

Evolution of National Space Policy as Predominantly Implicit Policy: India, an Intrinsic Case Study

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Abstract: India, despite being a leading space-faring nation, and operating one of the six largest space programmes in the world, has developed little in terms of expressly documented national space policy over its 58-year history of space activity—besides two standalone policy documents primarily designed to address some operational policy issues pertaining to satellite communication services and use of remote sensing data. However, the Indian space programme, given its phenomenal technological advancements and operational maturity achieved over the decades, clearly exhibits evidence of having been continually and consistently guided, since its very inception, by a cohesive and consistent policy so far as its directional and strategic policy aspects are concerned. In other words, there does exist an apparent undeclared policy embedded in the Indian space establishment that has continued to inform and guide its strategic decisions and actions. The objective of the present case-study is to systematically describe the evolution of the national space policy of India, predominantly as implicit policy, as reflected by the key decisions and actions of the Indian national space establishment since beginning of the Indian space programme. This analysis strives to identify the directional and the strategic elements of policy as reflected by the decisions and actions of the space establishment, and the socio-economic, technological, political and institutional factors that have influenced such policies.

Key words: Space policy, implicit policy, Indian space policy and legislation, national space establishment, Indian space programme.

1. Introduction

With space technology applications becoming an indispensable tool in many facets of sustainable development, governance, and national security in countries across the world, the necessity of effective regulatory frameworks at the national and international levels is being increasingly emphasised at international fora on space. This is important for two main reasons: firstly, in order to foster and facilitate the growth of national space activity by the private sector actors, as well as the government, as desired in optimal harnessing of the potential of space technology and its applications in the spheres of socio-economic development, governance and national security; and secondly, in order to ensure that space activities, which, by their very definition

involve the use of the global common pool resource “outer space”, are conducted in compliance with international space law and in conformance with relevant international normative frameworks. This in turn requires that the space activities undertaken within individual countries be informed and guided by a competent national space policy.

However, despite the growing emphasis placed by the international space community on development of both national legislation on space and national space policies underpinning such legislation, they are currently at various levels of evolution across space-faring as well as space emerging countries. As regards the national space policy, many countries, despite not having introduced to date a formally adopted and publicly declared national space policy in the form of an explicit policy document, nevertheless appear to have consistently guided their national space activities by what appears to be the “implicit policy” embedded in their respective national space establishments—with

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such implicit policies, particularly the directional and strategic elements of such policy, finding expression in the decisions and actions of the respective national space establishments.

India, despite being a leading space-faring nation in the world, and having commenced its space research activities as far back as 1962 within just five years of the dawn of the space-age in 1957, has developed little in terms of documented space policy to date. What is currently available as formally adopted and publicly declared elements of Indian space policy consists of the Satcom Policy of 1997 [1] and the National Remote Sensing Data Policy of 2011 [2]—both being standalone policy documents designed to address some operational and regulatory issues in the respective fields of activity, rather than a broader national policy document on space.

However, the fact remains that the Indian space programme, going by the account of its phenomenal development with successively advancing technological feats, clearly exhibits the evidence of having been continually guided, since its very inception, by a cohesive and consistent policy so far as its directional and strategic policy aspects are concerned. In other words, there does exist an undeclared policy, embedded in the Indian space establishment, which has continued to inform and guide the decisions and actions of the system, finding expression therein as what the author identifies as a “system-embedded implicit policy”.

The objective of the present case-study is to systematically describe the evolution of the national space policy of India predominantly as implicit policy, as reflected by the key decisions and actions of the national space establishment of India since the beginning of the Indian space programme.

This study examines the evolution of India’s space policy since beginning of the country’s space programme in 1962 [3]. The analysis divides this 58-year history of Indian space activity into three distinct periods: 1963-1991, 1992-2019, and from 2020 onwards, as identified by the author.

The significance of the study is mainly twofold: firstly, it provides an intrinsic analysis of how the Indian space activity has been informed and guided by a predominantly implicit policy—as opposed to a publicly declared explicit policy—during the country’s historical course to emerge as a leading space-faring nation in the world; secondly, it serves as a basis for pre-judging and generalizing to some extent the efficacy of, and potential limitations in, adopting such a predominantly implicit policy approach by a country, with regard to the directional and strategic elements of its national space policy.

