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The transformation of India's space policy: From space for development to the pursuit of security and prestige

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A B S T R A C T

This article explores the transformation of India's space policy from a focus on space for development to the pursuit of security and prestige. India's early space programme was largely defined by a developmental rationale, aimed at addressing socio-economic challenges through space technology and applications. However, in recent years, India's space policy has undergone a significant change, as the country tries to leverage its space capabilities for strategic objectives, including enhancing its national security, achieving greater status in the global space order, and projecting its great power aspirations. This article offers a comprehensive overview of India's space programme by highlighting the country's high-profile exploration projects, the involvement of the private sector, and the use of space technology as a foreign policy tool and a source of soft power. It also analyses changing perceptions of the country's strategic environment and evolving geopolitical dynamics that have resulted in a reorientation towards the military uses of space. It also assesses the implications of this transformation for India's space programme, its relations with other space actors, and the global governance of outer space.

1. Introduction

India's space policy has undergone a remarkable transformation in recent years. One of the most noteworthy characteristics of India's space programme from its inception has been its focus on the use of space technology for socio-economic development. However, in the last decade or so, India's space policy has shifted towards a greater emphasis on national security and international prestige. As far as civilian activities are concerned, this shift is marked by a growing interest in space exploration and scientific missions and the use of space technology as a foreign policy tool. At the same time, another important aspect is the increasing involvement of the private industry in the Indian space sector. In the field of military space activity, this shift is reflected in new capabilities, including the development of dual-use and dedicated military satellites and anti-satellite capabilities, and the establishment of a tri-service Defence Space Agency. By exploring the historical context, political motivations, and technological developments driving this transformation in India's space policy, this article seeks to provide a comprehensive understanding of the evolution of India's space policy and its future trajectory.

Although the article is empirically orientated, it is informed by realist insights especially in the context of discussing India's increased sense of insecurity stemming from China's growing military power, which also involves an emphasis on military space capabilities, hence the inclusion of India's pursuit of security in the subtitle of the article. However, our mostly realist reading of this transformation in India's space policy is nuanced by our recognition that other approaches are also useful in a complementary manner. In this context, for example, we also agree with constructivists that national interests are mediated by identity and norms. Seen from this angle, exploration projects epitomise India's pursuit of great power status and prestige rooted in the country's unique history and colonial experience.[1]

Consequently, our article is organised in the following way. The first section offers a historical overview of India's space programme from its inception, highlighting the ways in which the predominant focus has been on the use of space for development, modernisation, and technological independence. The second section then examines India's recent shift towards improving and expanding civil space activities. Apart from discussing India's space exploration projects, such as its lunar and Mars missions, as well as plans for a human spaceflight programme, this section also considers the role of the private sector and the use of space technology as a source of soft power and foreign policy. Next, the fourth

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[1] For a discussion of realism, constructivism, and outer space from an International Relations theory perspective, see Stroikos [1]. Although far from being the only drivers, India's quest for great power status and prestige can also be reflected in the development and testing of certain space weapons, such as anti-satellite (ASAT) weapons [2].

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section deals with the security and strategic aspects of India's space programme. A key issue here is New Delhi's changing approach to space that encompasses an increasing interest in the military uses of space. In doing so, this section discusses the contributing factors to this reorientation towards national security, with a specific focus on the China factor and the impact of US-China competition. Furthermore, this section considers how this change has been accompanied by the introduction of new institutions.

2. Historical overview: space for development

An important feature of India's space programme was that its establishment was driven by the Indian scientific community. It was the active participation of prominent Indian scientists involved in upper atmospheric studies, such as Vikram Sarabhai, who is considered the 'father' of India's space programme, in the International Geophysical Year (IGY) of 1957–58, which propelled space research in India.[2] As Kochhar observes, 'the IGY experience paved the way for the Indian space programme under Sarabhai' [4] (p. 815). Consequently, not only did India's participation in the IGY helped elevate the status of Indian scientists within India and abroad, but it also raised awareness among policy makers of the importance of science and technology [5].

Another notable aspect of India's space programme has been the focus on using space for civilian purposes tailored to the developmental and socioeconomic needs of the country. This is, of course, not to say that national security and prestige considerations were absent from the development and deployment of space technologies by India, especially if we remember that most of civilian space technologies can also be applied to serve military purposes because of the inherent dual-use nature of space technology [6]. After all, India's missile programme benefited from the development of space launch vehicle technology, at least as far as the Agni missile is concerned [7,8]. Rather, the point to emphasise here is that in sharp contrast to the overt military applications of other national space programmes, the Indian space programme gave priority to a number of civilian space-based applications and projects for societal and developmental benefits, such as communications, meteorology, and remote sensing [9–11] (pp. 1–2), [12] (pp. 142–3). As a result, there was reluctance to integrate the civilian and military programmes, although there is less resistance to this possibility in recent years as discussed later [5].

What merits emphasis in this regard is that the evolution of India's space programme cannot be understood without acknowledging the influence of the leadership of top Indian scientists in post-independent India, such as Hommi J. Bhabha, who is usually considered the "father" of India's nuclear programme, and Sarabhai. Significantly, both Bhabha and Sarabhai shared a particular vision of the place of science and technology as a driving force for achieving modernisation and development in India [13]. For Sarabhai, in particular, India as a developing country should prioritise the use of space technology for socioeconomic benefits to 'leapfrog' into modernity [14]. This also dovetailed with prime minister Nehru's belief that scientific and technological advancement was crucial for the construction of postcolonial India [13].

