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समाचार पत्रों से चयनित अंश

Newspapers Clippings

डीआरडीओ समुदाय को डीआरडीओ प्रौद्योगिकियों, रक्षा प्रौद्योगिकियों, रक्षा नीतियों, अंतर्राष्ट्रीय संबंधों और विज्ञान एवं प्रौद्योगिकी की नूतन जानकारी से अवगत कराने हेतु दैनिक सेवा

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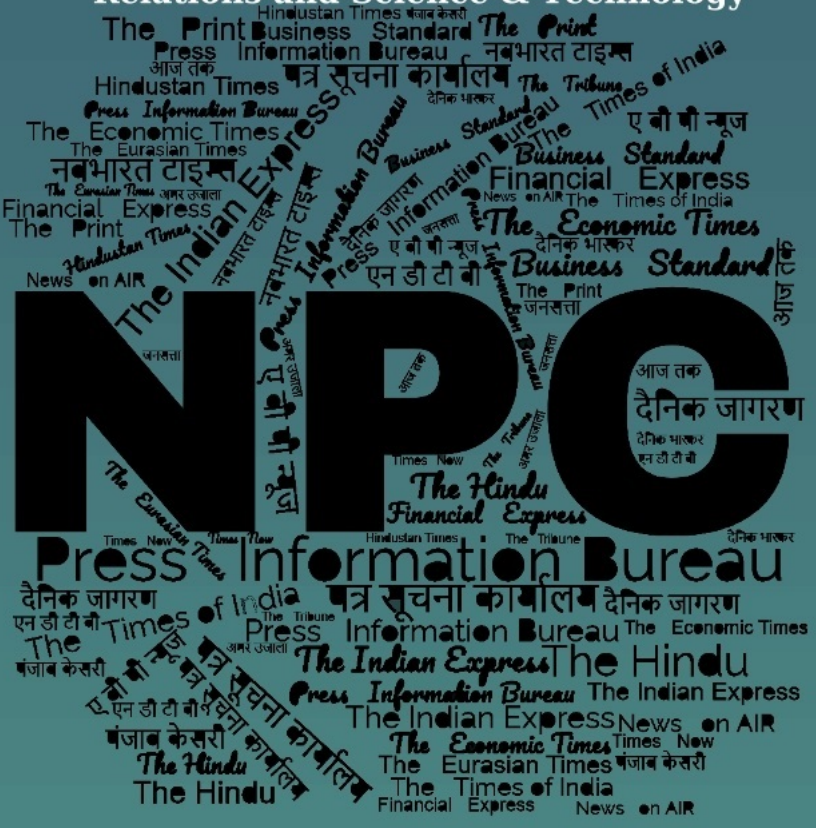

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Defence News

India gives tepid response to Russian push for Su-57, long-range drones and submarines

Source: The Hindu, Dt. 11 Dec 2025

Russia's latest pitch to expand defence cooperation — including offers of the Su-57 fifth-generation stealth fighter, long-range drones and submarines — has met with a lukewarm response from India, officials familiar with the matter said. A senior official said that in the run-up to President Vladimir Putin's recent visit to India, Moscow made repeated outreach promoting platforms such as the Geran series of kamikaze drones, submarines and aircraft.

"India didn't show much interest in the equipment offered by Russia. The Russians were expecting major movement on the sidelines of the visit and are still pursuing the proposals. We are very much focusing on development of indigenous products," the official said. Despite high expectations, the much-watched defence announcements during Putin's visit did not materialise. While 19 agreements aimed at boosting bilateral trade were signed, there was no breakthrough on collaboration involving the Su-57 or Russia's S-500 air defence system.

The restrained response comes at a time when India is driving an aggressive push towards self-reliance in defence manufacturing. On Sunday (December 7, 2025) in Leh, while dedicating 125 newly completed Border Roads Organisation (BRO) projects to the nation, Defence Minister Rajnath Singh underscored the transformation in domestic capacity.

Paradigm shift

He highlighted that India, once heavily dependent on arms imports, now boasts a record defence production value of ₹1.51 lakh crore, up from ₹46,000 crore in 2014. Defence exports have surged from under ₹1,000 crore to nearly ₹24,000 crore in a decade. It reflects a paradigm shift. The Geran drones — Russia's indigenised variant of Iran's Shahed-136 kamikaze drone — have played a major role in Moscow's low-cost attrition strategy in Ukraine, enabling mass salvo attacks. But Indian manufacturers and services have not shown interest in acquiring them.

Earlier, on October 29, the 23rd Working Group Meeting of the India–Russia Inter-Governmental Commission on Military Technical Cooperation was held in Moscow. Co-chaired by Sanjeev Kumar, Secretary (Defence Production), and Andrey A. Boytsov, First Deputy Director of Russian Federal Service for Military-Technical Cooperation (FSMTC), the discussions spanned tri-service cooperation and defence R&D. The meeting concluded with the signing of a Protocol outlining fresh areas of collaboration and mutual growth — even as big-ticket defence deals remain elusive.

https://www.thehindu.com/news/national/india-response-to-russian-push-for-su-57-long-range-drones-and-submarines/article70380636.ece

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Key part to be fixed before Dhruvs with Navy, Coast Guard fly again

Source: The Indian Express, Dt. 11 Dec 2025

The Advanced Light Helicopter (ALH) Dhruv fleet of the Indian Coast Guard (ICG) and the Indian Navy will soon receive manufacturing modifications to a key component, senior officials familiar with the developments have told The Indian Express. These modifications, officials said, will be implemented in batches before the helicopters are delivered to the ICG and the Navy, about six months from now.

It is learnt that the Defect Investigation Committee, probing the crash of a Coast Guard-operated ALH Dhruv on January 5, recommended a manufacturing process improvement of the Non-Rotating Swashplate Bearing (NRSB) for the choppers with the Navy and Coast Guard to improve its fatigue life.

These helicopters operate in corrosive saline environments and have to deal with the mechanical stress of deck landings. An NRSB in a helicopter is a mechanical component that passes inputs via flight controls into the movement of the main rotor blades.

All 28 Dhruvs with the ICG and the Navy will now undergo the requisite manufacturing modifications to the specific part of the choppers in batches over the next few months, before they are returned to the forces in around six months and cleared for flying. There has been no official comment from the HAL on the matter.

All ALHs with the ICG, Navy, Army and IAF were grounded after an ICG-operated Dhruv crashed in Porbandar on January 5, killing three personnel on board. A fracture of the NRSB was detected in the Dhruv that crashed.

The Defect Investigation Committee probing the crash found the need for this specific manufacturing modification in the NRSB of the ALHs of only the Navy and the ICG, but not in those with the Army and the IAF. The ALH fleet of the Army and the IAF have already resumed flying operations.

The sea test

Deck landing stress and exposure of mechanical components to the corrosive saline environment of the seas put naval helicopters through more gruelling tests, different from the choppers operated by land-based forces. The ALH naval variant awaits modification to a key component.

The committee looked at possibilities that could have contributed to the fracture, and on the way forward, including new checks and possible changes in manufacturing. This is the first time such a fracture of a key component took place in a Dhruv, a workhorse of the Indian Armed Forces, in 25 years of its induction into the military. A variety of tests for different batches were carried out, after which data was collected and analysed to reach the conclusion.

The Dhruv, an indigenously designed and developed ALH, is a twin-engine, multi-role, multi-mission new-generation helicopter in the 5.5 tonne weight class. According to the HAL website, a total of 345 helicopters were produced until June 2024 including 313 for the Indian Armed Forces. The choppers together have clocked over four lakh flying hours.

