systems, advanced materials, and artificial intelligence.

Enhancing Global Standing and Diplomatic Leverage

Shubhanshu Shukla's historic mission significantly elevates India's global standing within the space community. This achievement serves as a potent foreign policy tool, opening doors for deeper diplomatic collaborations and strengthening international partnerships.

Existing collaborations with Russia on astronaut training, France on life support systems, and the recent agreement with Australia for crew recovery support exemplify India's proactive engagement in space diplomacy.

Conclusion: Charting India's Space Future

The historic Axiom 4 mission with Shubhanshu Shukla crossing the Karman Line marks a defining moment in India's space exploration journey. This achievement demonstrates India's sophisticated approach to balancing indigenous capability development with strategic international collaboration.

As the International Space Station approaches its operational conclusion and commercial space platforms emerge, India has positioned itself advantageously in the evolving global space landscape. The nation's commitment to the Indian space program, exemplified by Gaganyaan and supported by missions like Axiom 4, establishes a solid foundation for sustained human presence in space.

Through this strategic engagement, India is not merely participating in the future of space exploration but actively charting its trajectory as a comprehensive and influential space power,

inspiring future generations while contributing to humanity's cosmic aspirations.

Liberatech Space to offer custom Earth-observation products for commodity, energy and environmental monitoring

Debra Werner | 30 June 2025

Source: [Space News](https://spacenews.com/liberatech-space-to-offer-custom-earth-observation-products-for-commodity-energy-and-environmental-monitoring/) | <https://spacenews.com/liberatech-space-to-offer-custom-earth-observation-products-for-commodity-energy-and-environmental-monitoring/>



Borre Pedersen, KSAT Earth observation sales director, (left) and Yasunori Yamazaki, Liberatech co-founder, CEO and chief marketing officer, forged a strategic-collaboration agreement. Credit: Liberatech

SAN FRANCISCO – While working in finance years ago, Yasunori Yamazaki traveled to mines to conduct due diligence. Later, as Axelspace chief business officer and Astroscale head of brand management, he considered how satellites could simplify the task.

As a result, one of the first products being

developed by his new company Singapore-based Liberatech Space, is Earth-observation and analysis for mining-sector investors.

Yamazaki co-founded Liberatech in 2024 with Tom James, co-founder and CEO of Singapore-based Tradeflow Capital Management, to use satellite data to address challenges in the commodity, energy and environmental industries.

“The company utilizes space technology, primarily satellite-imagery data, to create products and services directly for the user,” Yamazaki, who serves as Liberatech CEO and chief marketing officer, told SpaceNews.

Custom Products

To date, Liberatech has focused primarily on the finance sector. Instead of developing one-size-fits-all products, “we have been speaking to potential clients to understand the optimal product and services that will fit well with them,” Yamazaki said.

Liberatech is working with Kongsberg Satellite Services of Norway. The strategic partnership announced June 10 was forged to marry KSAT’s extensive Earth observation and communications infrastructure with Liberatech’s artificial intelligence-enhanced analytics.

KSAT joined forces with Liberatech because “what Yasu and Liberatech want to achieve fits very well with our mindset about bringing a wide portfolio of analyzed data to the clients on a very short timeline,” said Borre Pedersen, KSAT Earth observation sales

director.

In addition to operating a global ground station network, KSAT is known for collecting and sharing Earth-observation data products related to vessel tracking, oil and gas operations, and environmental monitoring.

“We can do the analytics and processing,” Pedersen said. “Then Liberatech will integrate in our value-adding products to create solutions for clients.”

For example, KSAT has expertise in combining synthetic aperture radar (SAR) data with other types of Earth imagery to “reveal details that are not visible to human eye,” Pedersen said.

For the mining sector, combining Yamazaki’s experience with KSAT’s decades of experience with SAR, “will create a very powerful solution that will help the owners and the investors to going

Space is Hard: There is no Excuse for Pretending it's Easy

Robert N. Eberhart | 30 June 2025

Source: [Space News](https://spacenews.com/space-is-hard-there-is-no-excuse-for-pretending-its-easy/) | <https://spacenews.com/space-is-hard-there-is-no-excuse-for-pretending-its-easy/>



A SpaceX Starship upper stage, or ship, being prepared for an earlier test flight. The ship for the tenth test flight exploded during ground tests June 19.