In addition to being charismatic individuals, Bhabha and Sarabhai were successful in establishing a network of institutions to support their activities coupled with the patronage of political and scientific elites, not least because of the 'national significance' and symbolism associated with nuclear and space projects [15] (pp. 29–30). In this way, like the nuclear programme, India's space programme represented a powerful symbol of India's postcolonial modernity, statehood, and national prestige [16].

It was in this context that India made its first steps in the use of space technology after IGY. More concretely, as a consequence of the efforts of Bhabha and Sarabhai, the Indian government identified space research and the peaceful uses of space as a key issue that was placed under the Department of the Atomic Energy (DAE). In February 1962, DAE formed the Indian National Committee for Space Research (INCOSPAR), under the chairmanship of Sarabhai, to facilitate international cooperation in space. This led to the establishment of the Thumba Equatorial Rocket Launching Station (TERLS) in 1963 used for the launch of sounding rockets. In the same year, India launched the first Nike-Apache sounding rocket, which was supplied by NASA [5,17]. India's international cooperation in sounding rockets at TERLS would gradually lead to the development of India's indigenous *Rohini* sounding rockets, which in turn would lay the foundations for the development of India's first launch vehicle [18] (pp. 30–44).

With the expansion of space research and development throughout the 1960s, the establishment of an organisation intended to facilitate the next phase of an indigenous full-fledged space programme on the basis of self-reliance envisioned by Sarabhai was deemed appropriate. To this end, the Indian Space Research Organisation (ISRO) was created in 1969 under his chairmanship. An important aspect of this period was a series of experimental projects through international cooperation that contributed to the accumulation of much needed expertise in space technology orientated towards socioeconomic benefits. This was manifested in the Satellite Instructional Television Experiment (SITE) that was conducted in 1975–1976 under a collaborative agreement with NASA aimed at broadcasting educational television programmes to rural areas. Likewise, India carried out the Satellite Telecommunication Experimental Project (STEP) during 1977–1979 using the Franco-German Symphonie satellite [5].

Apart from such experimental projects, India embarked on an effort to build indigenous launch capabilities that culminated in the successful launch of the Satellite Launch Vehicle (SLV)-3 in 1980, which was followed by the development of more advanced launch vehicles, such as the Augmented Satellite Launch Vehicles (ASLV), the Polar Satellite Launch Vehicle (PSLV), and the Geosynchronous Satellite Launch Vehicle (GSLV).[3] After the launch of India's first indigenously developed satellite, *Aryabhata*, in 1975, progress was also made in space applications, typified by the Indian National Satellite (INSAT) system, which began being deployed in the early 1980s. As per remote sensing, the successful launch of the two experimental *Bhaskara* satellites paved the way towards the development of the Indian Remote Sensing (IRS) satellite programme, which became operational in 1988.[4] Since then, the INSAT and IRS satellite systems have provided various critical space-based applications, such as communications, broadcasting, tele-education and telemedicine, disaster monitoring, meteorological observation and forecasting, and management of natural and earth resources [5,11]. The development of these more advanced and mission-specific systems since the mid-1980s signified a shift from the experimental to the operational phase of the Indian space programme [8].

3. Enhancing and expanding civil space activities

3.1. Space exploration

A striking aspect of India's space programme in recent years has been the diversification of its space activities [20]. To be sure, India continues to prioritise the development of more advanced space-based applications, such as communications and remote sensing, and satellite launch vehicles. For example, with regard to communications satellites, in

[2] IGY was a major global scientific project embodying scientific internationalism that focused on geophysical activities and led to the dawn of the Space Age with the launch of Sputnik [3].

[3] On the history and evolution of India's launch vehicles, see, Rao and Radhakrishnan [19]; Raj [18]; and Singh [17].

[4] Bhaskara-1 was launched in 1979 and Bhaskara-2 in 1981.

addition to building and operating the INSAT system, India has been developing the GSAT series of satellites. In the field of remote sensing and earth observation, along with the IRS satellite programme, India now operates a wide range of remote sensing satellite series, including Cartosat, Resourcesat, Radar Imaging Satellite (RISAT), and Oceansat. In terms of launch vehicles, India has built and operates the PLSV and the GSLV, including its heaviest model, GSLV Mk III, also referred to as the Launch Vehicle Mk III (LVM 3). It is also working on the Small Satellite Launch Vehicle (SSLV) aimed to be used for the launch of small satellites, the first successful flight of which took place in February 2023.[5] Meanwhile, progress has been made in relation to satellite-based navigation services. ISRO has established jointly with the Airport Authority of India (AAI) the GPS Aided Geo Augmented Navigation (GAGAN) system, a Satellite Based Augmentation System (SBAS), and the independent regional satellite-based navigation and positioning system, the Indian Regional Navigation Satellite System (IRNSS) or NavIC (Navigation with Indian Constellation).[6]

Arguably, however, a noteworthy feature is the expansion of India's civilian space programme that now encompasses a wide range of activities, such as space exploration and scientific missions, the involvement of the private industry, and the use of space technology as a foreign policy tool. In this way, while India's space policy is still defined by the focus on the use of space for socioeconomic benefits, there is also a discernible shift in India's space programme that is reflective of a rising great power.[7]

