India's Space Security: Challenges and Issues for Legal Structure

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Abstract

Space is fast becoming the new frontier for both national security and space-related scientific research. Space-based assets are critical to the defence of a nation, as well as to global communication, navigation and surveillance. As India's space program rapidly expands and the country's strategic interests develop, it is encountering increasing challenges in protecting its space technologies. The legislative and regulatory frameworks governing space security remain inadequate, even though organisations such as ISRO and DRDO have enhanced India's space capabilities through technological developments. India has been a significant worldwide force in the evolving 21st-century world order throughout the past ten years. India, with its steady economic and technological growth, especially in information and communication technology (ICT) and other high-end strategic technologies, has emerged as a major player in the global arena of technology. This development further strengthens India's argument for becoming one of the world's leading powers soon. Technology has been a major driver of India's growth. But the real challenge now is to sustain this success and meet key national goals in a world of rising security threats and international relations characterised by both cooperation and competition. This paper will examine these security issues and challenges from a technological point of view.

Keywords

National security, Technological challenges, Strategic competition, ISRO, DRDO, Information and Communication technology.

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Introduction

India has achieved great progress in space science and technology and has emerged as a key player in international space exploration and strategic capability. But this development does not take place in a vacuum. India is facing serious sociopolitical and economic challenges that impact directly or indirectly its economic growth and national security. Political unrest, regional conflicts, economic inequality and social inequity are some of the issues that can impede the successful implementation of space programmes and the strategic advantages such technology can offer. These interlinked issues must be addressed if scientific progress in space is to make a real contribution to national development and security. This paper examines and explores challenges and issues of legal systems in the past, present and future. With the development of technology in the twenty-first century, India is confronted with international concerns for its national security, including the use of modern weapons to fight terrorism and the rise of militarism in its border regions. This statement reflects how India has focused on and faced challenges over the past decades to the present.

The author says that while the chances of a major war have diminished in many developed countries, border tensions in Asia, particularly between China, India and Pakistan, remain a major concern. Additionally, there is now a greater chance that nuclear weapons will be employed in such circumstances. India has additional difficulties as a result of China and Pakistan's strategic alliance, especially in the form of low-level disputes and an increase in terrorist activity, many of which are connected to Pakistan. Other security issues that India is dealing with include increased militancy in the northeastern regions and tensions with Bangladesh as a result of illegal migration. To safeguard its national security in this complicated context, India must maintain both a strong balance of power with China and a technological and military advantage over its smaller neighbours (Mallik, 2008).

However, India's defence and strategic planners face unique difficulties as a result of its nuclear policy, which is founded on the ideas of Credible Minimum Deterrence (CMD) and No First Use (NFU). To keep ahead of its competitors and maintain national security, India's deterrent must rely more on technological and military might because it supports international nuclear disarmament and opposes the development of sizable nuclear weapons stockpiles (Mallik, 2008). In a similar vein, it's critical to acknowledge that visionary scientists, especially Homi J. Bhabha and Vikram Sarabhai, provided strong direction for India's space program during the post-independence era. Sarabhai, who helped shape India's space vision, and Bhabha, the father of the country's nuclear program, both strongly believed in the power of science and technology to drive modernisation and national development.

For Sarabhai in particular, space technology was a tool to help India, a developing country, achieve quicker social and economic advancement rather than only being a matter of defence or prestige. Prime Minister Jawaharlal Nehru's belief that scientific progress was crucial to creating a powerful, contemporary, post-colonial India was also in line with this vision (Rajagopalan, 2024).

India's space exploration developed in the 1960s, there was an increasing need for a specialised body to advance the nation's space program into the next stage, emphasising self-reliance, a goal that Vikram Sarabhai vigorously championed. His role was to develop space technology, and the Indian Space Research Organisation (ISRO) was formed in 1969 to do this. The Satellite Instructional Television Experiment (SITE) was conducted in collaboration with NASA from 1975 to 1976 with the aim of transmitting educational television programs to rural areas. The Satellite Telecommunication Experimental Project (STEP), which tested and developed satellite-based communication systems utilising the Franco-German Symphonie satellite between 1977 and 1979, was another significant project (Rajagopalan, 2024).

Another author said ISRO was established as the main organisation for space exploration and research in India under the Indian Space Research Organisation Act, 1969. The goals of ISRO are stated in specific terms in this Act, the promotion of the use of space technology and science for the benefit of national development. It also gives ISRO the authority to conduct research, development, and other critical activities relating to space technology (Kumar, 2023).

