

# Space Technology in India

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**“You are wise, because you observe everything from a distance.”**

-Paulo Coelho; The Alchemist.

These words of the book ‘The Alchemist’ are true for space technology because it enables us to observe everything from a distance. This is a modern technique of humanity. In this regard, Space Technology refers to the application of engineering principles to the design, development, manufacturing, and operation of space travel and exploration technologies and systems. Space Technology offers new means to address global challenges and encompasses satellites, space stations, ground stations, monitoring and tracking centres, downstream analytics AI, software, etc. It plays a vital role in the modern world by enabling telecommunications, navigation systems, weather forecasting, climate monitoring, and national security. India has emerged as a major space power, with the Indian Space Research Organisation (ISRO) successfully developing reliable, low-cost indigenous space technology including satellite launch vehicles, communication and observation satellites.

The space activities in India started with the setting up of Indian National Committee for Space Research (INCOSPAR) in 1962. Initial years saw the work on atmospheric studies with the establishment of Thumba Equatorial Rocket

Launching Station (TERLS) near Thiruvananthapuram at southern end of the country. The Indian Space Research Organisation (ISRO) established in 1969, took the space programme to altogether new level in the coming years with programmes aimed at harnessing the benefits of space technology for the national and societal development.



The Indian Space programme is characterized by a **vision to use space technology for national development**. The primary objective of the space programme is to establish operational space services in a self-reliant manner in the thrust areas of satellite communication, satellite-based resource survey/management, satellite navigation, satellite meteorological applications and other emerging areas and to carry out sustained research and development in these areas. Department of Space (DOS) is the responsible for promoting the development of space science, technology, and applications towards achieving self-reliance and facilitating all-around development of the nation. DOS implements the space programmes through **Indian Space Research Organization (ISRO)** and other national laboratories.

ISRO is the national space agency, responsible for research and development as

well as execution of projects related to space science, technology and applications. ISRO is also responsible for research and development in cutting edge technologies. To address the vast areas of the mandate, different centres and units have been created by ISRO, each specializing in specific domains of space activities like launch vehicles, satellites, payloads, applications, launchpad, ground segment, etc.

Satellites are objects that orbit a bigger celestial body than itself. They might be natural or man-made. Man-made satellites are very important for space technology and remote sensing process. These are some types of man-made satellites:

1. Communication satellites - For radio, television, telephone, internet
2. Navigation satellites - To provide positioning, navigation, and timing services.
3. Earth observation satellites - For weather monitoring, land/vegetation/resource mapping, etc.
4. Space observatories/astronomy satellites
5. Military/surveillance satellites
6. Space stations - For human spaceflight activities

When we discuss about the **application of the Space technology** and satellites, they have become integral to modern-day living, enabling innovative applications and revolutionary capabilities across domains.

1. **Communication Applications:** Satellites are used extensively for communications like television, radio, internet, telephone, and weather data transmission. Communications satellites play a vital

role in linking remote areas on Earth.

2. **Navigation Applications:** Navigation systems like GPS, GLONASS, Galileo, and NavIC provide location and timing information globally and regionally through satellite signals.
  3. **Earth observation:** Earth imaging satellites are used for weather forecasting, climate monitoring, land use mapping, disaster management, etc. They provide geospatial data about Earth's features like land, oceans, and atmosphere.
  4. **Space science:** Hubble Space telescopes provide stunning images and data about distant stars, galaxies, and cosmic phenomena. Spacecraft explore planets and moons. The International Space Station is used for microgravity experiments.
  5. **National security:** Spy satellites and associated systems are used for intelligence gathering and reconnaissance. Satellite early warning systems can detect missile launches.
  6. **Commercial purposes:** Satellites provide direct-to-home television, business communications, and support industries like agriculture, mining, and offshore. The space sector is also seeing private companies focus on space mining and space tourism.
  7. **Technology advancement:** Space tech innovations in robotics, computing, materials, etc. lead to spinoff benefits on Earth in fields like health, transportation, public safety, etc.
- The space sector has been opened up for **private participation** subsequent to the space

reforms announced by the Government of India in 2020. Indian National Space Promotion and Authorization Centre (IN-SPACe) is the independent nodal agency under DOS to permit and oversee the activities of private entities in the country. Some of the progresses are the following-

1. **Indian Space Policy 2023:** It aims to boost India's space capabilities, enable commercial space presence, use space to drive technology development, pursue international collaboration, and create an ecosystem for implementing space applications.
2. **Indian National Space Promotion and Authorization Centre (IN-SPACe):** It serves as a single window clearance and authorization agency for space launches, establishing launch pads, buying and selling satellites, and disseminating high-resolution data among other things.
3. **Indian Space Association (ISpA):** It is a premier industry association representing Indian space and satellite manufacturing companies, advocating policy reforms, fostering collaboration, and supporting private sector engagement in the space sector
4. **100 % FDI permitted:** The Indian government allows up to 100 percent foreign direct investment (FDI) under the automatic route for manufacturing components, systems, and subsystems for satellites, ground segments, and user segments.

Almost everything has its pros and cons and space technology is not the exception. The rapid advancement of space technology in recent decades promises immense benefits but also

raises complex ethical, environmental, and security challenges that warrant careful consideration. Some major concerns are as following-

1. **Weaponization of space:** The development of anti-satellite (ASAT) weapons and space-based military assets could lead to militarisation and conflict. Intelligence and surveillance satellites are being increasingly used for military purposes. Strategic build-up of offensive space capabilities driven by security concerns is increasing now.
2. **Inequitable access:** Space technology and capabilities are concentrated among a few dominant space powers. Issues of equitable access to space services, resources, and orbits, especially for developing nations. There is a need for inclusive development of space for the benefit of all humanity.
3. **Space Debris:** Growing hazardous space debris in Earth orbit due to discarded rocket parts, defunct satellites, etc. Increased collisions pose a risk to operational satellites and manned missions. Coordinated efforts for debris remediation and prevention is required on global level.
4. **Technology proliferation:** Sensitive dual-use space tech like rocketry and satellites spreading unchecked. Possibility of weapons development and covert military programs under civilian cover. There is urgent need for export controls and checks on proliferation in this modern competitive world.

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