Credit: SpaceX

The headlines in the space industry over the past month have delivered a sobering reminder: space is not forgiving, and certainly not friendly to overpromising entrepreneurs. From iSpace's second failed lunar landing attempt (making them 0 for 2) to SpaceX's ongoing Starship test flight setbacks — amid a backdrop of exploding prototypes and shifting goalposts — the evidence is mounting that the commercialization of space is not progressing in the triumphant arc that press releases might suggest. This isn't just a series of flukes. It points to a structural, strategic and cultural problem in how we talk about innovation, cost and success in space today.

Let's be blunt: 50 years ago, we did this. We sent humans to the moon, not once but repeatedly, and brought them back. With less computational power than your phone, using analog systems and slide rules, we achieved

feats of incredible precision, reliability and coordination. Today's failures, even when dressed up as "learning opportunities," raises the obvious question: Why are we struggling to do now what we once achieved decades ago with far more complexity and far less technology?

Until very recently, the failure rate of private lunar exploration efforts underscored this reality. Over the past two decades, not a single private mission had fully succeeded — until last March when Firefly Aerospace's Blue Ghost lander touched down on the moon. It marked the first fully successful soft landing by a private company. That mission deserves real credit. But that credit comes with important context: It took two decades of false starts, crashes and incomplete landings — from Space IL's Beresheet to iSpace's Hakuto-R and Astrobotic's Peregrine — before even one private firm delivered on the promise of lunar access.

The prevailing industry answer — "we need to innovate for lower cost" — rings hollow. What's happening now isn't innovation; it's aspiration masquerading as disruption. Take iSpace as an example. The company claims to be a "low-cost" provider, but that doesn't hold up under financial scrutiny. It seems that their pricing doesn't reflect the real cost of delivery. The financial reports on iSpace's website show that their gross margin isn't nearly enough to cover the costs of running the company. They may look like a bargain compared to NASA, that's because they seem to be charging far less than the true cost of their missions, masking risk with financial optimism, and inviting failure under the guise of competitive advantage.

Is it criminal? No. The customer still gets a service, and markets still function. But it is disingenuous to promote it as sustainable, scalable innovation. If you sell space service for less than its total costs, and it doesn't work, it isn't viable — no matter how shiny the rocket looks.

SpaceX's Starship saga is another emblem of this phenomenon. Yes, progress requires trial and error. But we must stop measuring success by launch views and splashy animation reels. When the same core systems fail in similar ways, time after time, we must ask whether this is aggressive iteration or just poorly managed ambition. Failure alone isn't innovation. Only failure followed by measurable, demonstrable improvement is. For contrast, look at the F-1 engine that powered the Saturn V — still the most powerful rocket engine ever flown. Its early prototypes suffered from catastrophic combustion instability. The engines literally tore themselves apart in violent explosions. But instead of rushing to launch, NASA and Rocketdyne engineers dedicated engineering talent analyzing high-speed film, instrumenting combustion chambers and systematically redesigning injector patterns. They solved it — not through luck, not through iteration by crashes — but through engineering discipline. The result? A rocket that flew 13 times without a single engine failure. That's how space is done. Not with bravado and broken boosters, but with precision, patience and a refusal to accept "good enough."

Which brings us to the most baffling contradiction in today's space narrative: how can companies that struggle to land a basic

lunar probe or launch a single fully successful test flight simultaneously promise hotels on the moon and interplanetary travel to Mars? When a company can't reliably land a small uncrewed vehicle on the moon — or re-enter Earth's atmosphere without catastrophic failure — there is no rational basis for discussing lunar resorts or Martian colonies. It would be like designing a luxury yacht without first knowing how to build a canoe. These grand visions make for great headlines and investment decks, but they hollow out credibility in the long run. The public and investors deserve goals tethered to progress, not just imagination.

Worse still is how these companies now frame their failures. In iSpace's most recent attempt, during the final and most critical 15 minutes of the landing sequence — when the spacecraft was making its descent and the online audience was transfixed — they cut away from the landing reporting and brought on their CFO to talk to the viewers. Instead of explaining what was happening with the vehicle, they spoke about investor confidence and the resilience of their business model. It was a baffling shift, almost as if the financial narrative mattered more than the flight outcome. The same disconnect can be seen in SpaceX's messaging. While the company routinely frames each Starship explosion as a necessary step in rapid iteration, two consecutive full-stack flights, Flight 7 and Flight 8, failed during stage separation. That's not fast learning. That's failing to fix a known issue but the saying they will spend their investor's money on a more ambitious attempt. At some point, calling repeated, preventable failures "progress" ceases to be engineering — and starts to look like marketing.

