SPACE SITUATIONAL AWARENESS AND THE UTILITY OF THE *ARTHASHASHTRA* FOR FOREIGN POLICY

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> Who controls Low Earth Orbit, controls near Earth space. Who controls near Earth space, dominates Terra. Who dominates Terra, determines the destiny of Humankind.
>
> — Everett C. Dolman (2001)[1]

STRATEGIC SIGNIFICANCE OF SSA FOR MILITARY OPERATIONS

Space Situational Awareness (SSA) can be defined as the requisite foundational, current intelligence, predictive knowledge that enables characterisation of space objects and the operational environment upon which space operations depend, thereby facilitating decision-making in the battlespace. Militarily, SSA enables us to be aware of the status of our own and the adversary's satellites and also understand the threat

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1. Everett C. Dolman, *Astropolitik* (UK: Frank Class Publishers, 2002), pp. 6-7.

emanating from them on our systems so as to gain an insight about the enemy's intent. Today, space is congested and contested. The outer space threat continuum, ranging from irreversible to reversible threats, is shown in Table 1.[2] In the present scenario, continuous monitoring and tracking of space assets and forewarning of threats to own assets (space, ground, and space-based services) is important to initiate proportionate mitigation actions. Outer space, at present, has more defunct objects than functional ones and the proposed large constellations are likely to change the scenario completely. It is expected that the number of operational satellites will surpass that of space debris by 2030. Consequently, the total number of space objects of more than 10 cm in Low Earth Orbit (LEO) is expected to be about 60,000 by 2030. Therefore, SSA is necessary for the monitoring, and protection of national space assets.

Table 1: Counter-Space Threat Continuum

Ser. No	Type of Threat	Counter-Measure Method
(a)	Irreversible	High Altitude Nuclear Detonation
		Ground Site Attack
(b)		Direct Assent ASAT (Anti-Satellite)
(c)		High Power Laser
(d)	Reversible/ Irreversible depending on capability	Laser Dazzling/Blinding
(e)		High Power Microwave
(f)		Using Co-Orbitals
		Cyber Attacks
(g)	Reversible	Uplink and Downlink Jamming
(h)		Spoofing
(i)		Using SSA for Tracking, Warning, and Targeting

2. US Defence Intelligence Agency Report, "Challenges to Security in Space", 2022, https://www.dia.mil/Portals/110/Documents/News/Military_Power_Publications/Challenges_Security_Space_2022.pdf, Accessed on January 21, 2023.

Military and Civil Perspective of SSA: From a military perspective, SSA is fundamental for the conduct of counter-space operations. Sensitivity to possible threats to space assets by kinetic and non-kinetic attacks from the land, sea, air, and space, especially due to their vulnerability, necessitates the inescapable need for robust SSA. The significance of SSA envisaged from the military and civilian perspectives is elucidated in Tables 2 and 3 respectively.

Table 2: Military Significance of SSA

Ser. No	Military Perspective
(a)	Characterisation of satellites.
(b)	Threat warning and assessment to Indian satellites.
(c)	Orbital passes over Indian region of foreign operational satellites
(d)	Blind spot time slot identification and line of view analysis of foreign satellites to conceal defence activities (ground and sea) at a particular region.
(e)	Identification of intentional manoeuvres (post-facto) by any foreign satellite and prediction of regular intentional manoeuvres using Artificial Intelligence (AI) tools.
(f)	Electromagnetic interference investigation.
(g)	Intentional manoeuvres during conflict.
(h)	Detect and report undeclared satellite launches.
(i)	Proactively ensure continuous satellite availability during war.

Table 3: Civilian Significance of SSA

Ser. No	Civilian Perspective
(a)	Knowledge of Resident Space Objects (RSOs) for safety of launch operations.
(b)	Undertake, through Conjunction Analysis (CA) and Collision Avoidance Manoeuvres (CAMs), evasive actions for Indian satellites.
(c)	Visibility, access, and ground track analysis of all operational satellites.
(d)	Reentry prediction of time and impact location of risk objects.