2. Materials and Methods

The time bounds of the present case study span from the beginning of the Indian space programme in 1962 until present; the setting is the historical context of development of the Indian space programme over the above period; and the case study focuses on the evolution of Indian national space policy, which has predominantly remained implicit policy as reflected by the directions and strategies adopted by the Indian space establishment, in contrast to an explicitly declared self-contained national space policy document.

As for data collection, the details of development of Indian space activities to its present status, which are found in the website of the ISRO (Indian Space Research Organization) and other official websites of GoI (Government of India), met the major part of the data requirements, complemented by several other web-based documents such as publications and media-reports by relevant authorities of the Indian space establishment. Data gathering also involved conducting a one-to-one teleconference with a high level ex-official and distinguished scientist of the ISRO, mainly for the purpose of obtaining further information and clarifications regarding the data gathered from websites and other documents. To that extent, this interview also contributed to validating of data.

The process of analysis mainly constituted identification of the directional and the strategic elements of policy as reflected by the major decisions and actions of the Indian space establishment on the one hand, and the socio-economic, technological, political and institutional factors that have influenced such policies, during each of those three distinct periods identified above over the 58-year history of Indian space activity, on the other hand. In addition to the directional and strategic elements of the predominantly implicit policy reflected by the decisions and actions of the space establishment, the Satcom Policy of 1997 and the National Remote Sensing Data Policy of 2011 referred to above were also used in the analysis.

3. Case Analysis and Discussion

Given the evolution of India's space activity over the past 58 years, with the apparent directional and strategic policies underpinning the space programme undergoing significant changes over time, the key factors that have influenced the national space policy of India—both the implicit policy as reflected by the national space programme, and the two limited-scope special-purpose policy documents available as publicly declared policy—in its evolution through each of those three periods identified above by the author, are discussed in the following subsections. This discussion also entails an analysis of the efficacy and deficiencies of the policy followed during each period, as observed by the author. This is followed by an analysis of the evolution of institutional structures and mechanisms of the Indian space establishment, reflecting how it has influenced, and has been influenced by, the policy adopted during each successive period.

3.1 *The Technology Development and Experimental Phases and Beginning of the Operational Phase (1962-1991)*

The Indian space programme, having gone through

its developmental phase during 1960s and 70s followed by the experimental phase of 80s, entered into its fully operational phase by early 1990s. The Indian communication satellite system—known as INSAT (Indian National Satellite)—marked the completion of the launch of its first series of operational satellites with the launch of INSAT 1D in 1990, and the first operational remote sensing satellite series—known as IRS (Indian Remote Sensing Satellite)—completed the launch of its first two satellites by 1991 [4]. Apart from this technology perspective of the space programme, there are at least two other factors, viewed from political and economic perspectives, that warrant the author's decision to treat the year 1991 as a line of demarcation between two distinct periods for the purpose of the present analysis: firstly, 1991 marks the beginning of the era of open economy in India, which could, in theory, impact the country's policy on space activity, particularly in relation to commercial space activity; secondly, it also coincided with collapse of the Soviet Union—the space superpower that, until then, had been India's major technology partner in space technology capacity development.

From the perspective of national capacity in space technology, the country had managed to acquire and fully develop the technological capabilities required for indigenous development of operational earth observation and communication satellites, and very significantly its own indigenous launch vehicles, thus emerging in the process as only the sixth nation in the world to acquire full capabilities in space technology. This shows the fact that as far as the directional and strategic policies pertaining to technology acquisition and development are concerned, the exclusively government-controlled Indian space programme had achieved what the implicit policy underpinning it was targeting to achieve in terms of technology development, experimental operations, and full-fledged operational services, during the above three-decade period.

From a political perspective, it is observed that the key decisions and the strategic aspects of implementation of the space programme took place within the guarded walls of the Indian space establishment—no different from the approach followed at the time by all leading space-faring nations. The key directions and strategies adopted by the programme demonstrate the fact that amongst the prominent factors that had influenced the directional and strategic elements of policy during the time were India's interests of self-reliance in space technology and harnessing of its benefits in socio-economic development of the country; in national security; and in emerging as a regional geo-political power. Thus, with no formally adopted and publicly declared national space policy in existence, the outcome of the space programme during the above period serves as an implicit expression of the directional and the strategic elements of the underpinning policy that was "system-embedded" in the Indian space establishment.