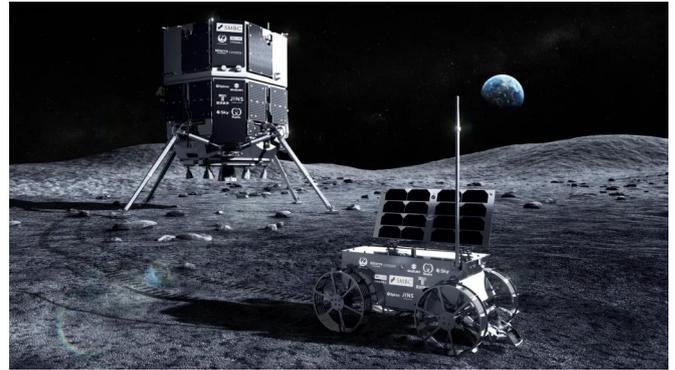
This is not a call for a retreat to Cold War models or Apollo-era budgets. It's a call for seriousness. If we're truly entering a new space age, then it needs to be built on sound engineering, transparent economics and meaningful technical leadership — not PR strategy. Let's stop pretending that burning money in orbit is a business model.

The dream of a sustainable, entrepreneurial space ecosystem is still alive. But it won't happen unless we stop celebrating hype and start demanding results. Until then, the real innovation we need is not in spacecraft — it's in accountability. The engineers of Apollo didn't tweet success before they had it. They spent years in wind tunnels, test stands and control rooms solving problems atom by atom. When the F-1 engine exploded, they didn't call it a "learning opportunity" and move on — they fixed it until it worked every time. That is the standard. That is the legacy. And if this new generation of space companies truly wants to lead humanity forward, they must learn to respect it, not just reference it.

Second ispace Mission Ready for Lunar Landing Attempt

Jeff Foust | 04 June 2025

Source: [Space News](https://spacenews.com/second-ispacemission-ready-for-lunar-landing-attempt/) | <https://spacenews.com/second-ispacemission-ready-for-lunar-landing-attempt/>



An illustration of ispace's Resilience lunar lander and its Tenacious lunar rover. Credit: ispace

WASHINGTON — Japanese company ispace is set to make its second attempt to land on the moon this week as the company looks ahead to larger, more ambitious lunar landers.

The Tokyo-based company slightly revised the landing time for its Resilience lunar lander in a statement late June 3. The landing, in the Mare Frigoris region of the northern hemisphere of the near side of the moon, is now scheduled for 3:17 p.m. Eastern June 5, seven minutes earlier than previously announced.

The tweak in the landing time, ispace said, came after engineers reviewed maneuvers performed May 28 to lower the spacecraft's orbit to 100 kilometers. "Their review of the orbit, the performance of the spacecraft, and the landing sequence have resulted in an updated landing time," the company stated.

Resilience launched in January on the same Falcon 9 that carried Firefly Aerospace's Blue

Ghost 1 lunar lander. While Blue Ghost made a successful landing on the moon March 2, Resilience took a longer, low-energy trajectory, going as far as 1.1 million kilometers from the Earth before returning and entering lunar orbit May 6.

Resilience is ispace's second attempt to land on the moon. The company's first lander, similar in design to Resilience, crashed when attempting a landing in April 2023. The company concluded that a software problem caused the spacecraft to believe it was on the surface when it was still at an altitude of five kilometers.

"Since that time, we have drawn on the experience, using it as motivation to move forward with resolve," Takeshi Hakamada, founder and chief executive of ispace, said in a June 4 statement. "We are now at the dawn of our next attempt to make history."

Payloads

The lander carries several payloads from Japanese companies and a Taiwanese university, including a water electrolyzer, a food production experiment and a deep space radiation problem. The lander also has a "commemorative alloy plate" from Bandai Namco Research Inc., the research arm of Japanese entertainment company Bandai Namco. The commercial payloads on the lander have a combined contract value of \$16 million, ispace stated in financial reports.