Four Dhruvs have crashed since 2023, including the crash in January this year. In March 2023, a Navy Dhruv MK III had made an emergency landing on water, off the coast of Mumbai. The same

month, an ALH Dhruv Mk III of the Coast Guard crashed close to Kochi International Airport during a training flight. In September 2024, another Coast Guard chopper was forced to ditch at sea off the coast of Porbandar, killing three personnel.

https://indianexpress.com/article/india/key-part-to-be-fixed-before-dhruvs-with-navy-coast-guard-fly-again-10413988/#:~:text=It%20is%20learnt%20that%20the,to%20improve%20its%20fatigue%20life.

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Growing public-private synergy is driving India's indigenous warship construction: Secretary (DP)

Source: Press Information Bureau, Dt. 10 Dec 2025

"Growing synergy between the public and private sector is driving India's indigenous warship construction," said Secretary (Defence Production) Shri Sanjeev Kumar as he endorsed Quality Assurance-led reforms, specifically the Green Channel certification and increased digitalisation as vital catalysts for empowering MSMEs and ensuring faster delivery of defence assets. He was virtually addressing the South Zone Quality Assurance Industry Conclave 2025 organised by the Directorate of Quality Assurance (Warship Projects), Department of Defence Production in Coimbatore, Tamil Nadu on December 10, 2025.

"To realise the goal of Viksit Bharat by 2047, we must leverage technology to streamline processes," Shri Kumar said, emphasising that reducing friction in the supply chain is essential for operational readiness.

Speaking on the occasion, Joint Secretary (Land Systems), Department of Defence Production Dr Garima Bhagat called for a paradigm shift in the industry's approach to quality. Underscoring a move from inspection to prevention, Dr Bhagat urged industry partners to adopt strong public-private partnerships where quality is built into the manufacturing process rather than tested for at the end.

Key Highlights of the Conclave include:

- Strategic Dialogue: A platform for strengthening cooperation between the Indian Navy and industry partners regarding component quality.
- Tech Integration: Discussions on adopting advanced technologies to ensure combat readiness.

- Vision Alignment: Reaffirmation of Quality as the anchor of self-reliance, supporting the path toward a developed India by 2047.

The conclave served as a high-level strategic forum to align the Southern India defence industrial base with the nation's vision of 'Aatmanirbhar Bharat' and 'Maritime Vision 2047'. It brought together key government officials and approximately 80 industry representatives from the major industrial hubs of Coimbatore, Chennai, and Bengaluru. The event focused on fostering a robust ecosystem for indigenous warship construction through advanced Quality Assurance (QA) frameworks.

https://www.pib.gov.in/PressReleasePage.aspx?PRID=2201856&reg=3&lang=1

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AI-powered threats Demand Urgent overhaul of India's Coastal defence and Security

-by Kripa Nautiyal (a retired Additional Director General of the Indian Coast Guard, a defence and strategic studies expert, an alumnus of the US Naval War College)

Source: The Pioneer, Dt. 11 Dec 2025

India must urgently modernise its coastal security infrastructure to counter an emerging generation of AI-enabled threats that could render traditional maritime security apparatus and defences obsolete. With artificial intelligence democratising advanced military capabilities, hostile actors now have access to autonomous underwater vehicles, coordinated drone swarms, and cyber-physical attack systems that were exclusively the domain of superpowers just years ago. We face a fundamentally different security environment from that which existed even five years ago. The convergence of AI, autonomous systems, and sophisticated cyber capabilities creates threats that can materialise with unprecedented speed and lethality along our 11,098-kilometre coastline.

The Invisible Underwater Menace

Perhaps most alarming are autonomous underwater vehicles—sophisticated submarine drones capable of operating for weeks without surfacing while maintaining minimal acoustic signatures that challenge conventional sonar detection. Security analysts warn of scenarios in which torpedo-sized AUVs could be launched from vessels over 100 nautical miles offshore, using AI navigation to autonomously infiltrate major ports. Once positioned, these systems could attach explosives to naval assets, conduct prolonged reconnaissance of underwater defences, or remain dormant as sleeper weapons activated on command. Larger AUVs pose direct threats to critical underwater infrastructure, including submarine communication cables carrying 99 per cent of international data traffic, oil and gas pipelines, and desalination plant intake systems.

The AI advantage is significant: these systems learn from each mission, make autonomous decisions without detectable communications, recognise optimal attack timing based on traffic patterns, and adapt tactics when they encounter countermeasures. China's deployment of underwater autonomous systems in the South China Sea, combined with commercially available AUV technology requiring minimal modification and accessible 3D-printed components, has lowered the barrier to entry dramatically.

Swarm Intelligence and Saturation Attacks

While single-drone incidents have garnered attention following recent security events, AI introduces exponential complexity through swarm intelligence. Defence experts envision scenarios involving 50 to 100 coordinated drones overwhelming point defences through saturation attacks, with distributed decision-making eliminating any central control point vulnerable to jamming. Maritime applications include simultaneous strikes on multiple naval and coast guard targets, with AI coordination identifying and engaging vessels while electronic warfare drones jam communications and radar.

Port infrastructure becomes vulnerable to precision attacks on fuel depots, coastal security chains of static sensors, control towers, and cargo terminals, with thermal imaging identifying high-value targets and adaptive re-targeting if primary objectives are defended. The technology remains disturbingly accessible: commercial drones modified with open-source AI software, facial recognition technology repurposed for ship identification, and gaming industry processors providing the computational power for AI operations.

The Cyber-Physical Convergence

Security analysts have identified the integration of cyber warfare with physical autonomous systems as perhaps the most dangerous scenario—a three-phase attack chain beginning with AI-powered malware penetrating port management systems, followed by AUVs, surface vessels, and drones positioning during the cyber preparation phase while maintaining radio silence. The synchronised final phase would see cyber attacks disabling port security systems and communications while physical autonomous systems execute coordinated strikes, with AI-driven adaptive tactics responding in real time to defensive measures.

Real-world precedents demonstrate the viability of such attacks. Stuxnet demonstrated cyber-physical attack capabilities against Iranian nuclear facilities. Iran captured a US drone through GPS spoofing. Russia has launched cyber attacks on Ukrainian infrastructure. Chinese advanced persistent threats have infiltrated maritime industry networks globally. Adversaries are also using AI defensively—training algorithms to identify and exploit blind spots in surveillance systems, generating synthetic radar signatures mimicking benign vessels, creating false AIS location data, and producing jamming patterns that appear as technical malfunctions rather than attacks.

The Professional Recruitment Threat

Recent security incidents involving educated professionals—doctors, engineers, and IT specialists—have raised concerns about recruitment for AI-enabled operations. Data scientists could develop sophisticated algorithms for weapon systems, robotics engineers could build and modify autonomous platforms, and cybersecurity experts could create malware and conduct reconnaissance. Security officials have expressed particular concern about operatives who could play significant technical roles in cyber operations, drone piloting from safe houses, and intelligence gathering while maintaining lower suspicion profiles.

Remote operation capabilities eliminate traditional suicide-attack requirements, fundamentally changing the threat landscape. Encrypted communication platforms enable pre-programmed autonomy, whereby AI systems receive initial instructions through dead-drop emails and secure messaging, with no real-time communication during operations, eliminating interception risks.

Global Best Practices

International response models offer templates for Indian adaptation. The United States Navy has deployed advanced sonar arrays tuned for small AUV detection, AI-powered acoustic analysis,

defensive drone swarms, and autonomous underwater vehicles for harbour protection. Israel's multi-layered defence includes the Drone Dome system, with AI radar classification distinguishing bird flocks from drone swarms, electronic warfare jamming, and laser interception. Singapore's smart port security integrates autonomous patrol boats, underwater monitoring, AI-powered cargo screening, and comprehensive cyber defence.