India wants a comprehensive space security framework to secure its national interests in an increasingly competitive global context. Space has emerged as a major theatre of strategic and economic competition, and India faces many constraints that prevent it from fully protecting and promoting its space interests. These challenges include government restrictions, technology deficiencies, and financial constraints. These issues are intimately tied to the nation's broader ambitions for economic expansion and international clout. These are important issues, and the literature that follows discusses how India can solve these issues to enhance its position in space and safety on the global stage.

India's strategic space capabilities

India has become a space power in the last 20 years, incrementally developing critical strategic space capabilities. India uses space assets for surveillance, safe communication, disaster management and accurate targeting with the help of advanced satellite systems like RISAT (Radar Imaging Satellites), GSAT (communication satellites) or NAVIC (regional navigation). The 2019, marked a major milestone in its military space capability by completing the successful anti-

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satellite (ASAT) test under Mission Shakti, proving India's ability to protect its space objectives throughout hostilities. But India too has many serious problems to face. These are poor budgets compared to superpowers such as the US and China, the absence of any cohesive space security policy and space military. The increasing weaponisation of space, cyber-attacks on satellite networks, and the threat of space debris pose serious security and operational problems. India also has an underdeveloped legislative and regulatory system, especially with regard to the role of private companies and integration of the military space. These are issues that need to be resolved if India's future goals in space are to be safeguarded and advanced.

Chandrayaan-3 launch, source: OpIndia, 24 August, 2023. Govt releases a report card of India's space program over the last nine years

"India's Stellar Decade in Space: Launching an impressive 389 out of 424 foreign satellites in 9 years. A testament to our prowess in space innovation"

MyGov India, August 23, 2023.

India has entered a new phase of space exploration and technological growth with the incredible achievement of Chandrayaan-3. The mission enhanced the nation's standing in space exploration worldwide and demonstrated its expanding scientific capacities. The Indian government is concentrating on growing its space and defence security sectors in the wake of this accomplishment. Through ISRO and IN-SPACE, investments are being made to advance satellite technology, create domestic launch vehicles, and encourage business involvement in space missions.

The government is using space technology in the defence sector for disaster management, surveillance, and national security. Advanced satellite communication and navigation systems are being developed to support the armed forces. Initiatives such as Prime Minister Modi's "Make in India" and "Aatmanirbhar Bharat" are boosting the indigenous production of defence equipment and reducing dependency on imports.

After the success of Chandrayaan-3, the Prime Minister has welcomed the country for its development and growth towards space and security for the Nation.

Source: Aug 24, 2023, 12:30 am IST, New Delhi. Prime Minister Narendra Modi addresses the nation via video conferencing on Wednesday. (AFP)

"The Chandrayaan-3 Mission's successful landing on the moon is a clarion call for developed India, a sign that the country's space mission will continue to break new ground"

The Indian Prime Minister, Narendra Modi, has welcomed the people of India had encourage towards the achievement of Chandrayaan-3. He also encouraged the people of India that, saying:

"From today, the myths associated with the Moon will change… In India, we call the earth "ma"(mother) and the moon "mama" (uncle). It was once said "chanda mama bahut door ke hai" (the Moon is very distant). Now, one day will come when children will say chanda mama bas ek tour ke hai (the Moon is just a tour away),"

The Indian Space Research Organisation (ISRO) was established in August 1969 and is responsible for India's civilian space exploration programme. In 1975, the nation launched its first satellite, Aryabhata, marking a significant advancement in space exploration. Since then, India has made remarkable progress and currently operates **57 satellites** across various domains, including communication, navigation, and earth observation. In **2019,** India conducted **7 successful space launches,** representing about **6% of all global launches** that year. This placed India fourth globally, behind **China (38 launches),** the **United States (29),** and **Russia (19),** and equal with the number of launches by **Europe.** ISRO mainly works on **robotic space missions**, especially to the **Moon and Mars.** India's earliest lunar mission, Chandrayaan-1, launched in 2008, helped confirm the presence of water and ice on the lunar surface. In contrast to NASA's Mars project, which cost $651 million that

same year, India's Mars Orbiter project (Mangalyaan) was launched into orbit around Mars in 2014 for a mere $74 million. So, India succeeded in becoming the first country in Asia and globally to have a successful Mars mission on the first attempt.