In addition to those payloads, Resilience carries a small rover, Tenacious, developed by ispace's European subsidiary. It is equipped

with cameras and a shovel that will collect lunar regolith. That regolith sample will then be sold to NASA under a \$5,000 agreement announced in 2020, part of an effort by the agency to establish precedence for rights to space resources.

Tenacious also carries an art project called Moonhouse, developed by a group led by Swedish artist Mikael Genberg. The Moonhouse is a model of a typical Swedish house, measuring 12 by 10 by 8 centimeters and weighing 100 grams. The rover will deploy the Moonhouse onto the surface, ideally in a location that will allow it to be photographed with the Earth in the background.

"All culture boils down to one thing, that is that we try to communicate and recommunicate and recommunicate what it is to be human, what life is all about," Genberg said of the project during a June 4 briefing. Placing a model of a typical house on the moon offers a new perspective on that question, he argued. "The thing that would really create the perspective would be a red house on the surface of the moon."

The Moonhouse was produced using 3D-printing technologies in aluminum and uses customized space-rated red paint. The company that the project worked with to produce the house had warned that it would not be possible to print it as designed, found it could be done. "In that sense, we feel that maybe we pressed technology a little bit forward," Genberg said.

Once the team finds an appropriate location for the Moonhouse, the rover will go there

and fire a bolt to release the house, dropping eight centimeters to the surface. That required extensive testing at a European Space Agency facility with a simulated lunar landscape. “We’ve been as worried about these last eight centimeters as ispace is about their landing,” said Emil Vinterhav, head of the project’s technical team.

Genberg declined to disclose the cost of the Moonhouse, including getting it to the moon, saying only it was comparable to the cost of a “really nice house with a good pool” on Earth.

“This house is kind of a symbol for the future of life, maybe,” he said, arguing that for life to continue it must expand beyond Earth, then quoted a comment from a retired Swedish politician. “Maybe a house on the moon is exactly what the world needs right now.”

Finances and future plans

As Resilience prepares for its landing, ispace is actively working on two more lunar landers. The company’s U.S. subsidiary is building the Apex 1.0 lander for what it calls Mission 3, a lander for a NASA Commercial Lunar Payload Services (CLPS) program mission led by Draper. That mission is now scheduled to launch in 2027 after a change in engines for the lander, announced May 9, pushed the mission back from 2026.

In Japan, ispace is building a separate lander for Mission 4, also scheduled for 2027. That lander will feature a new design, called Series 3, and has \$80 million in financial support from the Japanese government. The mission will also place into orbit a satellite funded by JAXA’s

Space Strategy Fund to search for water ice and metals below the lunar surface. The company said it expects to have a “core role” in developing the satellite.

In an earnings presentation May 9, ispace laid out a roadmap for additional missions using landers built in the United States and Japan, projecting three more missions in 2028 and 2029. That will depend in part on the ability of ispace U.S. to win CLPS task orders in partnership with other companies. In April, ispace U.S. announced an agreement with Redwire, which is one of the companies on the CLPS contract, to work together to seek future CLPS missions.

For the fiscal year ending in March 2025, ispace reported net sales of 4.74 billion yen (\$32.9 million) and a net loss of 11.9 billion yen. For its current fiscal year, the company is forecasting net sales of 6.2 billion yen but a net loss of 8.3 billion yen. The company is covering those losses with loans, including a \$35 million loan from Mizuho Bank, Ltd. announced May 14 and a \$70 million loan from Sumitomo Mitsui Banking Corporation announced May 22.

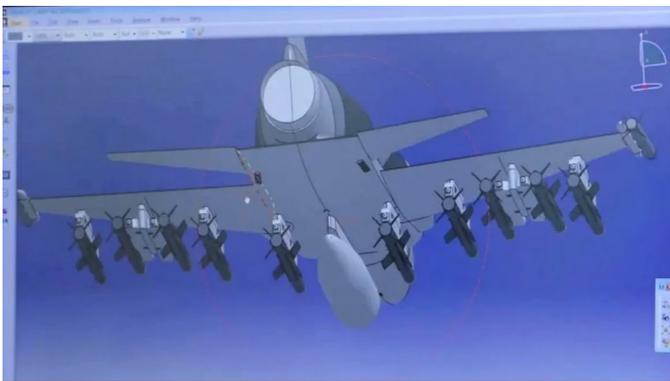
“Our goal is to build the cislunar economy, one in which the moon and Earth are economically and socially connected. We view the success of the lunar landing as merely a stepping stone toward that goal,” Hakamada said in his June 4 statement, referring to the upcoming Resilience landing. “We believe these missions open the door to outer space for more people.”