A Comprehensive Implementation Strategy

A three-phase implementation strategy for India spanning five years may be considered:

- Phase 1 (0–12 months) should focus on deploying underwater sensor arrays at five major ports, installing counter-drone systems at critical infrastructure, integrating AI-enabled systems with the existing National Coastal Security Operations Centre, and procuring autonomous underwater defence vehicles.
- Phase 2 (12–36 months) may require completing AI-enabled sensor networks covering all ports and 50 per cent of the coastline, establishing five AI-enabled Regional Coastal Security Centres at Mumbai, Kochi, Chennai, Visakhapatnam, and Port Blair, deploying autonomous defence systems at additional locations, and training thousands of personnel in AI and autonomous systems.
- Phase 3 (36–60 months) should aim for comprehensive AI-enabled sensor coverage of the entire coastline, deployment of autonomous defence systems at all critical infrastructure, complete cyber-physical defence integration, and the establishment of domestic production of key systems.

Technology and Training Requirements

The strategy requires multi-frequency sonar arrays capable of detecting various AUV sizes, magnetic anomaly detectors, high-frequency surface wave radar, 3D aerial surveillance, and AI-powered maritime domain awareness systems aggregating data from the Coast Guard, Navy, ISRO, DGLL, DG Shipping, Customs, and state police sources. Active countermeasures should include layered counter-drone systems combining electronic warfare jamming at close range, directed energy weapons and autonomous defensive drones at medium range, and modified surface-to-air missiles for area defence beyond five kilometres.

Organisational measures require establishing specialised Counter-Autonomous System Teams combining electronic warfare specialists, AI experts, maritime special forces, explosive ordnance disposal technicians, and cybersecurity professionals, with permanent stations at major ports and rapid deployment capabilities. Legal frameworks need updating to address autonomous system regulations, including mandatory registration of drones and underwater vehicles, licensing requirements for AI-enabled maritime systems, and clear rules of engagement for autonomous threats, with provisions for intelligence sharing with allied nations.

Community Engagement and Indigenous Development

Coastal community integration represents a critical force multiplier. Training fishing communities to identify autonomous systems, with secure reporting mechanisms and financial incentives, could provide thousands of additional monitoring points along India's extensive coastline. Indigenous capability development through a proposed National Maritime AI Lab would partner with IITs, the Indian Institute of Science, DRDO, and private-sector companies such as TCS, Infosys, and Tech Mahindra. Dedicated coastal test ranges would enable testing of autonomous systems and countermeasures in simulated port environments, with underwater testing facilities.

Public–private partnerships through start-up incubation programmes, challenge-based competitions for novel solutions, and fast-track procurement mechanisms would leverage commercial innovation across AI, robotics, cybersecurity, and sensor manufacturing sectors.

Ethical Safeguards and Regional Leadership

Human-in-the-loop protocols for lethal systems remain essential, with final engagement authorisation by human operators, multiple levels of verification before hostile classification, and regular testing to prevent false positives. Hardware-based security modules would prevent hacking of defensive systems, while transparency measures ensure public awareness and parliamentary oversight. Proportional response frameworks would provide graduated options before the use of lethal force, consider collateral damage risks, ensure compliance with international law, and mandate ethical review boards for new capabilities.

The Path Forward

The technology exists. The expertise exists within India. What is required is recognition that coastal security in the age of AI and autonomous systems demands a fundamental reimagining of our approach, sustained political will, bureaucratic reforms enabling integrated operations, and technical excellence that attracts India's best talent to the defence sector. With maritime commerce representing 70 per cent of India's trade value and critical infrastructure serving 1.4 billion citizens at stake, decisions made today will determine whether the nation can effectively defend its coastal interests against the next generation of AI-enabled warfare. The democratisation of advanced weapons technology, the asymmetric potential for small teams to inflict strategic damage, and the rapid pace of technological evolution all demand urgent action to modernise India's coastal defence architecture before adversaries exploit existing vulnerabilities.

https://www.dailypioneer.com/2025/columnists/ai-powered-threats-demand-urgent-overhaul-of-india-s-coastal-defence-and-security.html

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वायु सेना ने याद दिलाया बांग्लादेश में किए गए अपने अभियान

Source: Dainik Jagran, Dt. 11 Dec 2025

भारतीय वायु सेना ने बुधवार को असम के मोहनबाड़ी स्थित वायु सेना स्टेशन में 1971 के युद्ध में भारत की जीत की स्मृति में एक कार्यक्रम आयोजित किया। अधिकारियों ने बताया कि वायु सेना ने हवाई प्रदर्शन के माध्यम से तंगेल में बम गिराने की घटना, मेघना नदी पार करना, ढाका स्थित सरकारी भवन पर हमला और 1971 के भारत–पाकिस्तान युद्ध के अन्य महत्वपूर्ण अभियानों का पुनर्मंचन किया।

इस कार्यक्रम में भारतीय सशस्त्र बलों की वीरता और शौर्य को श्रद्धांजलि दी गई। वायु सेना प्रमुख एयर चीफ मार्शल एपी सिंह, वरिष्ठ सैन्य और असैन्य गणमान्य व्यक्ति, पूर्व सैनिक और असम के बड़ी संख्या में युवा इस कार्यक्रम में शामिल हुए। रक्षा मंत्रालय ने कहा, एसयू–30 एमकेआइ, सी–130, डोर्नियर, एएन–32, चिनूक, एमआइ–17, एएलएच और चीता विमानों द्वारा किए गए हवाई प्रदर्शन में 1971 के युद्ध के प्रमुख मिशनों पुनर्मंचन किया गया। इसमें तंगेल एयरड्राप, मेघना नदी पार करना और ढाका में सरकारी भवन पर हमला शामिल था।

इस प्रदर्शन ने भारतीय वायु सेना की परिचालन क्षमता और मिशन तत्परता को प्रदर्शित किया। इस अवसर पर '1971 के युद्ध के दौरान हवाई अभियान' विषय पर एक सेमिनार भी आयोजित किया गया जिसमें वायु सेना के पूर्व सैनिकों ने युद्ध में अपनी भागीदारी से जुड़े किस्से और अनुभव साझा किए। 'ट्रायम्फ फ्राम द स्काई–71' नामक एक प्रदर्शनी में युद्ध के समय की दुर्लभ

तस्वीरें प्रदर्शित की गईं। इसमें भारत की निर्णायक विजय का प्रतीक मानी जाने वाली औपचारिक मशाल 'स्वर्णिम विजय मशाल' की एक प्रतिकृति भी शामिल थी।

दुश्मन देश के दुस्साहस का मुंहतोड़ जवाब देने को तैयार : वायु सेना प्रमुख

वायु सेना प्रमुख एयर चीफ मार्शल एपी सिंह ने बुधवार को कहा कि भारतीय वायु सेना किसी भी शत्रु राष्ट्र द्वारा किए गए दुस्साहस का मुंहतोड़ जवाब देने के लिए पूरी तरह तैयार है। वायु सेना पिछले अनुभवों के आधार पर अपनी क्षमता और रणनीति में लगातार सुधार कर रही है।

उन्होंने यहां पत्रकारों से कहा, "अगर दुश्मन देश किसी भी तरह का दुस्साहस करते हैं तो हम उन्हें करारा जवाब देने के लिए पूरी तरह तैयार हैं।" किसी भी तरह की आपात स्थिति उत्पन्न होने पर भारत, विशेष रूप से भारतीय वायु सेना, दो मोर्चों पर युद्ध लड़ने के लिए तैयार है।

https://www.jagran.com/news/national-the-air-force-reminded-of-its-operations-in-bangladesh-40068238.html

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IAF marks 1971 victory with spectacular flying display at Mohanbari

Source: The Hindu, Dt. 11 Dec 2025

The Indian Air Force celebrated India's historic triumph in the 1971 war with a commemorative event at the Mohanbari Air Force Station in Assam on Wednesday (December 10, 2025), paying an inspiring tribute to the courage and valour of the armed forces. The ceremony was attended by the Chief of the Air Staff, Air Chief Marshal A.P. Singh, along with senior military and civilian dignitaries, veterans, and enthusiastic youth from across Assam.