Not surprisingly, perhaps, India's shift in focus on space exploration missions has attracted a lot of global attention, raising the profile of ISRO and strengthening India's credentials as a rising space power. More specifically, in October 2008, ISRO successfully launched India's first lunar probe called *Chandrayaan-1* (chandrayaan means 'moon craft' in Hindi), intended to gather data about the lunar surface. Apart from carrying five payloads from India, the mission was characterised by important international participation, as the mission also carried instruments from NASA, British, German, and Swedish research institutes (through ESA), and Bulgaria [23] (pp. 22–3). The mission experienced some technical hurdles, but it was widely seen as a success. Importantly, one of NASA's instruments aboard Chandrayaan-1 helped to confirm the presence of water on the Moon's surface [24]. The mission reinforced the notion of an Asian space race due to the fact that it was launched shortly after Japan and China had launched their own lunar probes. But the reality was that the idea for an Indian's lunar mission was initially coined in 1999 and a broad consensus about the need for such a mission emerged among the Indian scientific community in the ensuing years before its endorsement by the Indian government in November 2003 [23] (p. 19). The potential scientific benefits of such a mission were important [25] (p. 227). However, it also appears that China's growing profile in space in the early 2000s spurred India's interest in space exploration [12] (p. 157). Tellingly, in January 2003, China announced its plan for a lunar mission, which was followed by its first human spaceflight mission in October 2003. As Gurbir Singh observes, India felt compelled to respond, as "it risked its space programme being perceived internationally as immature and second to that of China" [17] (p. 344).

In July 2019, India successfully launched a follow-up lunar mission, *Chandrayaan-2*. The mission was initially planned as a joint project with the Russian space agency, Roscosmos, but given important delays on the part of the Russian side, India decided to proceed with the project on its own. As part of the mission, the Vikram lander, named after Vikram Sarabhai, was separated from the Chandrayaan-2 orbiter to attempt a soft landing on the moon to deploy a rover, but eventually the lander crashed into the lunar surface due to a technical issue. However, given that the orbiter will be in operation for far longer than it was planned, the mission is described as a partial success [21] (pp. 89–92). More recently, in August 2023, with its successful Chandrayaan-3 mission, India became the fourth country in the world, after the United States, the Soviet Union and China, to carry out a soft landing on the moon.[8]

Another important milestone in space exploration was India's first Mars mission, Mars Orbiter Mission (MOM), also called *Mangalyaan* (meaning 'Mars craft' in Hindi), which was launched in November 2013 and was put into orbit around Mars in September 2014. Not only did this make India the first country to reach Mars in its first attempt as well as the first Asian country to do so, but it was relatively a low-cost mission, leading Indian Prime Minister Narendra Modi to famously note that it was cheaper than making the movie Gravity [26]. However, MOM was executed in the brief span of six months and carried aboard only five scientific payloads. As a result, the scientific value of the mission was limited, and it makes more sense to consider it as a technology demonstration [21] (p. 92). Interestingly, the limited scientific value points to the importance of prestige considerations. It is clear that the success of Chandrayaan-1 rendered a mission to Mars more plausible as the next step for a country like India [27] (p. 72). But since then, it has been revealed that the unsuccessful Russian-Chinese Phobos-Grunt Mars mission in November 2011 provided further impetus for India to move quickly with a mission to the Red Planet ahead of China [28] (pp. 47–49). In other words, that India was the first Asian power to undertake a successful mission to Mars is not only a scientific achievement, but also a political one.

While these achievements may seem impressive enough, it is also noteworthy that ISRO has been working on India's first human spaceflight mission, *Gaganyaan* ("Gagan" means sky in Hindi, "yaan" is craft). In 2006, senior scientists met at ISRO to discuss the possibility of developing a human spaceflight programme, reaching the conclusion that the time was ripe for such a mission. Consequently, ISRO geared towards acquiring essential capabilities associated with a human spaceflight programme. For example, in 2007, ISRO successfully launched and recovered an Indian experimental spacecraft, the Space Capsule Recovery Experiment (SRE-1). Politically, the eleventh five-year plan for 2007–12 that was made public in 2007 mentioned the objective of a human spaceflight programme, but the twelfth five-year plan for 2012–17 released in 2013 merely mentioned the development of 'the critical technology and subsystems related to Human Space flight programme', indicating that a human spaceflight mission was not one of ISRO's priorities [17] (pp. 336, 334–337).

Nevertheless, India's ambition for a human spaceflight programme was given an impetus in August 2018, when on the occasion of his Independence Day speech, Prime Minister Modi announced plans for the country's first human spaceflight mission by 2022. According to these plans, the first phase of the programme will involve two uncrewed test missions carrying onboard a robot. Meanwhile, four Indian Air Force test pilots have already been selected as candidate astronauts for the Gaganyaan mission and began training at the Gagarin Research and Test Cosmonaut Training Centre (GCTC) in Russia [21] (pp. 126–7). Despite the fact that the mission has been subject to delays as a result of the global pandemic, it now seems to be back on track. In October 2023, ISRO started a series of test-flights for the Gaganyaan mission [29].

Beyond these lunar and Mars missions, it is also worth mentioning that in September 2015, ISRO successfully launched Astrosat, the first dedicated Indian astronomy mission for observing distant astronomical objects.[9] According to then ISRO's chairman AS Kiran Kumar, Astrosat "is one of the first scientific missions which will be available to the

[5] More information on the SSLV is available at: https://www.isro.gov.in/mission_SSLV_D2.html.

[6] For a useful account of these capabilities, see Singh [17]; and Lele [21].