Further, those implicit policy directions also find expression in some of the famous policy pronouncements by the founding fathers of the Indian space programme. Most prominent among them is the vision reflected in the following famous statement made by Dr. Vikram Sarabhai—the founder Chairman of ISRO, regarded as the father of the Indian Space Programme:

"There are some who question the relevance of space activities in a developing nation. To us, there is no ambiguity of purpose. We do not have the fantasy of competing with the economically advanced nations in the exploration of the moon or the planets or manned space-flight. But we are convinced that if we are to play a meaningful role nationally, and in the community of nations, we must be second to none in the application of advanced technologies to the real problems of man and society" [5].

The policy and strategy decisions on technology development that show a strong orientation towards applications serving socio-economic development are

recognized to have been continually guided by this vision.

Besides the above quote from Dr. Sarabhai, some other national policies that were being introduced in the post-independence India, particularly during 1950s and early 1960s, are likely to have shaped the guiding philosophy of ISRO and the larger Indian space establishment built around it. Even the first-ever science policy resolution of the post-independence India in 1958, placed emphasis on the need for India's scientific self-reliance in both "industry and agriculture" and "defence" [6]. While the role of space technology in its contribution to making India scientifically self-reliant, thus leading to its industrialization, was obvious, it is nevertheless logical to argue that, India's resolve to commence space research activities could have well constituted the foresight to explore the potential contribution of this new domain of advanced technology in realizing the second one of the aforesaid two vital national goals that the 1958 scientific policy resolution sought to realize—after all, space was far more closely associated with "defence" applications elsewhere in the world at the time, despite India's pronounced commitment to its civilian applications.

There are two facts, as explained below, that explicate this proposition: The first is the more obvious unprecedented technological capacity that the national security establishment of India would stand to derive from the future space capabilities of the country—satellite communication connecting any two desired points on the ground, reconnaissance and surveillance capabilities over India and the surrounding regions, and navigation support; the second is the technological cross-fertilization benefitting defence technologies. Standing in testimony to the latter is the fact that it was none other than ISRO's project director who successfully developed India's first ever indigenous satellite launch vehicle SLV-3, Dr. Abdul Kalam, who subsequently moved to the Indian Defence Research Organization to develop India's

Indigenous Ballistic Missile capabilities, later coming to be known as the father of India's missile programme [7]. It is a well-known fact that a rocket carrying a satellite into space and a ballistic missile carrying a warhead into the enemy territory share in common a major proportion of their core technologies.

Thus, it is reasonable to argue that such core elements of the founding philosophy of the Indian space establishment, whilst having been envisioned with a largely development centric notion, had nevertheless placed due emphasis on the prospects of deriving the strategic advantage of space technology in serving the country's national security interests; and they had naturally influenced the directional and strategic elements of the system-embedded implicit policy of the Indian space establishment.

Finally, an important observation is that there had been hardly any policy interventions attempted from a commercial perspective during the above period. Commercial space activity, which was yet to see the decade of its rapid take-off even in more developed space economies in the US and Europe, was a far cry in India's national economy which was still largely centrally controlled.

An apparent limitation in the policy followed during this period, as observed by the author, is that broader socio-economic integration of technology had been largely left to be handled in a scenario where a significant proportion of technology recipients, particularly the public sector user agencies of space applications, whose role in shaping this implicit policy had been kept largely passive, had to depend on, and be content with, the technology-push efforts of the space establishment largely relying on the technology-trickle-down effect to benefit the user-agencies.

3.2 Operational and Maturity Phases (1992-2019)

During this full-fledged operational and maturity phases of the Indian space programme, the apparent policy of the space establishment, viewed from the

technological perspective, appeared to be keeping pace with the other major space powers in terms of enhanced launch capacity, enhanced capacity to build large complex satellites and spacecraft, and venturing into interplanetary missions. Thus, the implicit policy direction of keeping abreast with frontiers of technology advancement is evident here. Also evident is the implicit policy resolve to continue to keep the development of capabilities in such advanced and strategic technologies confined to, and centrally controlled by, the space establishment.