Indian military personnel show skills during 'Vijay Diwas' celebration at Air Force Station Mohanbari, in Dibrugarh district, Assam, Wednesday, Dec. 10, 2025

In the event, the Indian Air Force simulated attack of the famous Governor residence attack at Dhaka in the 1971 war. The IAF said a breathtaking flying display featuring Su-30 MKI, C-130,

Dornier, An-32, Chinook, Mi-17, ALH and Cheetah aircraft vividly recreated iconic missions from the 1971 war, including the Tangail Airdrop, Meghna River Crossing, and the attack on the Governor's House in Dhaka. The display showcased the IAF's exceptional operational capability and mission readiness.

As part of the commemoration, a seminar on 'Air operations during the 1971 war' brought together air veterans who shared gripping anecdotes and firsthand experiences from the conflict. An exhibition titled 'Triumph from the Sky-71' displayed rare archival photographs from the war and featured a replica of the 'Swarnim Vijay Mashal', symbolising India's decisive victory.

https://www.thehindu.com/news/national/iaf-marks-1971-victory-with-spectacular-flying-display-at-mohanbari/article70380943.ece

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Science & Technology News

अंतरिक्ष में बड़े और साहसिक सपना देख रहा भारत

Source: Dainik Jagran, Dt. 11 Dec 2025

अंतरराष्ट्रीय अंतरिक्ष स्टेशन (आईएसएस) पर जाने वाले पहले भारतीय अंतरिक्ष यात्री भारतीय वायुसेना में ग्रुप कैप्टन शुभांशु शुक्ला ने बुधवार को कहा कि भारत 41 साल के अंतराल के बाद मानव अंतरिक्ष उड़ान के क्षेत्र में कदम रखते हुए अब बड़े और साहसिक सपने देख रहा है। शुक्ला एक्सिओम-4 मिशन के तहत अंतरराष्ट्रीय अंतरिक्ष स्टेशन का दौरा करने वाले वाले भारतीय थे। वह 18 दिन के अंतरिक्ष प्रवास के बाद 17 अगस्त, 2025 को अमेरिका से भारत लौटे थे।

कोलकाता स्थित भारतीय अंतरिक्ष भौतिकी केंद्र में आयोजित एक कार्यक्रम में स्कूल के विद्यार्थियों से बातचीत करते हुए उन्होंने कहा कि अंतरिक्ष रहने के लिए एक बेहतरीन जगह है, जहां गहरी शांति और अद्भुत नजारा होता है जो समय के साथ और भी मनमोहक हो जाता है। शुक्ला ने कहा कि आप जितना ज्यादा समय वहां रहते हैं, उतना ज्यादा आनंद मिलता है। हल्के-फुल्के अंदाज में उन्होंने कहा कि सच कहूं तो मेरा मन वहां से वापस आने का नहीं था। शुक्ला ने कहा कि अंतरिक्ष में मिला अनुभव प्रशिक्षण के दौरान सीखी गई चीजों से बिल्कुल अलग था।

उन्होंने कहा कि भारत के अंतरिक्ष विज्ञान का भविष्य बेहद उच्च्वल है, क्योंकि देश अब बहुत बड़े और साहसिक सपनों को साकार करने की दिशा में अग्रसर है। उन्होंने अमेरिका के सहयोग से किए गए अपने आईएसएस मिशन को भारत के विजन गगनयान को साकार करने की दिशा में एक महत्वपूर्ण कदम बताया।

'अंतरिक्ष मिशन से मिला अनुभव राष्ट्रीय संपत्ति

शुक्ला ने कहा कि इस मिशन से जो अनुभव मिला है, वह राष्ट्रीय संपत्ति है और इसका इस्तेमाल आतंरिक विशेषज्ञ समितियों और डिजाइन टीमों द्वारा आगामी मिशनों को सही दिशा देने के लिए पहले से ही किया जा रहा है। शुक्ला ने कहा कि देश की अंतरिक्ष महत्वाकांक्षाओं में गगनयान मानव अंतरिक्ष उड़ान कार्यक्रम, भारत का अपना अंतरिक्ष स्टेशन और चंद्रमा पर मानव लैंडिंग शामिल हैं। उन्होंने बताया कि चंद्रमा पर उतरने का लक्ष्य वर्ष 2040 तक रखा गया है, लेकिन इस परियोजना पर पहले से ही काम चल रहा है और यह क्षेत्र अगले 10 से 20 वर्षों में बहुत तेजी से विकसित होगा। गगनयान को 2027 में अंतरिक्ष भेजे जाने की उम्मीद है।

युवाओं में चुनौतीपूर्ण लक्ष्य को हासिल करने की क्षमता

विद्यार्थियों से बातचीत में उन्होंने कहा कि हालांकि ये लक्ष्य चुनौतीपूर्ण हैं, लेकिन आप जैसे युवाओं के लिए यह पूरी तरह संभव हैं, जिसे आप हासिल कर सकते हैं। उन्होंने युवाओं से भारत की आकांक्षाओं को पूरा करने की जिम्मेदारी लेने का आह्वान किया। उन्होंने यह भी कहा कि मानव अंतरिक्ष उड़ान कार्यक्रमों के विस्तार से रोजगार के विशाल अवसर पैदा होंगे। शुक्ला ने भारत के पहले अंतरिक्ष यात्री राकेश शर्मा के प्रसिद्ध शब्दों को दोहराते हुए कहा कि कक्षा से देखने पर आज भी हमारा भारत सारे जहां से अच्छा दिखता है। उन्होंने कहा कि यह उपलब्धि केवल उनकी नहीं, बल्कि पूरे देश की है।

भारत का युवा वर्ग अत्यंत प्रतिभाशाली

शुक्ला ने कहा कि भारत का युवा वर्ग अत्यंत प्रतिभाशाली है। उन्हें लक्ष्यों पर केंद्रित रहना होगा, जिज्ञासु बने रहना होगा और कठोर परिश्रम करना होगा। भारत को 2047 तक विकसित राष्ट्र बनाने की जिम्मेदारी उन्हीं की है। उन्होंने राकेश शर्मा के जमाने से आए बदलाव पर जोर देते हुए कहा कि भारत अब एक संपूर्ण अंतरिक्ष यात्री पारिस्थितिकी तंत्र विकसित कर रहा है। उन्होंने कहा कि गगनयान और आने वाले मिशनों के जरिए भारत के बच्चे अब न केवल अंतरिक्ष यात्री बनने का सपना देखेंगे, बल्कि उसे अपने देश के अंदर पूरा भी कर सकेंगे।

जब कोई व्यक्ति अंतरिक्ष जाता है, तो लाखों सपनों को उड़ान मिलती है

शुक्ला ने कहा कि जब कोई एक व्यक्ति अंतरिक्ष जाता है, तो लाखों सपनों को उड़ान मिलती है। इसलिए ऐसे कार्यक्रमों का निरंतर जारी रहना बेहद आवश्यक है। अब आसमान ही सीमा नहीं रहा। उन्होंने वैज्ञानिकों से कहा कि वे ऐसी प्रणालियां विकसित करें जो 20-30 वर्षों तक टिकाऊ हों और भविष्य की तकनीकों के साथ सामंजस्य बैठा सकें। उन्होंने यह भी कहा कि वे आगे और मिशनों में भाग लेने के इच्छुक हैं और एक स्पेस वाक करने का सपना देखते हैं, जिसके लिए उन्हें दो वर्ष का अतिरिक्त प्रशिक्षण लेना होगा।

https://www.jagran.com/news/national-indias-space-dreams-shubhanshu-shukla-in-kolkata-40068143.html

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Far from Delhi, IIT-Madras researchers study how pollutants behaves as they 'age'

Source: The Indian Express, Dt. 11 Dec 2025

What happens when emissions from a truck passing through Delhi at 2 am meet the morning sun at 8 am? How do aerosols — fine solid particles or liquid droplets suspended in the air — evolve chemically over time, and how does this evolution change their toxicity, size, and water-absorption capacity? Does the air get progressively more toxic as the concentration of particulate matter increases?