[7] On India's quest for great power status more generally, for example, see Basrur and Sullivan de Estrada [22].

[8] More information on Chandrayaan-3 is available at: https://www.isro.gov.in/Chandrayaan3_Details.html.

[9] More information on the Astrosat mission is available on ISRO's site: https://www.isro.gov.in/AstroSat.html.

Indian researcher community as an observation opportunity. This is a starting point for such things" [30]. Furthermore, in September 2023, India launched another scientific mission, Aditya L1, aimed at studying the Sun [31].

3.2. The role of the private sector

Although on a limited scale, the role of the private sector has been key in shaping India's changing space re-orientation.[10] Driven by a number of factors, including capacity crunch within the state space agencies, cheaper costs making access to space more affordable, and providing timely and cost-effective solutions, the private sector has emerged as an important stakeholder the world over. In fact, the industry has traditionally played a big role in western countries, but today private space players are no longer restricted to the west. The developing world, especially in the Indo-Pacific, in countries, such as China and India, recognise the enormous benefits of private sector engagement in enhancing their overall space competitiveness.

The Indian private sector is a relatively new phenomenon and a small one, too, but the Indian government is making some conscious policy decisions to increase their participation in a way that does not compromise the role of ISRO. This has led to the establishment of institutions such as the Indian National Space Promotion and Authorization Centre (IN-SPACe) and NewSpace India Limited (NSIL), which will facilitate larger participation of the private sector and enhance their positioning contributing to the Indian space growth story [36]. IN-SPACE has already begun to play an important role in strengthening the participation of the private sector. The Vikram-S became the first private sector rocket manufactured in India and was launched by ISRO. IN-SPACE worked with Skyroot Aerospace, the company that developed the rocket to make this a reality. Many in the private sector, including start-ups and small and medium-sized enterprises, have been waiting for this moment, and the expectation is that Mission Prarambh, the name given to the Vikram S launch, will open the doors for others. Many in the Indian space policy community believe that this mission has been helpful in rekindling the excitement about the Indian space programme and that the private sector can play a big role in the coming years [37]. ISRO clearly recognises the fact that there is a capacity deficit that can be addressed only by bringing in the private sector. The availability of private sector talent that can be tapped to step up India's competitiveness was not acknowledged for a long time because ISRO clearly enjoyed the exclusive role it had in catering to all of the Indian space requirements. But there is greater appreciation today of the private sector because start-ups and smaller establishments are far more nimble, effective, and cheaper in developing new and niche technologies than ISRO.

ISRO's privatisation of its launch vehicles, such as the Polar Satellite Launch Vehicle (PSLV), is another key development in the Indian space programme. Although developed by ISRO, the PSLV will be completely manufactured and operated by private industry players. The Indian Department of Space additionally plans to transfer the development of two of its rockets, the Geosynchronous Satellite Launch Vehicle (GSLV) MK III and the Small Satellite Launch Vehicle (SSLV), to its industry partners. Engaging the private sector in a range of activities including its routine launches and manufacturing rockets and satellites has a couple of important spin-off benefits. First, as a more competitive space player, ISRO can get a bigger share of the global commercial space market. Second, it would free up ISRO to focus on space exploration and other critical missions given the wide-ranging demands, including from India's security sector. It should also be noted that the Indian armed forces as well as the Ministry of Home Affairs and other security agencies are increasingly exploring space-based solutions to maintain vigilance of India's vast and porous borders.

3.3. International Cooperation

Accompanying this diversification and reorientation of India's space policy has been a growing realisation of the benefits that can accrue from the use of space technology as a source of soft power and a foreign policy tool. Undoubtedly, acquiring space capabilities has produced foreign policy spin-offs as well as opportunities for international cooperation from the outset, as we have seen. However, in recent years, under Modi, there has been an increasing focus on using space as an instrument of foreign policy and diplomacy that is more aligned with India's broader foreign policy agenda [9,38]. Within this shift, for the first time, in February 2015, the composition of the Space Commission was reconstituted with the induction of the Foreign Secretary as a member, illustrative of the significance attached to India's space programme and the potential role it can play as an instrument of foreign policy [39].

Further reflecting this dimension of India's space policy, New Delhi has stepped up civil space cooperation with space powers on a bilateral basis. Even though India-Russia space relations appear to have cooled off, the 2004 Next Steps in Strategic Partnership (NSSP) between the United States and India, which identified space as one of the key strategic areas of bilateral cooperation, paved the way for strengthening New Delhi's ties with Washington in civil space activities. One year later, the India–US Civil Space Joint Working Group was formed with the aim of identifying avenues for further cooperation, followed by a framework agreement in 2008. As a result, for example, NASA worked with ISRO on the *Chandrayaan-1* lunar mission through contributing scientific payloads, and NASA's Deep Space Network offered support for India's Mars mission. Typifying such increased interactions, NASA and ISRO are currently working on the NASA-ISRO Synthetic Aperture Radar (NISAR) satellite, a joint Earth-observing mission, while progress has also been made in commercial space cooperation.[11] Significantly, apart from the United States, India has also established closer relations with Japan and Australia, the other two members of the Quadrilateral Security Dialogue (QSD), also known as the Quad [40]. Of significant note too is India's cooperation with France, epitomised by two joint missions, the Megha-Tropiques satellite mission launched in 2011, and the Saral-AltiKa mission launched in 2013.[12] Other examples include India's civil space cooperation with the European Space Agency (ESA), the European Union (EU), Israel, Italy, Germany, and Vietnam [9].