Aerospace Industry

HAL Unveils HLFT-42 Trainer Concept with 10 Beyond Visual Range Air-to-Air Missiles and 2 Wingtip-Mounted Close Combat Missiles

Raghav Patel | 24 June 2025

Source: [Defence.in](https://defence.in/threads/hal-unveils-hlft-42-trainer-concept-with-10-beyond-visual-range-air-to-air-missiles-and-2-wingtip-mounted-close-combat-missiles.14647/) | <https://defence.in/threads/hal-unveils-hlft-42-trainer-concept-with-10-beyond-visual-range-air-to-air-missiles-and-2-wingtip-mounted-close-combat-missiles.14647/>



State-owned aerospace and defence company Hindustan Aeronautics Limited (HAL) has released new concept images of its Hindustan Lead-in Fighter Trainer (HLFT-42), showcasing a formidable weapons configuration.

The visuals reveal the advanced trainer jet armed with ten Beyond Visual Range Air-to-Air Missiles (BVR-AAMs) and two wingtip-mounted Close Combat Missiles (CCMs), signalling a strong focus on its secondary combat role.

The HLFT-42 is a next-generation supersonic aircraft designed to provide a seamless transition for pilots graduating to advanced frontline fighters.

The concept, which was first officially presented as a scale model at Aero India 2023,

is a critical component of India's strategy to achieve self-reliance in aerospace and defence technology.

Development of the platform is currently in a phase of design refinement based on detailed feedback from the Indian Air Force (IAF).

Engineered as a dual-role aircraft, the HLFT-42 combines the functionalities of an advanced trainer with those of a light fighter.

The aircraft features a total of 11 hardpoints—six under the wings, three under the fuselage, and two at the wingtips—capable of carrying a weapons payload of up to 5,000 kg.

This capacity allows for a versatile mix of armaments, including the potential integration of indigenous missile systems like the Astra BVR-AAM series and the future New-Generation Close Combat Missile (NG-CCM).

The primary purpose of the HLFT-42 is to bridge the training gap between basic trainers, such as the HAL HTT-40, and complex 4.5 and 5th-generation fighters like the HAL Tejas Mk2 and the upcoming HAL Advanced Medium Combat Aircraft (AMCA).

It is slated to replace the IAF's ageing fleet of BAE Hawk Mk132 trainers.

The aircraft will be equipped with modern avionics, a digital fly-by-wire system, and an Active Electronically Scanned Array (AESA) radar, preparing pilots for the sophisticated systems they will operate in frontline squadrons.

Beyond its training capabilities, the aircraft's robust design allows it to perform in active combat scenarios.

Its significant payload and advanced sensor suite will enable it to undertake both air-to-air and air-to-ground missions, serving as a cost-effective force multiplier.

This dual-role capability is a key feature, providing the IAF with a flexible platform for various operational needs, from peacetime training to deployment in low-intensity conflicts.

The HLFT-42 project also holds considerable potential for exports.

The global market for military trainer aircraft is projected to reach \$21 billion by 2033, driven by fleet modernisation and the need to train pilots for increasingly complex aircraft.

With its blend of advanced training features and combat capability, the HLFT-42 could be an attractive option for nations seeking affordable and versatile fighter-trainer platforms, positioning India as a significant competitor in the international aerospace market.

While still in the development phase, the project is moving forward, with HAL having issued a Request for Information (RFI) to global vendors for a suitable engine. The final selection of the powerplant and other key systems will be crucial in defining the aircraft's performance and timeline for induction.

Continued collaboration between HAL and the IAF will be essential to ensure the HLFT-42 meets the future requirements of India's air defence.

Despite 1,000-Second Scramjet Success, DRDO's Hypersonic Cruise Missile Program Still Awaiting Crucial Funding Sanction from MoD

Raghav Patel | 25 June 2025

Source: Defence.in | <https://defence.in/threads/despise-1-000-second-scramjet-success-drdo-hypersonic-cruise-missile-program-still-awaiting-crucial-funding-sanction-from-mod.14653/>



India's top defence research body has achieved a landmark success in developing the technology for hypersonic cruise missiles, but the formal project to create such a weapon is yet to receive financial approval from the Ministry of Defence, the organisation's head has confirmed.