From the perspective of commercial space activity, in 1992, the Indian space establishment created its first commercial entity, Antrix corporation, in the form of a fully government owned company under the department of space. Thus, the full range of ISRO's products from simple subsystems of a satellite to complete space craft, and services ranging from remote sensing data services, transponder leasing services, and training and consultancy services to satellite launch services, became commercially available for a potential worldwide clientele. Importantly, the mandate of Antrix also included facilitating the development of space technology based industries by India's private sector.

This notion of creating a commercial space industry by India's private sector, as well as the notion of commercial exploitation of the technological capabilities hitherto developed by the Indian space programme during its previous three decades of development, clearly signalled a new policy direction—whilst reflecting a policy response to the fundamental change undergone by the country's national economic policy in the previous year.

In 1997, the government introduced the "Satcom policy", the first of the only two publicly declared policy documents to be published to date by the Indian space establishment. The Satcom policy strived to achieve two main objectives: firstly, to enable private sector participation in the satellite communication services industry (television broadcasting,

telecommunication services and other), ensuring efficient utilization of the substantial transponder capacity that had been developed over the previous decades in ISRO's INSAT communication satellite constellation; and, secondly to infuse the dynamism and efficiency of the private sector to develop satellite communication services, using Indian or foreign satellites, in order to address the growing domestic communication needs. In either case, the operations were subject to a comprehensive licensing regime, addressing potential national security concerns, and also according preferential treatment to the use of Indian satellites. It may be safely concluded that Satcom policy of 1997, managed to serve the purpose that it was intended to serve in terms of the above two main objectives. This reflects the same two policy directions as those reflected in the move to create Antrix: firstly, commercialization of the unused capacity (in this case, the accumulated transponder bandwidth of the INSAT constellation which was hitherto available for use only by public sector entities, mainly for telecommunication and broadcasting); and secondly, facilitating entry of India's private sector into commercial space-technology based industry—a satellite communication based industry, in this case.

In 2011, the government introduced the second one of the only two publicly declared policy documents on space to be published to date—RSDP-2011 (National Remote Sensing Data Policy of 2011). This too is a limited-focus special-purpose policy document largely dealing with several operational policy issues: streamlining the access to remote sensing data by the government as well as non-governmental entities, whilst addressing the national security concerns associated with the use of remote sensing data. Therefore, RSDP-2011 stands as an operational policy in large part, mainly seeking to regulate the use of remote sensing data, which was not hitherto subject to such regulation.

Thus, each of the only two currently existing,

formally adopted and declared, policy documents on space activities is found to be operational policies in large part, designed to address mainly the regulatory and operational issues pertaining to a particular sphere of space application.

Beginning from around 2017, a few private commercial space companies have emerged with substantial technological capability. Two of the most prominent examples are Agnikul Cosmos and Bellatrix Aerospace, both high-tech start-up companies seeking to build and operate launch vehicles for small satellites. There are other significant players such as Skyroot Aerospace (an equipment supplier), and Vestas Space (a satellite solutions provider for the corporate sector).

Even the government space establishment's own resolve to establish its own commercial arm, NSIL (New Space India Limited), to produce and market on commercial scale such complex, high-tech and high value space technology products and services as manufacturing of launch vehicles and large satellites, and operation of launching services etc., using ISRO-developed technology, was made as late as 2019.

3.2.1 Drawbacks of the Implicit Policy Followed during 1992-2019

Some of the apparent drawbacks of the implicit policy followed during this period, as identified by the researcher, are as follows:

There has been a more than 15-year gap between the first policy resolve (in 1992) of the space establishment to encourage development of a commercial space industry with private sector participation (following liberalization of national economy) and actual emergence of start-up commercial space companies, with such advanced capabilities as development of launch vehicles for small satellites. This is to be viewed in contrast to the hundreds of companies in space-related industries that have emerged over the past two decades, which are mainly producing various components and

sub-assemblies for ISRO's products and systems, thereby effectively forming part of ISRO's upstream supply chain, rather than a self-sustained commercial space industry in its own right. It is logical to argue that the above delay has, therefore, been caused in major part due to lack of clarity about the policy, as perceived by industry, obviously caused by the absence of a clearly spelt out publicly declared comprehensive national space policy.