Yet, nowhere has this new component of Indian space policy been more apparent than in Modi's proposal for the development of a communications satellite by India, which was announced in June 2014 intended to be a goodwill gesture to the member countries of the South Asian Association for Regional Cooperation (SAARC), initially called 'the SAARC satellite'. Such a project was in accordance with Modi's 'neighbourhood first' policy aimed at revitalising India's relations with its South Asian neighbours through the promotion of regional connectivity and integration. The satellite was renamed to the 'South Asia Satellite' after Pakistan decided to withdraw from the project raising security issues, but the other SAARC members – Afghanistan, Bangladesh, Bhutan, Nepal, the Maldives, and Sri Lanka – welcomed the initiative. Eventually, the South Asia Satellite (GSAT-9) was launched in May 2017 with the goal of providing various services to the region, including disaster management support, tele-medicine, tele-education, and weather forecasting [43,44].

Plainly, China's growing profile in India's neighbourhood through

[10] For useful accounts of India's efforts towards space commercialisation and privatisation, see Aliberti [9]; Prasad [32]; Prasad [33]; Rajagopalan [34]; and Murthi [35].

[11] On India's space relations with key space players, inter alia, see Aliberti [9]; and Reddy [38].

[12] For detailed accounts of India-France space cooperation, inter alia, see Blamont [41] and Lele [42].

the use of space technology as a foreign policy instrument has been a key driver behind India's decision to develop the 'South Asia Satellite', as Beijing and New Delhi are vying for influence [43–45].[13] According to Vidya Sagar Reddy, the 'South Asia satellite' offers an opportunity for India to balance China's military build-up in the region by assisting its neighbours with infrastructure projects [38] (p. 173). However, growing tensions with China have not prevented India from participating in the 'virtual constellation of remote sensing satellites' within the context of the BRICS group that involves space cooperation between the space agencies of Brazil, Russia, India, China, and South Africa [46].

Nevertheless, the general point to make is that as India emerges as a space great power, so does its international responsibility to offer public goods, and the pursuit of the South Asia Satellite can be understood from such a perspective [38] (p. 171). But even though India's growing interest in the provision of public goods at the regional level is an important step that signifies a shift in its space policy, there is still the need for India to play a more active role as a norm-shaper' in the global governance of space activities in line with its status as a rising great power in space [47, 44].[14]

4. Security and strategic aspects

4.1. It's not all peaceful: India's changing approach to space

India had recognised the strategic and national security importance of space even earlier, but this was not given sufficient attention until the late 2000s. In fact, right at the beginning of a policy document that has come to be called the Sarabhai Profile outlining the space and nuclear agenda for India, it was noted that "the progress of science and technology is transforming society in peace and in war" (italics added) [50]. Even as there was this acknowledgement, Dr. Vikram Sarabhai did not give much prominence to security-related issues as the subsequent sections on space almost entirely focused on technological advancements in the context of economic development and no reference to the national security elements. Traditionally, New Delhi had a doctrinaire approach to space, with an emphasis on the peaceful and civilian uses of outer space, while being critical of the prospect of militarising and weaponising space by the great powers. This approach made India a vocal critic of the United States' Strategic Defense Initiative (SDI) programme and the repeated anti-satellite (ASAT) tests by the United States and the Soviet Union. India's peaceful pursuits in space also meant that it did not have the wherewithal to develop capabilities that went beyond the scope of peaceful uses of space. Thus, it is clear why India was a vocal critic of any militarisation or weaponisation of space.

But India's approach began to see some shifts since the early 2000s. This also coincided with India's own growing influence beyond South Asia, becoming a more active player in Asian and global politics, commensurate with its better economic wherewithal. These attributes influenced India's outlook and positioning on a number of issues, including space security. This is evidenced in India's changing approach, moving away from a policy based on declarations of morality and principles beyond national interests to one conditioned by pragmatism and national security considerations. This new approach led to India softening its rhetoric on the militarisation and weaponisation of space because New Delhi acknowledged the utility of some of these capabilities and approaches as its own threat perceptions had begun to change. The changing threat perceptions pushed India to seek technologies such as missile defence that it was critical of in the past when the United States and others pursued such capabilities. India's old policy positions were beginning to hurt its interests and not helping it address the new threats that appeared in its neighbourhood.

4.2. Contributing factors to India's changing space security orientations

4.2.1. Changing security perceptions

A key factor that has influenced India's changing space security orientations is the evolving threats in its neighbourhood, initially from Pakistan and later from China. China-Pakistan collaboration across a number of areas, including missiles and Beijing's growing space capabilities, have been of particular concern. China's transfer of small- and medium-range missiles to Pakistan and the broader missile proliferation in the region were early concerns that forced India to re-think its policy approaches on space and missile defense issues. However, in the past decade or so, these concerns have been overtaken by China's growing space capabilities, especially its counter-space technologies and broader space weaponisation efforts.