As the danger signal from Delhi's air pollution crisis flashes increasingly brighter, 2,000 km away, a team of scientists in Chennai are conducting an experiment to better understand what it is exactly that makes the air dangerous. Researchers at IIT-Madras are running a machine that simulates Delhi's pollution chemistry under controlled and accelerated conditions.

The simulation allows processes that unfold naturally over days in the capital's air to be compressed into hours inside a stainless steel chamber that is flooded with ultraviolet light and oxidants.

"We set it up about six months ago," said Dr Sachin S Gunthe, a professor at the environmental engineering division of the Department of Civil Engineering who leads the team at IIT-M's Centre

for Atmospheric and Climate Sciences. “We are trying to reproduce, inside the chamber, how particles form and age in the real atmosphere,” Gunthe told The Indian Express.

At the heart of the IIT-M experiment is a Potential Aerosol Mass Oxidation Flow Reactor (PAM OFR), a laboratory instrument used in atmospheric chemistry to understand air pollution and climate change.

Professor Sachin Gunte with his team at IIT-Madras.

The OFR creates an “artificial atmosphere” in which scientists introduce volatile organic compounds (VOCs), both biogenic (such as isoprene and alpha-pinene from trees) and anthropogenic (such as toluene, benzene, and xylene from traffic). Once vaporised, the VOCs are oxidised by hydroxyl (OH) radicals and exposed to intense UV radiation, which triggers a set of reactions that convert gases into particles called secondary organic aerosols (SOA). “The advantage,” Gunthe said, “is that whatever takes one to seven days in the open atmosphere, we can simulate in two or three hours.”

The results obtained in the reactor are compared with baseline data from a remote research station in Munnar, Kerala, which provides conditions closer to a clean atmosphere, and offers a reference point for natural processes. A striking insight from the first set of OFR experiments is that the health impact of fine particulate matter is not always proportionate to its mass concentration. “In some cases, a decrease in overall fine particulate matter mass concentration was linked to an increase in particle toxicity,” Gunthe said.

This suggests that what matters is not just how much particulate matter is in the air, but what it is made of, and how it changes as it ages in Delhi’s atmosphere. The team of about 20 students and faculty at IIT-M is now studying how “aged” particles behave when they reach the body’s first line of defence, the epithelial lining fluid (ELF) in the lungs. Lab-aged particles introduced into a mock-up of the lungs have been shown as capable of inducing oxidation in the epithelial lining and potentially triggering allergic responses.

“This is important,” Gunthe said. “People often say, if PM2.5 increases by this much, so many people will die. But unless we know how particles interact physiologically and when they meet the ELF, we cannot derive scientific results.”

According to Gunthe, the high concentrations of ultrafine particulate matter in Delhi are not just due to direct emissions; a significant portion that is yet to be quantified comes from secondary organic aerosols. In other words, a large share of the city’s PM2.5 is born in the sky, not in the tailpipe.

Globally, secondary organic aerosol formation peaks around noon — morning traffic produces nitrogen oxides (NOx), which react with VOCs to create ground level (tropospheric) ozone, which then forms OH radicals, the key oxidant.

“But in Delhi, the secondary formation often peaks much earlier in the morning,” Gunthe said. “Nobody talks about this. It means that other oxidants, not just OH, are driving the chemistry.” This irregularity is the reason Gunthe believes a comparison between Delhi and Beijing is superficial. “Beijing’s problem was very different,” he said. “The chemistry is different.”

The notoriously severe “airpocalyse” in China’s capital was caused by rapid industrialisation, the use of coal, and the explosion of the vehicular population. The government responded with its “war on pollution” around 2013, implementing strict controls on industry, promoting clean energy, and expanding public transportation, which led to a sharp decline in PM2.5 levels by 2017.

The PAM OFR is funded by IIT-M, but the experiment is in collaboration with the Max Planck Institute for Chemistry at Johannes Gutenberg University Mainz, the University of Manchester in the UK, and Harvard University and Georgia Institute of Technology in the US.

“Some instruments cost Rs 4-6 crore. No agency will immediately give you that money. So we go to collaborators, pitch our scientific ideas, and they lend us the instrument because they trust our rigour,” Gunthe said.

The researchers’ long-term goal is to “understand the underlying processes and mechanisms of SOA formations”. They are not yet ready to offer policy recommendations; however, it is understood that “If a significant secondary source can be pinpointed, and its precursors substantially reduced, that could form the basis for future policy implications”.

According to Gunthe, India needs better process-based monitoring, not just more air pollution sensors. He suggested that identical process stations be installed at six points across the Indo-Gangetic Plain from Jammu to Kolkata to track atmospheric chemistry along the region’s seasonal wind pathways. This, he said, will help quantify how much of the air pollution is local, how much is transported, how much is primary, and how much is secondary. “Unless you know the processes, you cannot treat the disease,” he said. “You will only treat the patient.”

https://indianexpress.com/article/cities/delhi/far-from-delhi-iit-madras-researchers-study-how-pollutants-behave-as-they-age-10413940/

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ISRO's 'Bahubali' to launch 6.5 tonne US commercial sat BlueBird-6 on Mon

Source: The Times of India, Dt. 11 Dec 2025

New Delhi: In a boost to Indo-US space cooperation, Isro will launch its heaviest American commercial communication low-earth orbit satellite, the 6.5-tonne BlueBird-6, from the Sriharikota spaceport on Dec 15.

Isro's 'Bahubali' rocket LVM3 will put the US satellite into orbit.

AST SpaceMobile, a Texas-based company that has built the space-based cellular broadband network, said, "BlueBird-6, a US licensed satellite, is scheduled to launch on Dec 15. It is the first of AST SpaceMobile's next-generation satellites. When launched, it will feature the largest commercial phased array in low earth orbit at nearly 2,400 sqft. This represents 3.5 times increase in size over BlueBirds 1-5 and supports ten times the data capacity."

BlueBird-6 is a "Block-2" satellite and part of a larger plan by AST SpaceMobile to deploy a series of satellites to achieve non-continuous service, with further launches scheduled through 2026.

Its aim is to bridge the "digital divide" by offering fast, unhindered direct-to-device mobile broadband service in areas with poor or non-existent terrestrial network coverage.

The BlueBird satellites are designed to deliver a high amount of bandwidth, with each unit capable of up to 10,000 MHz. They operate by partnering with existing mobile network carriers to enhance their networks using licensed spectrum.

The satellite arrived in India from the US on Oct 19. It was later transported by road to Sriharikota for integration with launcher LVM3, fuelling and final checks ahead of its launch. LVM-3 had recently put India's heaviest CMS-3 satellite, weighing 4.4 tonnes, into its orbit on Nov 2.

A three-stage launch vehicle, LVM3 rocket can carry payloads weighing up to 8,000 kg to low-Earth orbit (LEO) and 4,000 kg to geosynchronous transfer orbit (GTO).

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Celebration of Science Communication and Outreach at Vigyanika: Science Literature Festival 2025

Source: Press Information Bureau, Dt. 10 Dec 2025

CSIR–National Institute of Science Communication and Policy Research (CSIR–NIScPR), New Delhi in association with Vijnana Bharti (VIBHA), Indian Institute of Tropical Meteorology (IITM), Pune and Panjab University, Chandigarh successfully organised Vigyanika: Science Literature Festival 2025 during 8–9 December 2025 as an integral part of the India International Science Festival (IISF), 2025. The two-day festival celebrated the convergence of science, literature, language, and creative communication, bringing together leading science communicators, scientists, editors, scholars, and science poets from across the country. The event aimed to strengthen the culture of scientific temper through multilingual and culturally rooted forms of science communication.