PREREQUISITE FOR MILITARY SSA: PREFERENCE OF INTERNATIONAL COOPERATION OVER CONTESTATION

It is imperative to first articulate the qualifying requirements of SSA data and associated sensors unique to military grade SSA and thereafter examine the means (intrinsic/leased/cooperative SSA sensors) and ways [Government to Government (G2G) agreements/Memorandums of Understanding (MoUs)/foreign policy] to achieve the desired ends of being able to exercise strategic and technical autonomy in outer space by influencing/controlling outer space operations and preemptively evading outer space threats. Table 4 elucidates a few qualifying requirements for military grade SSA data and sensors:

Table 4: Qualifying Parameters: Military SSA Data and Sensors

Ser. No	Parameter	Qualifying Requirement
(a)	**Data**	Must be from authentic, verifiable sources/sensors with minimum latency.
(b)		Must be secured whilst at rest and in transit.
(c)		Must be highly accurate not only for own space assets, but also for space assets which may come near or conjunct with own space assets.
(d)		Data in multiple formats from various types of sensors [e.g., optical, radar, passive Radio Frequency (RF), etc.] must be able to be fused with no loss in precision towards generating a Common Operational Picture (COP) for the commander.
(e)		Must be continuously validated against known truths/ standards.
(f)		Must be able to be integrated from commercial and government sensors securely, with control available with the government agency.
(g)		Must not be able to be accessed by anyone/distributed outside the government agency without authorisation.
(h)		Must be inclusive of accurate space weather data for measurement, warning and forecasting of effects of celestial activities in orbit.

Ser. No	Parameter	Qualifying Requirement
(i)	**Sensor**	Global near real-time updates
(j)		Swiftly undertake manoeuvre detection
(k)		Low latency between sensor observing and availability of processed data
(l)		Ability to undertake change detection

Attributable to the cost prohibitive nature of intrinsically establishing a dedicated SSA network and to meet the above requirements (data and sensors), military SSA would require a network of globally distributed sensors as well as data sharing agreements between satellite and sensor owners, operators, and governments, which inherently is an international and cooperative activity.

ARTHASHASHTRA AND OUTER SPACE

India is regarded as one of the major space powers, which attributable to its growing economy and stable political governance, supplemented with nuanced international roles, attempts to position itself as a natural global leader, the *Vijigishu* (potential conqueror). The *Arthashashtra* elucidates aspects which augment a state's permanence and through it, progress in a broader sense. It also establishes linkages between internal security and external policy realms, all of which are applicable in the context of outer space, towards ensuring freedom of its usage and the possibility of increased control, likely contestation and even dominance. The *Arthashashtra* is distinct in its approach as one examines the concept of power fulcrummed on following *Dharma*, as it also factors in the well-being of subjects. Governed by his *Dharma*, when the king undertakes *Raksha* (protection of the state from external aggression) and *Palana* (maintenance of law and order within the state), he strives for the attainment of *Yogakshema* for his subjects.[3] In the construct of *Yogakshema*, *Yoga*, is the successful accomplishment of an object/activity, while *Kshema* is its

3. RP Kangle, *The Kautilya Arthashashtra Part-III* (New Delhi: Motilal Banarsidass Publishers, 1965), p. 118.

India demonstrated its ability for 'offensive defence' through "Mission Shakti" in 2019, which has made it one among the four nations to have achieved this capability.

peaceful and undisturbed enjoyment.[4] From an outer space SSA perspective, *Yogakshema* could be interpreted as utilising SSA for enhancing security, well-being, prosperity, and happiness for people of the world in general, and of India in particular.

STRATEGIC CONSTRUCT

In the Kautilyan framework, the *Vijigishu* must choose his aim between consolidation of acquisitions or enlargement of his kingdom. The chosen aim can then be progressed actively or passively. The chosen *Sadgunyas* (six methods of foreign policy) are implemented using the *Prakritis* (constituent elements of his state) and are expected to elevate the state from a position of decline to status-quo and eventually graduating to advancement or progression.[5] India demonstrated its ability for 'offensive defence' through "Mission Shakti" in 2019, which has made it one among the four nations to have achieved this capability.[6] Subsequently, while addressing the nation on March 27, 2019, Prime Minister Narendra Modi, stated, "The main objective of our space programme is ensuring the country's security, its economic development and India's technological progress. Today's Mission Shakti is another important step in ensuring these dreams, which is important for ensuring the security of all these three pillars."[7] These words reiterate the contours of economy, security and foreign policy, which India, the *Vijigishu*, having projected its space power, needs to adopt. The prime minister, whilst stating India's outer space objective, implicitly also defined