India had from early on developed surface-to-surface ballistic missiles, but Pakistan was quick to catch up with India given the assistance that Pakistan received from China, North Korea, and Iran. The best known among Pakistan's missile developed through such collaborations is the Ghauri medium-range missile [51]. Meanwhile, China also sold missiles such as M-9 and M-11 directly to Pakistan [52] (pp. 239–58). The strengthening collaboration between China and Pakistan on strategic weapons and delivery systems such as missiles was a compelling factor pushing India to recognise the utility of ballistic missile defenses (BMD). India began its pursuit of BMD in the mid-1990s, after the news of Pakistan's acquisition of the M-9 and M-11 missiles [53] (p. 606). India pursued a twin path to acquiring BMD, both through indigenous development and a number of foreign sources, including Israel and Russia. With both India and Pakistan going overtly nuclear, India's threat perceptions only intensified because its political relations with both China and Pakistan soured further. Also, because of the growing concerns about Pakistan's nuclear first-use policy, India had to ensure that its national command authority could survive a Pakistani nuclear strike, necessitating the BMD ever more in India's national security calculations [54,55]. The Indian pursuit of BMD also loosened up India's approach to broader arms control in the space and missile arena. This was first reflected in a clear fashion when US President George Bush pulled out of the Anti-Ballistic Missile (ABM) Treaty in 2001, and India became one of the few countries to welcome the US decision [56,57]. India's stamp of support for the US walking out of the treaty came as a surprise because traditionally India was one of the fierce opponents of missile defense systems. In fact, India opposed any effort that would broaden the arms race into outer space, the Indian position on SDI being one example of the Indian stand [58] (p. 114).

Towards the late 2000s, the Indian threat perceptions moved to those emanating from China. China's growing technological wherewithal in outer space, its pursuit of disruptive space technologies, and its overall tendency to threaten or use force had a great impact on India's threat perceptions that shaped the changing Indian approach to space. China's first successful ASAT test in January 2007 in particular, was a rude shock about the kind of threats that India should be prepared to deal with in its neighbourhood. This led India to reorient its interests in the space security domain. However, ASAT weapons are not the only arrow in China's quiver that is threatening to India. In direct competition with the US, China is developing the entire range of counterspace capabilities including ground-based lasers, direct energy weapons, cyber warfare capabilities and Rendezvous Proximity and On-Orbit Satellite Servicing (OOSS) technologies.[15] Further, according to the US Defense Intelligence Agency's 2022 report, *Challenges to Security in Space: Space Reliance in an Era of Competition and Expansion*, China possesses "a robust network of space surveillance sensors capable of searching, tracking,

[13] For a discussion of China as a great power in space and its bid for regional leadership, see Stroikos [48].

[14] Some of the issues covered in the section on India's space security have been covered more extensively in Rajagopalan [49].

[15] For a recent discussion of global counterspace capabilities, see Weeden and Samson [59]; and Harrison et al. [60].

and characterizing satellites in all Earth orbits." This is provided by a range of telescopes, radars, and other sensors that "allow China to support its missions, including intelligence collection, counterspace targeting, ballistic missile early warning (BMEW), spaceflight safety, satellite anomaly resolution, and space debris monitoring." [61] (pp. 16–17). India has remained concerned that these along with China's counterspace weapons can be used in ways that could disrupt satellite operations or even damage satellites. China's efforts at streamlining its organisations to create more synergistic utilisation of its space and counterspace weapons have also upped the ante. For instance, the establishment of the PLA Strategic Support Force (PLASSF) is seen as consolidating the PLA's outer space, cyber space and electronic warfare capabilities, increasing the potency of the force and operations. These are also reflective of China's intention to use these capabilities in conventional military operations [62]. China's primary competition is with the United States, but the capabilities it is developing have important cascading security implications for India and other Indo-Pacific space players [63] (p. 12). For example, India's own ASAT test was motivated by China's first successful ASAT test in January 2007 [57].

4.2.2. Impact of the US-China competition

The rise of China and the broader competitive dynamics in Asia and beyond have had an important influence on India's space programme. The rise of China with its growing space profile, which is in direct competition with the United States, has many direct implications for India. In addition, it has resulted in a number of situations that warrant attention from India. One such result is the current state of global arms control negotiations. Due to the heightened level of competition between major powers, any prospect of developing an arms control measure faces a bleak future. As one expert observes, "the US and China are in a cycle of distrust and military build-up right now." [64]. The competition and the resulting arms race and military build-up are true in the outer space domain as well, where existing arms control measures have proved inadequate and ambiguous in addressing the current and emerging threats to space security. Growth in counterspace capabilities in the form of ASAT weapons, cyber and electronic warfare means as well as the testing of these capabilities have seen a spike in the last decade. For instance, the Outer Space Treaty of 1967 has been quite useful in maintaining the sanctity of outer space, but the Treaty only prohibits the placement of weapons of mass destruction (WMD) and does not cater to today's security threats and challenges in space. In today's environment, challenges in space include the growth of the number and type of actors engaged in space, space debris, small satellites, counterspace weapons, arms race, and large satellite constellations, all of which result in unpredictability in space affairs. The lack of predictability in space can result in more competition and give way to an arms race due to increasing insecurities about each other's activities.

The answer is to reduce some of the prevalent tensions by encouraging more openness, information sharing, and other means that will create the effect of strengthening predictability in space. However, given the low level of support, especially among major powers, for recent global efforts to develop rules of the road that regulate activities in space, there is very little hope for any progress. This is even more challenging because the lack of consensus among major powers is not because they do not appreciate the challenges, but because other political issues have come in the way of their efforts to form consensus.