The relative stagnation of the Indian space economy during this period, which is mainly reflected by the absence of significant private sector participation, becomes further evident when viewed against the backdrop of two important observations. Firstly, it is since 1990s that private commercial space companies have emerged in large numbers elsewhere in the global space economy. Secondly, the overall national economy of India which, an year after economic liberalization in 1992, accounted for just 1% of the global GDP (Gross Domestic Product)—and was not within the 10 largest economies in the world at the time—has since then achieved a steady growth to claim 7.98% of global GDP in 2019 becoming the fifth largest economy in the world [8].

Thus, relative stagnation of the Indian space economy, suffering mainly from absence of significant private sector participation to create a strong commercial space industry, can be directly attributed to the lack of an explicitly declared policy direction in this regard, and further, to the fact that the system-embedded implicit policy in this case was still largely committed to the notion of centrally controlled space activity.

The overall policy direction, governing the national remote sensing data policy of 2011, has been aligned towards imposing rigid control measures to prohibit any conceivable “misuse” of remote sensing data in a manner that would potentially involve any concerns on national security, rather than towards promoting its wider use for socio-economic benefit, particularly through leveraging the involvement of

non-governmental private entities.

3.2.2 Significant Deviations from the Policy Followed during the Previous Period

There are two other important developments appertaining to the direction of the implicit policy observed during the 1992-2019 period, each signifying a significant deviation from the policy followed during the previous period. They are:

The inclination towards undertaking interplanetary missions (the two lunar missions Chandrayaan 1 and 2, Mars orbiter mission, and the proposed orbiter mission towards the Sun and the proposed human space-flight mission). They appear almost an anti-thesis to the founding philosophy of Dr. Vikram Sarabhai who said “...We do not have the fantasy of competing with the economically advanced nations in the exploration of the moon or the planets or manned space-flight...” as quoted in a preceding paragraph. The new implicit policy direction in this regard is evidently dictated by the policy resolve of the Indian space establishment to keep abreast with the developments in the new frontiers of space technology carried out by the other major space-faring nations.

India's resolve to demonstrate its anti-satellite capabilities, by destroying one of its own satellites in the orbit using a ballistic interceptor missile developed by the Indian Defence Research and Development Organization in March 2019, thereby becoming only the fourth country to acquire that capability after US, Russia and China [9]. This is an act to demonstrate its resolve to use space as a force, if so demanded by the security interests of its space assets, civilian or military, even if it means defiance of international normative principles on the peaceful uses of outer space.

3.3 Commercialization Phase (From 2020 Onwards)

The fundamental difference in the post-2020 direction of the aforesaid predominantly implicit policy, embedded into the Indian space establishment,

compared to its overall direction in the previous period (1992-2019)—which therefore warrants its treatment as a separate distinct period—is clearly the strong strategic policy resolve to develop a vibrant space economy by promoting private sector participation in commercial space activity, whilst translating ISRO's technology successes into commercial successes that will accomplish maximum possible wealth creation for the Indian economy.

The most important strategic move in this direction was the creation of the IN-SPACe (Indian National Space Promotion and Authorisation Centre, in June 2020, as an independent agency (involving private sector representation, and functioning under the space commission) for promotion, hand-holding and regulation of private commercial space companies [10]. Development of a commercial space industry with strong private sector participation inevitably calls for enactment of national legislation on space, and it is expected to be realised soon with the national space activities bill, which, by now, has reached the final stages in its process of enactment by the parliament. Further, the Indian space establishment is also fast working towards developing a comprehensive, integrated national space policy.

In the meantime, comprehensive transfer of the commercial space activities of ISRO to the fully Government of India owned commercial company NSIL is happening in parallel—a move that is expected to enhance the efficiency of commercial activity whilst making ISRO concentrate its energies on advanced research and development on new frontiers of space science and technology.

Increasing India's share in global space economy from its current figure of 2% to 7% by 2025 remains a major economic goal [11]. The economic and strategic gains made by the space industries in other advanced markets (most notably in the United States, with such powerful players as SpaceX), through facilitating private sector participation in commercial space activity, can be identified as a significant factor

influencing this major policy shift by India.