Dr. Samir V. Kamat, Chairman of the Defence Research and Development Organisation (DRDO), revealed that while a critical scramjet engine was successfully tested for over 1,000 seconds, the government's sanction to convert this breakthrough into a deployable missile system is still pending.

The situation places a spotlight on the gap between achieving advanced technological capability and the procedural steps required to weaponise it.

"In hypersonic cruise missiles, we have

recently proven scramjet propulsion for more than 1,000 seconds, which is a major breakthrough," Dr. Kamat stated at a recent event.

This successful ground test, lasting approximately 17 minutes, demonstrates that India has mastered the complex and essential technology of sustained supersonic combustion.

At a speed of Mach 5 (five times the speed of sound) or more, an engine running for this duration could theoretically propel a missile across a distance of over 3,000 kilometres.

Scramjet engines are air-breathing systems that use a vehicle's high speed to compress incoming air for fuel combustion, allowing them to operate efficiently at hypersonic velocities.

This technology is vital for hypersonic cruise missiles, which are prized for their ability to travel at speeds exceeding 6,000 km/h while remaining maneuverable.

Despite this technological leap, which places India in an elite group of nations, the path to an operational missile remains unclear. "We hope the government will sanction a program to convert this scramjet propulsion into a cruise missile," Dr. Kamat added, highlighting the need for official and financial backing.

The delay for the cruise missile project contrasts with another high-speed weapon program that has received government support.

The Ministry of Defence has already approved funding for a Hypersonic Glide Vehicle (HGV), a different class of weapon. An HGV is launched to a high altitude by a ballistic missile and then

glides to its target at hypersonic speeds.

In contrast, a hypersonic cruise missile is powered by its engine throughout its flight path, allowing it to fly at lower altitudes and change direction unpredictably, making it extremely difficult for enemy air defence systems to track and intercept.

The development of such a weapon is considered a strategic necessity for India, as global powers and regional neighbours, particularly China, are making rapid advancements in hypersonic technology. Both Russia and the United States are also actively developing and deploying various types of hypersonic weapons.

These systems offer the ability to strike high-value, time-critical targets with unprecedented speed, significantly reducing the reaction time for an adversary.

The DRDO's recent success builds upon previous milestones, including the 2020 flight test of the Hypersonic Technology Demonstrator Vehicle (HSTDV), which proved scramjet performance for a much shorter duration.

The 1,000-second test marks a significant advance in key areas like advanced heat-resistant materials and stable combustion under extreme conditions.

However, without formal sanction and funding from the Ministry of Defence, the expertise and technology developed risk remaining at the research level.

The creation of a fully operational hypersonic cruise missile requires substantial investment

for building prototypes, extensive testing, and integration with launch platforms like warships or fighter aircraft, presenting a significant hurdle that currently awaits clearance.

Further Reading

1. Why Are Gulf Countries Not Speaking Out Against Their Rival Iran? - <https://www.fdd.org/analysis/2025/06/19/why-are-gulf-countries-not-speaking-out-against-their-rival-iran/>
2. Hezbollah's Role in the Israel-Iran War Is to Await Iran's Orders - <https://www.fdd.org/analysis/2025/06/19/hezbollahs-role-in-the-israel-iran-war-is-to-await-irans-orders/>
3. Will there be Radiological Risks from Airstrikes on Iran's Nuclear Facilities? - https://resonantnews.com/2025/06/22/will-there-be-radiological-risks-from-airstrikes-on-irans-nuclear-facilities/?jetpack_skip_subscription_popup
4. B-2 Stealth Bombers Used to Attack Iran have Beds, Toilets, Microwaves - https://www.indiatoday.in/world/story/b2-bombers-us-strike-iran-bed-microwave-fridge-toilet-rest-space-trump-israel-war-911-special-heres-why-2745101-2025-06-23?utm_source=global-search&utm_medium=global-search&utm_campaign=global-searchsubscription_popup
5. Iran-Israel War: India Ramps Up Oil Imports from Russia, US in June - <https://www.thehindu.com/business/Industry/iran-israel-war-india-ramps-up-oil-imports-from-russia-us-in-june/article69723630.ece>

“Airpower isn’t a magic wand but it’s not futile either. History matters. And when the goal is to shape, rather than end, a conflict, the sky still matters.”

Guy Laron



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