A proposal on the Prevention of an Arms Race in Outer Space (PAROS) has been going on in various UN platforms, including the Conference on Disarmament (CD) in Geneva, the traditional venue for discussions on space security and arms control issues, for decades. But there is yet to be a substantive discussion on it. In recent years, there have been several efforts including the China-Russia sponsored draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects (PPWT), originally proposed in 2008 (with a revised text introduced in 2014); the EU-initiated International Code of Conduct for Outer Space Activities (ICoC), the UN Group of Governmental Experts (GGE) proposal on Transparency and Confidence Building Measures (TCBMs) in 2013, the 2018–19 GGE on Further Practical Measures for the Prevention of an Arms Race in Outer Space (PAROS), and the UN Open Ended Working Group on space security (2022–23). While the OEWG has gone through three sessions so far, the increasingly hostile relations between major powers do not give much confidence in arriving at a common perspective on the increasing space security threats and possible solutions to address them.

The absence of successful multilateral discussions and agreements would mean that states are driven by ever increasing insecurities. This leads to a bigger focus on military space programmes, making space extremely fragile from the kind of activities states and other space actors engage in. Rising insecurities could push states to engage in activities that result in intentional damage or disruptions in satellite functioning. If it continues unabated, the possibility of converting space into an active zone of warfare cannot be underestimated. But there are also other types of activities that need effective rules and regulations. Uncontrolled re-entry events are part of such activities that need international coordination in order to avoid intentional or unintended destruction to people and property. Recent Chinese re-entry events are cases in point.

Major power rivalry has also led to a major focus on military and security applications of space, making space much more integral to conventional military operations. This is an important difference when compared to the competition between the United States and the Soviet Union during the Cold War. The military use of space was primarily for strategic purposes, such as arm control verification. Unless certain red lines are drawn and regulations brought in, the tendency among the major powers to weaponise space can drive other states also to pursue space weaponisation.

The absence of effective multilateral discussions has an impact on India's space programmes, as it does for others. The inability to develop rules and regulations that might bring about certain restraint on some of the disruptive activities in space has pushed India to look at ways to secure its own interests and space assets. In India's case, the adversarial nature of relations between India and China following the Galwan conflict of 2020 has stumped the possibilities of any rapprochement between the two sides. This has forced India to develop appropriate deterrence measures across the board, including in outer space.

Shifting terrestrial politics to outer space is not unique to India-China relations alone. All major powers in the Indo-Pacific, including the United States, have been compelled to respond to the use and threat of force by China and its disruptive activities in all global commons [65, 66]. In the case of India, the most demonstrated counterspace technology development was India's ASAT test in March 2019, but India is also developing a much larger military focus for its space programme. Utilisation of space for passive military applications such as intelligence, surveillance, and reconnaissance (ISR) functions or for military communications is a given, but many states, including India, are keen to develop a range of capabilities that are not purely peaceful in nature. India has developed a series of dedicated military satellites for ISR and communication purposes, such as the GSAT-6 and GSAT-7A communication satellites. But India is also working on Directed Energy Weapons and lasers that have the potential to interfere with satellite functioning. These are essentially defensive and deterrence measures taken by India in response to what China has achieved so far in the counterspace domain. In India's case as well as in the case of others, they are only responding to the weaponisation trends, especially the growing Chinese space weaponisation efforts.

The net result of all of this is a budding arms race in space between China and the other Indo-Pacific space powers. One can see a parallel to the US-USSR space race that played out during the Cold War years. The space race is already playing out in terms of achieving various firsts – landing on the far side of the Moon, resource mining activities or China's efforts to set up its own space station, missions to Mars and plans for

setting up a base on the Red planet, among others. As mentioned previously, India stayed away from such politics for several decades, but finally succumbed to it with its Mars mission mentioned previously. There are also individual and joint missions being planned to the Moon, and interplanetary missions are also being envisaged. The India-Japan joint lunar mission is a case in point [67]. India's goals in this regard are also fulfilled by partnering with like-minded capable partners such as Japan, France, and the United States. India's difficult history in dealing with some of the major space powers has cast some limitations. Nevertheless, there is a greater appreciation of the need to put aside this history and embrace realpolitik to work with its new security partners, such as the United States, Japan, and Australia.[16]

4.3. India's policy and institutional measures

Even though India does not have a declared space policy, its policy stance can be gleaned from statements in the Indian Parliament as well as in multilateral platforms such as the CD in Geneva and other UN institutions in New York and Vienna. This suggests that there has been a distinct shift in India's policy stance since 2007, since China conducted its first successful ASAT test. India is making a slow but clear shift wherein there is an alignment with the broader trend as far as space security and norms are concerned. Despite the traditional Indian policy position articulating the need for legally binding verifiable mechanisms, there is greater appreciation for norms of responsible behaviour, at least as a starting point.

This is in recognition of the difficulties in today's international political scenario where getting all major powers to sign off on a legal measure is dreadfully challenging. This is not to suggest that India has given up on its insistence on legal measures or that it is entirely comfortable with normative measures or political instruments. In fact, Ambassador Anupam Ray, India's Permanent Representative to the Conference on Disarmament made a statement at the OEWG on May 9, 2022 saying that New Delhi "supports substantive consideration of Prevention of an Arms Race in Outer Space (PAROS) within the multilateral framework of the UN. We remain committed to negotiation of a legally-binding instrument on PAROS to be negotiated in the Conference on Disarmament, to address pressing issues relating to space security. India will play a constructive role in this process." He added that "universal and non-discriminatory" TCBMs are "useful" but that they can only play a "complementary role, [and] they cannot substitute for legally binding instruments in this field" [72]. While the official policy stance has seen limited change, India appears a lot more accommodating to the need to start with pragmatic TCBMs as first baby steps without insisting on legal measures as the only way forward.