India's space program's prestige was greatly enhanced when it successfully entered Mars orbit on its maiden try. Despite a setback in 2019 due to the failure of its lunar lander, the Chandrayaan-2 mission was partially successful in August 2019 when the orbiter successfully entered lunar orbit. In 2018, Prime Minister Narendra Modi announced plans to launch an Indian astronaut into low-Earth orbit by 2022 as part of the Gaganyaan mission, demonstrating India's increasing ambition in space exploration. Four Indian astronauts started a year-long training program at Russia's Yuri Gagarin Cosmonaut Training Centre as part of this initiative **(Goswami, 2020).**

Basically, India started making significant investments in developing systems for scientific and technological research after obtaining independence from British domination in 1947. Defence technology research and development were also a part of this endeavour. In 1958, the Defence Research and Development Organisation (DRDO) was established. India's national security issues from the country's founding led to the development of focused defence research. Many of these issues originated from unresolved border disputes at the time of independence. India has steadily advanced its military space technologies during the last 20 years. After the Kargil conflict of 1999, India decided to indigenise its spy satellites. The Technology Experiment Satellite (TES), which ISRO launched in 2001, was supposedly intended for civilian usage but also had security advantages. Later, ISRO launched two defence-related communication satellites: GSAT-7A for the Air Force in 2018 and Rukmini (GSAT-7) for the Navy in 2013. There are plans to build more of these satellites. Additionally, ISRO developed the Cartosat family of remote-sensing satellites with a 2.5 m resolution, primarily for military use, beginning in 2005. The resolution increased to 30 cm by 2019. Thanks to synthetic aperture radar (SAR) technology, India also has RISAT radar satellites that function in all weather conditions and at any time of day. Sindhu Netra, a tiny satellite for DRDO, was launched by ISRO in 2021 to monitor regions ranging from Africa to the South China Sea (Lele, 2023).

India has been strengthening its strategic space capabilities through successful missions like **Chandrayaan-2** and **Shukrayaan (Venus's mission).** However, the country still faces several challenges in establishing a strong position as a global space power. The government should frame effective policies to overcome these challenges and promote growth in the space sector. The above discussion

highlights India's space capabilities. The following section focuses on important literature related to India's space missions and the challenges the country faces in ensuring space security.

Legal and policy frameworks: India's existing structure

This article explores the fundamental obstacles India confronts in preserving space security as well as the legal and policy frameworks currently in place for space-related activity. The existing space governance structure in India, its legal and policy framework, and the main issues influencing national space security are all discussed in this article. According to the author, India's space law and policy can be divided into three categories. Policy analysis suggests that the development associated with the Indian space programme can be divided into three broad phases. The Satellite Instructional Television Experiment (SITE), the Satellite Telecommunications Experimental Project (STEP) and the utilisation of Landsat data from satellites for managing natural resources are instances of evidence-based demonstrations of the use of the vantage point of space to fulfil the nation's developmental requirements.

India had launched the "grand plan" for an autonomous comprehensive space development capability by the early 1970s and was operating on its initial satellite, "Aryabhata." The second phase is the phase of experimentation, where a comprehensive experience in the conception of space systems has been created. The period is characterised by early space launchers such as SLV-3 and ASLV, advanced earth-observing satellites such as Bhaskara I as well as Bhaskara II and India's first advanced orbiting satellite, APPLE. It made it easier to develop fundamental competencies. As a consequence, by the end of the 1970s and beginning of the 1980s, India had spent heavily on the development of labs and facilities and had launched a multifaceted program: Indian launch equipment via the Polar and geosynchronous launchers, Indian satellites for communication to INSAT, and Indian EO satellites used in IRS. In order to achieve self-reliance goals, the third operational phase involved understanding and analysing the intricate interplay of alternative approaches to arrive at the most optimal solutions and choosing to exercise buy or build options in parallel with the indigenous development plan (Nagai, 2015).

Similarly, Vikram Sarabhai is known as the father of the Indian space program. He established the basis and outlined the primary objectives of the current ISRO. Even now, India's space operations are still guided by his concept of exploiting space technology for national development. Sarabhai was adamantly opposed to creating a space program solely for notoriety or recognition on a global scale. Rather, he thought space science should be useful, particularly in fields like satellite

communication and weather forecasting (space meteorology). Before requesting financing from the government, he wanted to demonstrate how space technology could help the nation. Sarabhai had a significant impact because he came from a well-respected and affluent family and was a well-known scientist and institution builder. He was able to obtain the finances and backing required to start India's space research organisation thanks to his personal friendship with Prime Minister Indira Gandhi. Sarabhai was able to oversee India's nuclear and space programs concurrently after Homi Bhabha passed away in 1966, and he was appointed chairman of both ISRO and the Atomic Energy Commission (Baskaran, 2005).