3.4 Institutional Structures and Processes of the Space Establishment and Their Policy Implications

A major finding that emanates from the analysis of the institutional structures and the processes of the Indian space establishment is the fact that those institutional structures and processes, during their process of evolution into current status, have been acting as a product as well as a determinant of what the researcher identifies as the system-embedded implicit policy of the Indian space establishment.

The researcher has identified four key attributes of the Indian space establishment that have been intrinsically influencing its decisional processes and, therefore, help understanding of their implications on both the Indian space policy and its development.

The four attributes are:

- the institutional structure and the processes;
- the composition and the substantive positioning of its key actors;
- proximity to the power-centre of the Indian Government, and
- the organizational culture.

The first attribute appertains to the institutional structure of the Indian space establishment. Indian space programme, which has continued to be centrally planned and executed by the central government since inception, has been built and operated on an organisational structure characterized by some unique features. The space program is implemented by ISRO, which functions as an autonomous organisation of the Government of India within the purview of the department of space. The department of space operates directly under the Prime Minister of India, who functions as the Minister in charge of space. The secretary to the Government of India, department of space, who directly reports to the Indian Prime Minister, also becomes the ex-officio Chairman and the principal executive officer of the implementing agency ISRO.

In the meantime, the department of space is required to act in compliance with the broader policy, strategy and regulatory directions given by the Space Commission of India, which is also appointed by, and reporting to, the Prime Minister. While the commission comprises the highest level officials of the Indian Government, including the Principal Secretary to the Prime Minister, national security advisor, Cabinet Secretary, finance secretary, and currently the Foreign Secretary, and normally three to four eminent scientists and engineers, the secretary to Government of India department of space becomes the ex-officio chairman of the commission. Thus, the secretary department of space, who directly reports to the Indian Prime Minister both as secretary DOS (Department of Space) and chairman of the space Commission on the overall policy, strategy and regulatory aspects of the India's space sector on the one hand, also becomes the principal implementer of the Indian space program, on the other hand, in his capacity as chairman ISRO—a unique all-powerful three-in-one position.

There are a number of factors that contribute to making the decisional process of the space establishment efficient, transparent and easy-to-implement. On the one hand, the unique “three-in-one combination” of the apex positions of the three institutions makes the decisional process both smooth and fast, and on the other, existence of three separate institutional bodies, and particularly their composition, give their decisions the credibility and transparency, viewed from a national perspective.

The second attribute mainly pertains to the composition of the high powered national space commission. While the ten-member commission could comprise as many as five of India's top-most bureaucrats, many of them holding permanent, apolitical career-positions, with four of them, namely the principal secretary to prime minister, the secretary to the cabinet, the national security advisor and the secretary to the department of space, directly reporting

to the Prime Minister. Thus, the approval by the commission of a programme or a project necessarily amounts to a certificate of its alignment with the broader national interests.

The third attribute of the Indian space establishment, identified by the researcher as a factor that affects the directional and strategic policy decisions as well as their implementation, is what the researcher identifies as “proximity to the power centre”: the fact that the powerful three-in-one space secretary directly reports to the Prime Minister, while five of the top bureaucrats of the Indian government (four of whom are directly reporting to the Prime Minister in their respective substantive official capacities) constitute the space commission, and above all the fact that the Prime Minister himself functions as the Minister in charge, bring the space establishment extremely close to the power-centre of the Indian government. The obvious implications are faster decisions, priority in resource allocation, and faster implementation.

The fourth attribute is the organizational culture. The core elements of the founding philosophy of the Indian space programme—envisioned with a largely development-centric orientation, whilst deriving in the meantime its strategic advantage in serving the country's national security interests—have got internalized into the core-values of the organisational culture of the Indian space establishment; and they influence the system-embedded implicit policy that guides its strategic decisions and actions.

3.5 The Summary of Historical Evolution of Indian Space Policy

Based on the above analysis, the evolution of Indian space policy—more precisely the directional and the strategic elements of policy that characterise the national space policy at large—as reflected by the key decisions and actions of the national space establishment during each of the three distinct periods identified above by the author can be summarized as follows (Tables 1-3).

Table 1 Directional and strategic elements of policy: 1962-1991 period.