The festival opened on 8th of December with an inaugural session titled “Bhartiya Vigyan Vimarsh me Sahitya aur Sanchar Madhyamo ki Bhoomika”. The session explored the role of literature and communication platforms in shaping India’s scientific discourse. Dr. Paramananda Barman, CSIR-NIScPR offered an overview of Vigyanika. Dr. Neel Sarovar Bhavesh from VIBHA spoke about the significance of communicating science within the Indian context.

Shri Vivekananda Pai, General Secretary of VIBHA, delivered the keynote address. He discussed the importance of an Indian narrative in SciComm. He also highlighted the notable contributions of India in Science and Technology. Prof. Arun Kumar Grover, Former Vice-Chancellor of Panjab University, reflected on the history of India’s scientific institutions and science communication. Dr. Geetha Vani Rayasam, Director, CSIR–NIScPR highlighted the importance of communicating science in Indian context and mentioned about the contribution of CSIR-NIScPR in this domain. Finally, Dr. Rashmi Sharma, Head, NCSTC, DST, talked about the present day science communication approaches. Their insights underscored the continuing need for accessible and contextually grounded science communication across the country. Dr. Atul Kumar Srivastava, IITM presented the Vote of Thanks.

Later that day, the Vigyan Kavi Sammelan showcased a vibrant blend of poetry and science, highlighting how creative expression can illuminate scientific ideas. Esteemed science poets included Prof. Manoj Kumar Patairiya, former Director of CSIR–NISCAIR; Prof. Rajesh Kumar of IIT Indore; Sh. Mohan Sagoria, Associate Editor of Electroniki Aapke Liye; along with celebrated science poets Ms. Radha Gupta, Prof. Neera Raghav, Mr. Yashpal Singh ‘Yash’, TSRS Sandeep, and Dr. Anurag Gaur. Their poetries illustrated the power of poetry as a tool for public engagement with science.

The second day of Vigyanika featured a scientific session titled Vigyan Se Samruddhi – For Atmanirbhar Bharat, which focused on traditional knowledge communication and its role in advancing national self-reliance. The session brought together key figures such as Dr. Arvind Ranade, Director, NIF who highlighted the need for protecting traditional knowledge through intellectual property (IP) frameworks, and ensuring proper recognition to knowledge holders. Dr. Viswajanani J. Sattigeri, Head, CSIR-TKDL emphasized the importance of documenting, disseminating and implementing policy for traditional knowledge. Dr. N. Srikanth, DDG, CCRAS highlighted the importance of value-addition and accurate communication of traditional knowledge and its scientific basis. Lastly, Dr. Kanupriya Vashishth, Senior Program Officer, DBT-BIRAC talked about life sciences and biotech innovations in India. The discussion emphasized India’s rich

heritage of traditional knowledge, the importance of integrating it into contemporary scientific and innovation ecosystems, and effective communication.

The Apni Bhasha Apna Vigyan, a panel discussion highlighted the critical role of Indian languages in science communication and outreach. Speakers included Prof. Arun Kumar Grover; Shri Debobrat Ghose, Editor, Science India; Dr. Manish Mohan Gore, Editor, Vigyan Pragati; Dr. H. S. Sudhira, Director, Research Matters, Gubbi Labs; and Dr. Nanaocha Sharma, Director, BRIC-IBSD, Manipur. The panel highlighted that science communicated in one's own language fosters inclusivity, understanding, and deeper public engagement.

Vigyanika concluded with an interactive session titled Engaging and Creative Ways of Communicating Science showcased innovative outreach strategies from experts across diverse fields. Sh. Kollegala Sharma, former Chief Scientist at CSIR-CFTRI; Mr. G. Harikrishnan, Director, Capacity Building and Public Outreach at ISRO; Dr. Saurabh Sharma, JNU; and Ms. Pooja Rathod, Wildlife Cinematographer and Filmmaker, shared approaches that spanned storytelling, audio-visual media, field engagement, and public-facing scientific narratives. Their insights highlighted the evolving landscape of science communication in India.

As part of IISF 2025, Vigyanika reinforced its commitment to bridging the gap between science and society. Through literature, art, Indian languages, and creative media, the event demonstrated the transformative potential of culturally grounded science communication in fostering a scientifically informed and engaged society.

https://www.pib.gov.in/PressReleasePage.aspx?PRID=2201666&reg=3&lang=1

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Parliament Question: Science Stream Scheme

Source: Press Information Bureau, Dt. 10 Dec 2025

The Department of Science and Technology is implementing Innovation in Science Pursuit for Inspired Research (INSPIRE)- Million Minds Augmenting National Aspiration and Knowledge (MANAK); INSPIRE Scholarship for Higher Education (SHE) and Vigyan Jyoti programmes with an objective to attract meritorious youth to study basic and natural sciences at the college and university level and to pursue research careers in both basic and applied science areas including engineering, medicine, agriculture and veterinary sciences. The ultimate aim of these science stream programs is to expand the R&D base of the country.

INSPIRE MANAK (Million Minds Augmenting National Aspiration and Knowledge) scheme is implemented with objectives (i) to attract young students to study science and pursue research career (ii) to promote creative thinking and foster a culture of innovation among them. The INSPIRE MANAK Scheme intends to target young students in the age group of 10-17 years and studying in class VI to XII. All schools in the country, recognized by the District/ State Education authorities, whether Government or private, aided or un- aided, run by Central Government or State Government or local bodies, and having classes 6 to 12 are eligible to nominate 5 students from their schools, during the financial year. The nominations are sought from schools, by the Department, during specific period of the year, through online mode at E-MIAS portal (www.inspireawards-dst.gov.in).

The nomination process includes submitting of basic details of the students, bank account details, along with a brief idea/ synopsis of the proposed model/project. These online nominations are scrutinized on the basis of the idea provided by the students and the selected students receive financial assistance of Rs.10,000/- each, for preparation of project/model/showcasing of idea and participation at exhibitions organized at three levels viz. District, State and National. The financial assistance under this scheme is being transferred directly into the bank accounts of the students through Direct Benefit Transfer.

Scholarship for Higher Education (SHE) aims to enhance the rate of attachment of talented youth to undertake higher education in science intensive programs by providing scholarships and mentoring through summer attachment with leading researchers. The scheme offers 12,000 Scholarships every year @ Rs 0.80 lakh per year for undertaking Bachelor and Masters level education in natural and basic sciences for the talented youth in the age group of 17-22 years.

Vigyan Jyoti program encourages meritorious school girls to pursue careers in Science, Technology, Engineering, and Mathematics (STEM). The program primarily targets girls from classes 9th - 12th, especially those from underrepresented regions, to bridge the gender gap in STEM education and careers. Vigyan Jyoti also focuses on building confidence, leadership skills, and communication abilities, helping girls excel academically and socially. By nurturing talent at the school level, Vigyan Jyoti helps create a pipeline of future women scientists, promotes gender equality in STEM, and encourages girls to aim for higher education and research careers. The key performance indicators are being used to evaluate the success of scholarship/projects funded under these Science Stream Schemes.

The key performance indicators for evaluating the INSPIRE MANAK program include the innovativeness of ideas, as well as students' research and innovative aptitude in science and technology. Nominations are received from students across India, representing diverse backgrounds. The large number of participating students demonstrates wide engagement among schools and learners. Each year, about one million ideas are received nationwide. A rigorous screening process is conducted based on novelty, originality, and innovativeness. From these submissions, approximately 50,000 students are selected to participate in a three-tier competition at the District, State, and National levels. Students selected for the State-level competition receive mentoring support for prototype development and potential commercialization.