The legislative and policy framework of India's space program was described in the preceding section. The research methodology employed in this study will be explained in the following section.

Research methodology

This study's technique is essentially qualitative and analytical. It is predicated on a thorough analysis of secondary data sources, such as official ISRO and DRDO reports, government documents, national space policies, international treaties, research papers, and academic articles. In order to examine India's legal and policy framework in light of international space governance systems, the study also takes a comparative perspective. The approach helps in identifying the key challenges and gaps in India's existing law and space security architecture. The method used in this article is qualitative research, based on the data from books, reports and official sites. The study reviews the space laws and policies of India and compares them with the space laws and policies of other countries in order to comprehend the key challenges and issues related to space security.

Challenges for India's space security

India's space security faces multiple new difficulties as space gets more congested and competitive. One of the major concerns is the militarisation and weaponisation of space as other nations develop powerful surveillance networks as well as anti-satellite (ASAT) weapons. In addition to this, India also has to safeguard its increasing satellite fleet from electronic disturbances, space debris, and possibly cyber-attacks. An additional obstacle is the lack of a comprehensive national space protection plan and a revised legal system to accommodate new threats. In addition, some strategic structures might be at risk if they are dependent on foreign technology. India's long-term security should be based on developing international collaboration on the safe and secure use of space, strong satellite networks and building space situational awareness (SSA). India is mostly a land-based nation geographically. There are two elements of the strategic environment: external and internal. Particular

instances of the outside component are political unrest in neighbouring countries and the presence of other states with nuclear weapons. While several of India's neighbours, including Afghanistan, Maldives, Nepal, Pakistan, and Sri Lanka, face political unpredictability or crises, India enjoys a stable democratic government.

Additionally, China and Pakistan, two nations with nuclear weapons, border India. Iran and other nations in the wider region are quickly acquiring nuclear weapons. Additionally, India's security faces strategic concerns due to foreign nuclear submarines operating in the Indian Ocean. Therefore, nuclear weapons constitute a significant component of India's strategic worries, coupled with political instability. Maintaining peace and order within a nation by upholding the law and guarding against internal dangers is known as internal security. These dangers might range from little difficulties like civic unrest to major ones like widespread violence, armed uprisings, or inadequate cybersecurity (Kalid, 2021).

India's space security is impacted by a number of circumstances that have made it difficult for the nation to become recognised as a major space power on a global scale. To boost national security and sustain its strategic position, the government needs to adopt a clear policy agenda centred on improving space security. This entails boosting funding for the space industry, improving technological capabilities, and creating a robust legal and regulatory framework to close current gaps. Strengthening India's legal structure for space operations will help the country to realise its objective of establishing itself as a leading space power and to safeguard its national interests.

Suggestions for Strengthening India's Legal and Policy Framework

A put together is a set of essential steps to enhance India's space rules and regulations framework. To begin with, India needs to draft a detailed national space legislation that defines the duties, liabilities and responsibilities of public as well as private actors engaged in space activity. Also, regarding new issues related to space weaponisation, cyber-attacks and the issue of orbital debris, which are of growing concern, a focused space security policy is required. Furthermore, there is a need for a separate regulatory body that will be responsible for monitoring business space operations, issuing licenses and providing information on compliance with international standards. In addition, the issue is a review of existing policies, including the Satellite Communication Policy as well as the Remote Sensing Data Policy, to bring them in consonance with present-day global developments. India should be a part of some bilateral and multilateral treaties that promote the safe and sustainable utilisation of space and should participate actively in international space governance discussions.

Conclusion

Based on what we have discussed above, in terms of accountable oversight of space operations, India should put into effect national space regulations and an effective space-related security policy. It must build its own technology, find financing, and collaborate with private industry. Moreover, India needs to set up a dedicated space security body, work with foreign partners and shield its satellites from cyberattacks. By doing these things, India is going to be able to ensure space safety and emerge as a leading global space power. The key findings indicate that India's space security is challenged by the lack of comprehensive national space legislation, the emergence of space threats such as debris and hacking, and poor coordination between civilian and defence space organisations. India will have to enhance international collaboration, build technical independence and establish a robust legal and policy framework to deal with these challenges. The country also needs to increase space situational awareness and invest in innovation, research, and private sector engagement to ensure long-term security and leadership in the world's space community.

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