Directional policy	Strategic policy
<ul style="list-style-type: none"> • Develop national capabilities in space technology as a matter of high national priority. • Achieve the status of a space-faring nation. • Optimally harness the potential of space technology and its applications in socio-economic development activity, particularly involving rural India; in enhancement of India's defence preparedness; and in general technological advancement towards industrialisation of India. • Make the national space establishment, its strategic facilities, and technological capabilities highly secure. • Position the institutional structure of the national space establishment closely linked to the power-centre of the central government. • Align with the space super power Soviet Union as the strategic technology partner. • Maintain the profile of an active responsible player amongst the International Space community. 	<ul style="list-style-type: none"> • Acquire and develop core scientific and technological capabilities in building of satellites and basic launch vehicles, and in satellite communications and space-borne remote sensing. • Develop indigenous launch vehicles and space transportation infrastructure. • Develop indigenous capacity to build communication satellites, and develop an indigenous constellation of experimental communication satellites. • Develop indigenous capacity to build earth observation satellites, and develop an indigenous constellation of experimental earth observation satellites. • Deploy domestic telecommunication services and public television and radio broadcasting services through indigenous constellation of telecommunication satellites. • Develop the capacity of the public sector organisations to use space applications, including those involving satellite communication and space borne remote sensing, in implementation of socio-economic development activities and delivery of public services. • Conduct Remote Sensing applications projects at the National, State and Local levels through a well-established multi-pronged implementation architecture in the form of NNRMS (National Natural Resources Management System). • Strengthen applications in the priority areas including agricultural crops inventory; water resources information system; ground water prospecting; forest working plans, biodiversity and coral mapping; potential fishing zones and ocean state forecasts; rural development; urban development; monitoring of glacial lakes and water bodies; and disaster management support including mapping and monitoring of cyclones, floods, landslides, monitoring of agricultural drought, forest fire, earthquakes, and monitoring and forecast of extreme weather events. • Develop the Indian Space Research Organisation as the central execution agency of the Indian space programme; administer the Indian space programme under a separate dedicated department of the government; regulate national space activity by a national space commission independent of the department of space and ISRO; and however ensure harmony and integrity amongst policy and strategy, execution, and regulation by making apex positions of all three organizations namely Chairman ISRO, Secretary DoS and, Chairman NSC (National Space Commission), to be held by one and the same person at any given time. • Ensure the topmost officials who carry the responsibility at the national level for the subjects of finance, national security, foreign affairs, as well as space, constitute the apex policy and regulatory body, NSC. • Maintain the Department of Space and the National Space Commission directly under the Prime Minister. • Secure admission to, and play an active role, at the United Nations committee on the Peaceful Uses of Outer Space and other international fora on space.

Table 2 Directional and strategic elements of policy: 1992-2019 period.

Directional policy	Strategic policy
<ul style="list-style-type: none"> • Develop advanced capabilities in all vital aspects of space science and technology. • Achieve a leadership position among space-faring nations. • Strengthen harnessing of space technology and its applications in socio-economic development activity. • Develop a commercial space industry whilst ensuring that the strategic capabilities in advanced technologies are securely guarded well within the national space establishment. • Strengthen harnessing of space technology and its applications in enhancing defence preparedness. • Demonstrate the strategic capabilities in space in national security and defence, as a deterrent to adversaries. • Venture into the domain of interplanetary missions. 	<ul style="list-style-type: none"> • Indigenously develop advanced launch vehicles and space transportation infrastructure. • Develop and expand the indigenously developed constellation of operational communication satellites. • Develop and expand the indigenously developed constellation of operational earth observation satellites. • Maximise the use of the indigenous constellation of operational telecommunication satellites by telecommunication services and public television and radio broadcasting services, engaging the private telecommunication services providers and broadcasters, while introducing a regulatory regime for the same. • Bring the use of remote sensing earth observation data under a comprehensive regulatory regime for operational control and national security. • Further expand the capacity of the public sector organisations to use space applications, including those involving satellite communication and space borne remote sensing, in implementation of socio-economic development activities and in delivery of public services. • Indigenously develop a domestic constellation of GNSS satellites. • Commission interplanetary missions to Moon, Mars and the Sun. • Institute a human space flight project. • Commission multiple collaborative projects for scientific exploration with leading international space-faring partners.