4. Ibid.
5. LN Rangarajan, *The Arthashashtra* (Gurugram: Penguin Books, 1992), p. 525.
6. Mission Shakti e-book, DRDO, https://www.drdo.gov.in/mission-shakti-ebook. Accessed om January 21, 2024.
7. Address of the Hon'ble PM Shri Narendra Modi to the nation on March 27, 2019, "Mission Shakti", https://www.indiatoday.in/india/story/mission-shakti-narendra-modi-full-speech-1487838-2019-03-27. Accessed on January 21, 2024.

the outer space *Yogakshema*. The article attempts to explore if the *Arthashashtra* and its interpretation of outer space *Yogakshema* (the idea of security, well-being, prosperity, and happiness for people of the world in general and of India in particular), can be gainfully utilised towards articulating foreign policy in the outer space domain, especially focussed on SSA. In doing so, the article emphasises the prerequisites of military/civil SSA, that to optimally reap the technological benefits of SSA, it is necessary to privilege cooperation over contestation in the outer space environment.

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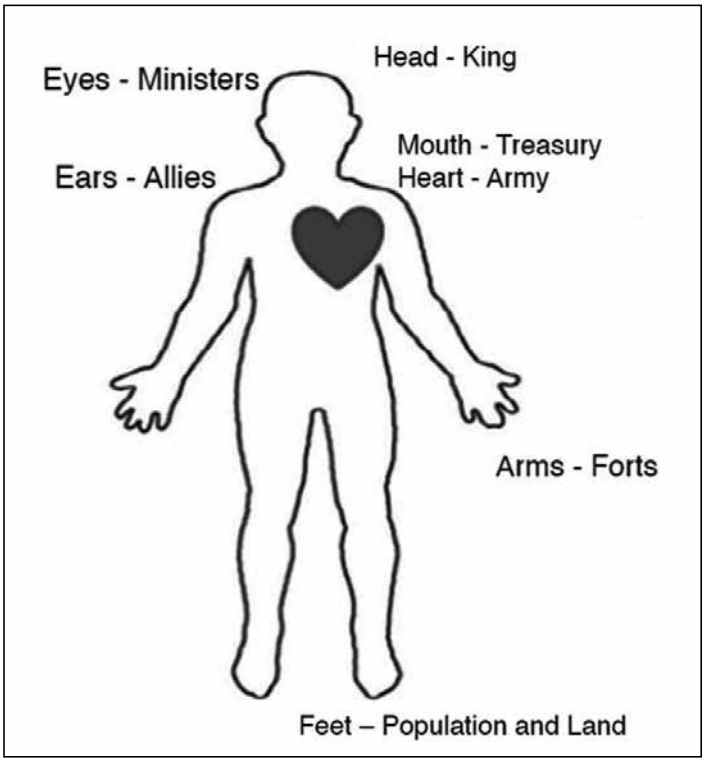
SAPTANGA THEORY

The *Saptanga* theory is the conceptual foundation of the Kautilyan state and statecraft (from the domestic and foreign policy perspectives) and is expounded in detail in Books VI and VIII respectively. The seven constituent elements of the state, enumerated in accordance with their relative importance are as follows:[8]

(a)	*Swamin*	-	Ruler
(b)	*Amatya*	-	Minister
(c)	*Janapada*	-	Territory with people settled on it
(d)	*Durga*	-	Fortified capital
(e)	*Kosa*	-	Treasury
(f)	*Danda*	-	Armed force
(g)	*Mitra*	-	The ally

8. Kangle, n. 3, p. 127.

Fig 1: Saptanga Depiction[9]



ESTIMATING RELATIVE SPACE POWER (SSA) BY THE *SAPTANGA* THEORY

The interlinkages of *Saptanga* territorial constituents with *Saptanga* outer space constituents are mentioned below in Table 5. Thereafter, the constituent elements of China, the USA and Russia have been examined with respect to SSA from a *Saptanga* construct and compared vis-à-vis India, for estimating India's relative bargaining power.