The key performance indicators for evaluating the INSPIRE-SHE program include the selection of students who rank within the top 1% of their respective Central or State Boards. For continuation of the scholarship, scholars are required to maintain consistent academic performance, securing at least First Class (60% marks) annually. In addition, students are encouraged to undertake a short-term summer internship of 6–8 weeks to conduct research at any reputed academic organization

across the country. The research projects are evaluated by the respective research supervisors, and upon successful completion, mentorship support is provided to the students. Each year, mentorship support is extended to ~4000 scholars who successfully complete their research projects. INSPIRE-SHE has thus created a substantial academic and research talent pool for pursuing careers in Science and Technology.

The Vigyan Jyoti Program plays a pivotal role in increasing the participation of girls in STEM and addressing the underrepresentation of women in higher education and research in technology, engineering, mathematics, and high-energy physics. Activities such as student–parent counselling, role model interactions, visits to knowledge partners (IITs, NITs, CSIR labs), STEM sessions, tinkering activities, and resource distribution have significantly enhanced girls' interest in STEM. Hands-on tinkering activities have improved conceptual understanding. Academic support sessions have strengthened preparation for competitive examinations. Mentoring by scientists and STEM professionals has inspired girls to envision future careers in STEM fields.

Science stream schemes do cater the marginalized and underrepresented groups in science and research, and the details are as follows:

Financial Year	INSPIRE- MANAK			INSPIRE- SHE			Vigyan Jyoti		
	SC	ST	Female	SC	ST	Female	SC	ST	Female
2022-23	6614	4051	22150	621	153	5025	3470	3285	17859
2023-24	7767	4461	22687	622	105	4725	4823	3261	23149
2024-25	8803	4692	26127	881	143	5784	5961	3950	29437

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Parliament Question: National Geospatial Mission And Data Policy

Source: Press Information Bureau, Dt. 10 Dec 2025

The Digital Elevation Model for the entire country is available on 10m resolution. The National Geospatial Mission envisages creation of DEM on 25 cm resolution for Plain & undulating area including all urban area and 1-3 m for hilly & mountainous region. The Union Budget (2025-26) has announced National Geospatial Mission to develop foundational geospatial infrastructure and data. Using PM Gati Shakti, this Mission will facilitate modernization of land records, urban planning, and design of infrastructure projects with an initial outlay of ₹100 crore. The proposed mission has these major components - Modernization and Strengthening of National Geodetic Reference Frame, Strengthening of Geospatial Data and Mapping Infrastructure, Establishment of Geo-ICT Infrastructure,

The Policy envisages Unified Geospatial Interface (UGI), an electronic data querying and processing service to provide consumer-oriented products, applications, services and solutions using the Geospatial data and metadata contained in the NGDR and utilizing the data supply

chains from the Central and State Level Partnering Agency Data Nodes. National Institute of Geospatial Science & Technology (NIGST) has already developed foundational as well as advanced level courses to equip the workforce for required skilling in geospatial domain for officers of Survey of India and also the other central & state level officers. Further, the Capacity Building program includes identifying needs and building on existing capacities, formulating skills/competency standards and qualifications, studying and choosing the right from a wide range of approaches, making the training-of-trainers plans; and strengthening Training Infrastructure to reach national and regional levels.

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Parliament Question: Initiatives to help technology startups reach unicorn

Source: Press Information Bureau, Dt. 10 Dec 2025

The Government has been actively supporting creation of conducive ecosystem for innovators, entrepreneurs and startups through its various schemes and initiatives across the country, including in the state of Karnataka, Maharashtra and Rajasthan.

The Government has launched the Research Development and Innovation (RDI) scheme to support cutting edge technology, deep-tech projects and startups. The main objectives of the RDI scheme are to encourage the private sector to scale up research, development and innovation (RDI), finance transformative projects, support acquisition of technologies which are critical or of high strategic importance and facilitate setting up of Deep-Tech Fund of Funds. The scheme is led by the Department of Science & Technology (DST) as the nodal department. With an outlay of Rs. 1 lakh crore in next 6 years, the RDI scheme targets sunrise sectors including energy security and transition, and climate action; deep-technology including quantum computing, robotics and space; artificial intelligence and its application in agriculture, health and education; biotechnology, biomanufacturing, synthetic biology, pharma, medical devices; and digital economy including digital agriculture.

Under the National Quantum Mission (NQM), DST has actively supported startups working in the domain of quantum technologies, specifically quantum computing, quantum communication, quantum sensing, and quantum materials & devices. The Mission is to support an expanding pool of quantum startups, provide them appropriate funding, give access to advanced infrastructure, and provide mentorship opportunities through partnerships with industry. Under NQM, financial support has been provided to seven startups in the different areas of Quantum Technologies.

DST is implementing the National Mission on Interdisciplinary Cyber Physical Systems (NM-ICPS), which was approved by the Union Cabinet with an outlay of Rs. 3660 crores. Under this mission, 25 Technology Innovation Hubs (TIHs) have been established in reputed academic institutions across the country. Each TIH specializes in advanced technology domains such as Artificial Intelligence (AI) & Machine Learning (ML), Robotics, Internet of Things (IoT), Cybersecurity, Quantum Technologies, FinTech, etc. More than 800 Startups have been benefitted under the mission. I-HUB for Robotics and Autonomous Systems Innovation Foundation at Indian Institute of Science (IISc), Bengaluru and IIITB Comet Foundation at International Institute of Information Technology (IIIT), Bengaluru have been established in the state Karnataka; I-Hub Quantum

Technology Foundation at Indian Institute of Science Education and Research (IISER), Pune and TIH Foundation for IOT and IOE at Indian Institute of Technology (IIT), Bombay have been established in the state of Maharashtra; IHUB Drishti Foundation at Indian Institute of Technology (IIT), Jodhpur and BITS BioCYTiH Foundation at Birla Institute of Technology & Science Pilani have been established in Rajasthan. These six TIH have cumulatively supported 160 startups in cutting edge R&D.

DST through 'NIDHI' (National Initiative for Developing and Harnessing Innovations) program has extended end-to-end startup support to nurture startups from ideation to commercialization. It includes a variety of program components for Startups like PRAYAS - prototyping grant for early-stage innovative ideas, hand-holding support to startups through Technology Business Incubators, seed funding and acceleration support for rapid scaling of startup businesses. Under NIDHI–PRAYAS program 2,254 innovators/startups have been supported, with sanctioned funding of ₹173.27 crore. Out of these 2254 innovators/startups, 381 are from Karnataka, 312 from Maharashtra and 56 from Rajasthan. Around Rs. 1400 crore has been provided through NIDHI program to network of DST established academic incubators for creating an ecosystem for supporting science & technology (S&T) based startups. Over 12000 startups have benefited from the DST supported programs. DST has established 17 incubation centres in the state of Karnataka, 14 in the state of Maharashtra, and 4 in the state of Rajasthan, to provide comprehensive support and help startups progress in their idea to commercialization journey.

The Anusandhan National research Foundation (ANRF) under DST has been able to strengthen Industry-Academia linkages through their various programs. One of the key mechanisms adopted to bridge the gap between academic research and market-appropriate products is the structured support across Technology Readiness Levels (TRLs). Under the new framework, ANRF is supporting research from basic and early-stage development, i.e. up to TRL- 4, while the RDI scheme is mandated to support projects from TRL-4 and above, to advance prototypes, pilot demonstrations, and scale-up activities. This coordinated approach enables a smooth transition from laboratory research to commercially deployable technologies.

