



A New Horizon: India's Space Science Achievements Since 1947

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Abstract: Since Independence in 1947, India has made commendable progress in research and technology in space science. Be it the formation of the Indian Space Research Organisation (ISRO) or going forth on better interplanetary missions, India has emerged to be one of the toughest contenders in the race of space exploration. This paper aims at the advancing India's space program and layout its salient features regarding the chronological achievements, space technologies employed and the social and economic development achieved through these endeavours. It particularly explains how the program of space development has raised Indian science levels and contributed to outer space activities of other states and served for the development of India.

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1. Introduction

The development of space science in India is an epic of resilience, innovation, and vision. Free from the shackles of British rule in 1947, the march to tap technology in space for the development and self-reliance of the country began. The Indian space program, under the aegis of the Indian Space Research Organisation or ISRO, soon gained recognition as one of the most respected space agencies in the world, and it has done several notable achievements that contribute significantly to scientific research, technologies arising out of the development, and international cooperation.

2. Early Foundations of Space Science in India (1947-1969)

Establishment of INCOSPAR and Early Space Research

It was in this year, 1962, that INCOSPAR was set up under the chairmanship of Dr. Vikram Sarabhai, sometimes known as the father of the Indian space program, and that meant the beginning of an Indian space odyssey. The INCOSPAR's main motto was to advance the frontiers of space research and applications of space technology for peaceful purposes. The committee established the Thumba Equatorial Rocket Launching Station-TERLS, near Thiruvananthapuram, Kerala, which was to be the take-off point for India to join the space arena.

Transition to ISRO

In 1969, INCOSPAR was transformed into the Indian Space Research Organisation (ISRO), signifying a more focused and organized approach to space research. With a clear vision to utilize space technology for national development, ISRO began working on satellite and launch vehicle technologies, setting the stage for future advancements.

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** Received: 29-August-2024 || Revised: 30-August-2024 || Accepted: 30-August-2024 || Published Online: 30-August-2024.

The Development of Satellite Technology (1970-1980)

Aryabhata: India's First Satellite

Major success in the various fields of space technology was achieved by India when this country successfully launched its first satellite, Aryabhata, into space on April 19, 1975. The name given to this first satellite was after an ancient Indian mathematician and astronomer. It was developed for conducting experiments in X-ray astronomy, solar physics, and aeronomy. Though some technical difficulties were encountered within a few days after the satellite reached orbit, it marked the turning point in the capability of India for designing and building satellites.

Establishment of INCOSPAR and Early Space Research

After Aryabhata, ISRO launched two successive satellites, the Bhaskara series, in 1979 and 1981, respectively, devoted to Earth resources management. In fact, these satellites supplied data for agriculture, forestry, hydrology, and other such disciplines that proved how space technology can be gainfully exploited for socio-economic development in the country. After these two, subsequent successful missions helped ISRO establish its credentials related to satellite technology.

3. Establishing Launch Vehicle Capabilities (1980-2000)

Development of the Satellite Launch Vehicle (SLV) and Augmented Satellite Launch Vehicle (ASLV)

Thus, the indigenous development of launch vehicle technology heralded a new era for the Indian space program in the 1980s. The Satellite Launch Vehicle, designed to put small payloads in low Earth orbit, launched the Rohini RS-1 satellite into orbit on July 16, 1980. This marked India's entry into the select league of nations with capabilities in the production and design of their own launch vehicles. Success was followed by the Augmented Satellite Launch Vehicle, ASLV, developed by ISRO, which could carry more payload mass and launch it with increased reliability. After initial failures, the ASLV program was able to place satellites into orbit, further improving India's capabilities in space launch technology.

Polar Satellite Launch Vehicle (PSLV) and Geosynchronous Satellite Launch Vehicle (GSLV)

Further into the 1990s, more developed launch vehicles were being developed, and by 1993, the Polar Satellite Launch Vehicle was operational. The capable and reliable PSLV quickly became the workhorse of ISRO, launching numerous satellites for both domestic and international clients. With GSLV, heavier payloads up to geostationary orbit could be launched and thus represented another major leap by India in developing launch capabilities and expanding its reach into space activities.

4. Milestones in Space Exploration (2000-2020)

Chandrayaan-I: India's First Mission to the Moon

In the year 2008, India conducted its first mission to the Moon, which was known as Chandrayaan-I. It would involve the high-resolution remote sensing of the lunar surface with particular emphasis on the chemical and mineralogical mapping of the Moon. There was one major scientific discovery associated with Chandrayaan-I: the confirmation of water molecules that were assumed to be present on the surface of the Moon—a finding with great implication for future research and utilization of the Moon.

Mars Orbiter Mission (MOM): A Leap into Interplanetary Space

The Mars Orbiter Mission of India, generally referred to as Mangalyaan, was launched on November 5, 2013. It thereby became the first interplanetary mission of India. It is designed to study the topography, morphology, composition, and atmosphere of Mars. MOM successfully entered Mars orbit on September 24, 2014, and for India, it was a feather in its cap, becoming the first to achieve this feat on its maiden attempt and at much lesser cost as compared with similar missions launched by other space agencies. Success of MOM reflected an increasing proficiency on the part of ISRO in handling difficult space missions and built India's credit as a major player in space explorations.

Chandrayaan-2 and Gaganyaan: Towards Human Spaceflight

Its successor mission, Chandrayaan-2, was launched by India in 2019 to continue the exploration of the lunar South Pole. Although the lander Vikram did not touch down softly, as intended, vital data is still coming from the orbiter. These giant strides have been followed by ISRO with their current projects, such as the Gaganyaan program, which targets the first manned space voyage of India, scheduled to take Indian astronauts into outer space before the turn of this decade. Gaganyaan will thus be a realization of the Indian dream in taking a major stride toward achieving a sustained human space exploration program.

5. Advancing Satellite Capabilities and International Collaboration (2020-Present)

Expansion of Satellite Programs

In the last few years, India's satellite capabilities have increased manifold in navigation with NavIC, earth observation, and communication. These satellites provide essential services related to disaster management, agriculture, urban planning, and environmental monitoring through ISRO, helping in not only vital services of national development but also improving the quality of life for millions of people.

International Collaborations and Future Missions

International collaboration has emerged as a feature of the Indian space program, with ISRO cooperating with NASA, ESA, JAXA, and other space agencies in joint missions, research efforts, and sharing of technology. Future missions, such as the Aditya-L1 mission to study the Sun, and cooperation concerning lunar research, mark further commitments of India toward global space research and international cooperation.

6. Conclusion

The Indian Space Research Organisation, in fact, grew from these humble beginnings to become a powerhouse in the area today, with innumerable achievements to its credit in satellite technology, launch vehicles, and interplanetary exploration. Moreover, ISRO's feats are not only significant in enhancing scientific capability but also are an example of the power of space technologies to drive socio-economic development. While India plans far-reaching projects in space, including manned flights and deeper space exploration, the country's space program is being thrust to the fore, perhaps to play the most significant role in shaping up the future scheme of global space research. After the independence of the country, regarding developments and achievements in space science, what India has done stands proof of this vision, perseverance, and ingenuity of its scientists and engineers. As the country goes on with the agenda of exploring new avenues in space, there is complete commitment to work on this technology toward the benefit of humanity at large, translating into global knowledge and progress.

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8. Conflict of Interest

The author declares no competing conflict of interest.

9. Funding

No funding was received to support this study.