Table 2 to be continued

<ul style="list-style-type: none"> • Venture into the domain of human space flight. • Continue to accord the highest level security to the national space establishment and its strategic facilities, and make technological capabilities highly secure. • Continue to maintain the institutional structure of the national space establishment closely linked to the power-centre of the central government. • Develop and strengthen multiple strategic relationships with other leading space-faring nations, following the collapse of the Soviet Union. • Maintain the profile of an active responsible player amongst the International Space community. 	<ul style="list-style-type: none"> • Conduct an anti-satellite test. • Develop a commercial space industry by establishing fully government owned, commercially run companies to engage in commercial space activity involving advanced technologies. • Foster the development of domestic commercial companies as upstream suppliers to support the government-run manufacturing and services involving core technological capabilities in space. • Continue to develop and expand the Indian Space Research Organisation as the central execution agency of the Indian space programme; continue to maintain the same institutional arrangements amongst ISRO, DoS, and NSC. • Continue to have the representation of the topmost officials that carry the responsibility at the national level for the subjects of finance, national security, foreign affairs, as well as space, at the apex policy and regulatory body, NSC. • Continue to maintain the Department of Space and the National Space Commission directly under the Prime Minister. • Expand and strengthen India’s activity in various fora of International Space Community, including the United Nations committee on the Peaceful Uses of Outer Space. • Develop multiple bi-lateral partnerships with space emerging nations in furtherance of foreign policy interests.
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Table 3 Directional and strategic elements of policy: 2020 onwards.

Directional policy	Strategic policy
<ul style="list-style-type: none"> • All of the above followed during 1991-2019, except the new directional policy of strongly encouraging the development of a private sector led internationally competitive commercial space industry using ISRO-developed advanced technological capabilities. 	<ul style="list-style-type: none"> • Continuation of all of the strategic policies followed until 2019, other than the following changes: • strategic policy leading to creation of IN-SPACe as an independent agency operating within the purview of national space commission for promotion and facilitation of development, and regulation, of a private sector led commercial space industry. • Development of national space legislation and introduction of a formally adopted publicly declared national space policy (both of which are in process). • Re-defining the role of ISRO to focus on developing highly advanced scientific and technological capabilities, divesting the high-tech commercial space activities to NSIL (New Space India Limited) which in turn will deliver the same through the private sector.

4. Conclusion

The Indian space policy, which has consistently and cohesively guided the evolution of the Indian national space programme from its humble beginnings in 1962, to achieve the position of one of the six largest space programmes in the world today, has remained predominantly the implicit policy of the national space establishment of India. It has evolved through successive phases of the Indian space programme, as identified in the analysis, guiding the acquisition and development of national capacity in space technologies, and its operational deployment for harnessing its potential in the spheres of socio-economic development, governance, and national security.

Until recent years, there had been hardly any major incentive for, or influence upon, the Indian space establishment to formulate and adopt a publicly declared explicit national space policy, due to a simple reason: the “system-embedded implicit-policy” of the national space establishment was effectively delivering what it was primarily expected to deliver—to achieve and maintain the status of a leading space-faring nation in the world, and promote space applications in the aforesaid spheres of activity.

The unique institutional structure of the Indian space establishment, including its composition and proximity to the power-centre of the Indian government, as illustrated in the analysis, has provided the ideal environment to achieve the above mission, through directional and strategic policies that

were centrally planned, closely coordinated and efficiently executed within the walls of the space establishment. This rarely called for being informed and guided by a publicly declared explicit space policy, except in addressing such specific operational and regulatory issues as those pertaining to satellite communication services by the private sector and the use of remote sensing satellite data—for which purpose-designed limited-scope policy documents were formulated, publicly declared, and implemented.

However, the recent years have seen a major shift in India's approach to space policy. Formulation and adoption of a publicly declared, explicit, comprehensive national space policy, together with national legislation on space, has now become a top priority of the Indian space administration. The rationale stems from India's recent resolve to translate its accumulated technology gains in space into economic gains in a globally competitive, private sector-led commercial space industry. Establishment of the IN-SPACe in 2020, and the transfer of high-tech commercial space activity from ISRO to NSIL are major strategic moves already taken in this new policy direction.

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