Under the Startup India initiative launched in 2016, the Department for Promotion of Industry and Internal Trade (DPIIT) has provided a platform for registering Indian startups. As on 31st October 2025, 1,97,692 entities have been recognized as startups by DPIIT which have reported to have created over

21.11 lakh direct jobs. Under Startup India initiative, the Government constantly undertakes various efforts to support startups across industries and sectors. The flagship Schemes namely, Fund of Funds for Startups (FFS), Startup India Seed Fund Scheme (SISFS) and Credit Guarantee Scheme for Startups (CGSS) support startups at various stages of their business cycle.

The Biotechnology Industry Research Assistance Council (BIRAC) has been providing early-stage funding to biotech startups and entrepreneurs under Biotechnology Ignition Grant (BIG) scheme and BioNEST (Bio-Incubators Nurturing Entrepreneurship for Scaling Technologies). BIRAC has been instrumental in building a vibrant biotech innovation ecosystem in India. Through Public-Private Partnerships, it has undertaken a multitude of activities, ranging from funding high-risk translational research, supporting nascent ideas and establishing specialised bio-incubation centres. BioNEST & E-YUVA centres have supported over 2,700 incubatees & students. More than 1,300 Intellectual Properties (IP) have been filed by the incubatees, and over 800 products have been developed, reaching various stages of market deployment.

Ministry of Electronics and Information Technology (MeitY) has been providing financial and technical support under Technology Incubation and Development of Entrepreneurs (TIDE) and Gen-Next Support for Innovative Startup (GENESIS) schemes to Deep Tech startups in the domain of Electronics and ICT domain. Department of Space (DoS) has established Indian National Space Promotion and Authorization Center (IN-SPACe), which is driving India's Space startup ecosystem.

Innovations for Defence Excellence (iDEX), was launched in 2018 to foster innovation & technology development in Defence & Aerospace by engaging industries including Startups/ MSMEs/ Individual Innovators, R&D institute and Academia. iDEX provides grants and other support to iDEX winners (Startups/SMEs) to carry out R&D which has potential for Indian Defence and Aerospace needs.

DST has supported a NIDHI Centre of Excellence in AI/ML at T-Hub, Hyderabad which is a Technology Hub established by the Government of Telangana. Similarly, Department of Biotechnology (DBT) has established Bio- Technology Parks in partnership with state governments. Such Centre-State collaboration to promote innovation in cutting edge technologies, have strengthen Unicorn growth at the national level.

The Government has also implemented periodic activities and programs with States such as State Startup Ranking, State Startup Policy, National Startup Awards etc. which have played an important role in establishing synergies between the centre and different states, and in the holistic development of the startup ecosystem in the country. The S&T based entrepreneurial infrastructure and strong support mechanisms created by the Government during the last 10 years such as translational research hubs, startup incubators, research labs, fabrication facilities, generous support from ideation to Proof of Concept (POC), seed funding to acceleration, assistance in raising external funding, etc has provided seamless opportunities to students and innovators to take up entrepreneurship as career and own innovative ventures.

The initiatives of Government have significantly strengthened India’s startup and innovation ecosystem by improving access to capital, easing regulatory barriers, and expanding incubation infrastructure. They have also fostered wider economic development by promoting entrepreneurship beyond major cities. In their journey, four of the DST supported startups have reached to Unicorn status. Some of the startups supported under DST programs who have attained tangible scale are QuNu Labs, QpiAI, Ather Energy, IdeaForge, Razorpay, Uniphore, FarEye, Lauras Labs, Gupshup, Atomberg, Agnikul, Offgrid Energy Labs, etc.

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New light to track gene editing

Source: Press Information Bureau, Dt. 10 Dec 2025

A newly engineered CRISPR protein could help scientists observe the molecular scissors called Cas9 enzyme as it enables them to edit genomes using the CRISPR-Cas9 system for treating genetic diseases including cancer.

Gene therapy could be a permanent cure for many life-threatening hereditary diseases. Developing effective, affordable, and safe gene therapy methods remained a challenge for decades. A major breakthrough to address this challenge came in the form of CRISPR, a gene-

editing tool that uses a guide RNA to direct a Cas9 enzyme to a specific DNA sequence, where it precisely cuts the DNA. The CRISPR-Cas9 had been designed to cut and correct DNA with accuracy. However, scientists could not observe Cas9, the molecular surgeon, in living cells in real time. Traditional detection methods rely on fixing or breaking open cells, making it impossible to track the process as it unfolds.

Tracking gene editing as it happens or watching the molecular machinery as it works, cutting, repairing, and rewriting DNA inside living cells can help monitor CRISPR operations in living cells and tissues without destroying them.

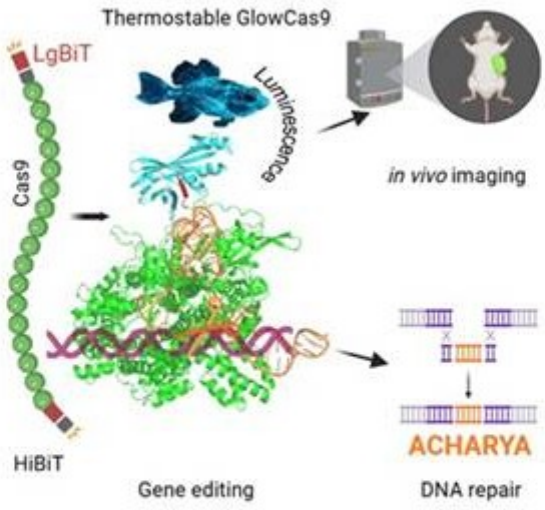

Fig: Schematic presentation of engineered thermostable reporter GlowCas9 development for theratracking applications

Scientists from Kolkata based Bose institute, an autonomous institute of the Department of Science and Technology (DST), has come out with a solution for this. A team led by Dr. Basudeb Maji, has created GlowCas9, a CRISPR protein that lights up while performing gene editing. Their study, published in Angewandte Chemie International Edition opens a new chapter in the visualization and tracking of genome engineering. Arkadeep Karmakar, a Ph.D. researcher in Dr. Basudeb Maji's lab, designed GlowCas9, a bioluminescent version of Cas9 that glows inside cells, by fusing Cas9 with a split nano-luciferase enzyme derived from deep-sea shrimp proteins.

These inactive enzyme pieces reconnect when Cas9 folds correctly, producing light. This is because when the pieces are brought to close proximity, they can reassemble to restore enzymatic activity and produce a visible signal akin to the gentle light of fireflies. This glowing activity allows scientists to monitor CRISPR operations in living cells, tissues, and even plant leaves—without harming them.

They have found that GlowCas9 is very stable and maintains its structure and activity at higher temperatures compared to the conventional enzyme. Such sturdiness is important for gene therapy, where stable Cas9 delivery can greatly increase treatment success. GlowCas9 also increases the precision of homology-directed repair (HDR), a DNA repair process crucial for fixing hereditary mutations that are linked to genetic diseases like sickle cell anaemia, muscular dystrophy and so on.

As a symbolic demonstration of precision, the researchers programmed GlowCas9 to insert the DNA corresponding to "ACHARYA" into the genome, honoring Acharya Jagadish Chandra Bose, the legendary founder of the Bose Institute. This efficient, custom-designed DNA sequence

insertion highlights the potential of the technology for targeted gene correction and repair. GlowCas9 can also be tracked in plant systems, hinting at safe, non-transgenic applications in crop improvement.

By merging gene editing with light emission, GlowCas9 pioneers the emerging field of theratracking or visualizing molecular gene therapy in motion. This invention moves us closer to a future where scientists not only correct genes but can literally watch healing begin. Reference: Engineered Thermostable Chemically Responsive GlowCas9 System for Real-Time Therapeutic Monitoring Applications. Arkadeep Karmakar, Arpita Hota, Sadiya Tanga, Vivek Kumar, Pallabi Das, Anitha Eswari S, Mala Thapa, and Basudeb Maji*. Angewandte Chemie International Edition, 2025.

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