A second factor that India is pushing consciously is a keen desire to integrate with the global non-proliferation architecture. India is a member of all global export control regimes except the Nuclear Suppliers Group. This is indicative of India's commitment to global measures but also demonstrative of the pragmatic steps that India is taking to be part of the solution as far as space security and non-proliferation goals are concerned. That India has tightened domestic export control regulations in tune with its commitments to global export control regimes reflects the Indian desire to be a key partner in the global non-proliferation regime [73].These are important changes considering the earlier Indian position on these issues, where India stood out as a vehement critic of the SDI and the ASAT tests of the United States and the USSR [58] (p. 114).

China's ASAT tests also pushed India to establish new institutions for better coordination and effective policy thinking on space from a security perspective. The calls for a tri-service space command gathered momentum, and this initially led to the creation of an Integrated Space Cell within the HQ Integrated Defence Staff, Ministry of Defence, in 2008. This was an important first step in bringing together the Department of Space, the Ministry of Defence, and the armed forces to develop a more synchronised approach to India's space dealings. The Indian Ministry of Defence explained that the Cell was created in order to formulate "offensive counter space systems like anti-satellite weaponry, new classes of heavy-lift and small boosters and an improved array of Military Space Systems … in our neighbourhood." [74]. A decade later, after India conducted its first ASAT test in March 2019, India felt the need for more dedicated military space institutions to streamline its efforts in the space security domain. This led to the establishment of a tri-service Defence Space Agency (DSA), a provisional institutional set up before India could establish a full-fledged aerospace command [75, 76] This was followed by the Defence Space Research Organisation (DSRO), tasked with something similar to India's existing Defence Research and Development Organisation's (DRDO), but with a focus on research and development for its space security capabilities. DSRO is meant to focus on capability development according to the strategy framed by the DSA. The DSA is headquartered in Bangalore and has a staff of 200 personnel, staffed from existing offices such as the Defence Imagery Processing and Analysis Centre, New Delhi, and the Defence Satellite Control Centre, Bhopal [77]. Among the three Indian military services, the Indian Navy has been the most proactive. More than a decade ago, it set up an office called the Assistant Chief of Naval Staff (Communications, Space, and Network Centric Operations; ACNSCSNCO), with the aim to manage space-based military capabilities for the Indian Navy. The Navy saw this as an important step, as it moved from a "platform-centric Navy" to a "network-enabled Navy" [78].

Along with policy and institutional measures, India has also undertaken a number of technological steps in terms of increasing the space assets available to the military. These include not only dedicated military satellites but also a range of dual-use satellites that can be used by the military. Strengthening the military's communications and surveillance has been a particular focus. On the counterspace side, India's ASAT capability is the most visible one, but the DRDO is also believed to be working on a range of other technologies. Dr. Satheesh Reddy, Director General of the DRDO, noted in an interview that the DRDO is "working on a number of technologies like DEWs (directed-energy weapons), lasers, electromagnetic pulse (EMP) and co-orbital weapons etc". Although he quickly clarified that using these will be political decisions, he stressed the importance of space in the military domain, saying that "the best way to ensure security is to have deterrence" [79].

5. Conclusion

This article has examined the transformation of India's space policy from a principal focus on space for development to a pursuit of security and prestige. The analysis has revealed that this shift is driven by a complex set of factors, including changes in India's strategic environment, its great power aspirations, and evolving geopolitical dynamics. The implications of this transformation are significant, both for India's space programme and for the global governance of outer space. More specifically, the first section provided a historical outline of India's space programme from its beginning, emphasising its primary concentration on utilising space for development, modernisation, and technological self-reliance. In contrast, the subsequent section investigated India's recent shift towards enhancing and extending civil space activities. This section discussed India's high-profile space exploration achievements, such as the Chandrayaan programme and its first Mars mission, as well as plans for a human spaceflight programme, before examining the role of the private sector and the use of space technology as a tool for soft power and foreign policy.

In strategic and security terms, India has started to develop a range of space capabilities to catch up with advancements in space both in the Indo-Pacific and beyond. New Delhi has had to re-orient itself to an extent because it felt that inaction could leave it vulnerable in a critical

[16] See, for example, White House [68]; White House [69]; Rajagopalan [40]; Rajagopalan [70]; Ministry of External Affairs [71].

national security arena. Irrespective of the security compulsions and the need to act in a decisive manner, India's decisions have not been easy considering its steadfast position against the weaponisation of space for several decades. But increasingly, as explained earlier, India is shifting away from a morality and principles-based approach to one that is shaped by pragmatism and national security considerations as the primary drivers of India's new approach to space. Given the worsening geopolitical conditions in the Indo-Pacific, it is unlikely that India will return to its comfortable old position of insisting on the peaceful uses of space. Instead, India's policy approach to space will continue to be complex and nuanced, and possibly align more with its new security partners in how to address the growing threats to space security. In fact, India's space programme will continue to grow, with the private sector as a capable partner shouldering the heavy weight of the growing demands on space. India will not abandon its peaceful pursuit of space, but its space policy will not be just about social and economic development, but also about addressing military and security needs.

CRediT authorship contribution statement

Rajeswari Pillai Rajagopalan: Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing. **Dimitrios Stroikos:** Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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