9. Lecture on the *Arthashashtra* at the Naval War College by Dr Kajari Kamal, August 3, 2023. The human body and its sense organs are associated with the *Prakritis* towards aligning with Kautilya's explanation of the seven '*Angas*' of the body working in harmony, which depicts the nature of the state as a whole.

Table 5: Territorial and Outer Space *Saptanga* Interlinkages

Ser. No	*Saptanga* Element	Outer Space *Saptanga* Interlinkage
(a)	*Swamin* and *Amatya*	The government policies and rules which have furthered SSA (civil/military) and ensured attainment of strategic and technical autonomy. Implicitly to consider the overall benefit which includes the immediate as well as potential future gain, whilst even foregoing any apparent benefits. Further, as per the *Arthashashtra*, internal security/stability is a necessary prerequisite for concentrating efforts on foreign policy options. Therefore, a prosperous and peaceful neighbourhood is a prerequisite for India's economic growth, national security, and its ascension in the global political order. *Apropos*, distribution of outer space global public goods (e.g., through sharing the SSA COP) for the benefit of the developing and underdeveloped countries, especially in the immediate neighbourhood can be considered an immediate spin-off.
(b)	*Janapada*	The number of SSA satellites and ground sensors (radar/optical) under the Command and Control (C2) of a nation, whether in its sovereign territory or abroad. A stronger/potent *Janapada* would implicitly translate to greater control over the outer space environment (legitimacy), thereby ensuring improved proximity warnings, conjunction, and collision avoidance analysis, etc. Explicitly, it would mean improving outer space agility for offence (*Danda*) and defence (*Durga*). Further, strengthening *Janapada* would also necessitate higher economic investments (*Kosha*)/G2G cooperation/ MoUs, etc. towards building/launching and operating SSA sensors.

(c)	*Durga*	The ability to use SSA for improved proximity warnings, conjunction, and collision avoidance analysis, etc, towards safeguarding (defence) of sovereign assets (space/territorial/maritime).
(d)	*Kosha*	Extent of budget allocations to the space sector, along with government policies towards augmenting civil military outer space collaboration, Research and Development (R&D).
(e)	*Danda*	Offensive ground/space-based actions (from space, in space or to space) based on accurate SSA inputs provisioned on real-time basis. This would include the ability to undertake kinetic and non-kinetic Counter-Measures (CMs).

Swamin and Amatya

The USA and Russia: The USA and Russia have been militarising space since the early 1960s. Both countries, with the support and approval of their political and administrative machinery, developed an extensive space presence during the Cold War and experimented in offensive counter-space capabilities primarily aimed at each other. With the collapse of the USSR, Russia projected its intention to remain a major actor in space, considering it a strategic military region and a sign of international prestige, and in 1992, it created the world's first Space Force and the Russian Space Agency. The US, in 1993, post collapse of the USSR, terminated its ambitious Strategic Defence Initiative (SDI) programme, while continuing to exert its dominance in outer space through successive governments by revisiting the domains of weaponisation and militarisation of outer space.

China: China's space programme began in 1956 and was substantially assisted by the former USSR. China's first major milestone came in 1970 when it launched its first artificial satellite, the Dong Fang Hong 1, from the Jiuquan launch centre, making China the fifth country to send a satellite into orbit (after the USSR, the US, France, and Japan). By the 1980s, China began launching satellites on a regular basis, and entered the commercial market,

offering to send satellites into space for companies and other countries at much cheaper cost than the US. In 1992, China announced Project 921, a programme to launch and return to the Earth a crewed spacecraft. This goal was achieved in 2003, when China became the third country after the US and Russia to use its own rocket to send a human into space. In 2015, China created the PLA SSF (People's Liberation Army Strategic Support Force), which deals with space, cyber and counter-measures. China sent a rover to Mars in 2020, accomplished a soft landing on the far side of the Moon in 2019 and collected and brought back to the Earth samples from the lunar surface. In November 2022, China finished the Tiangong space station, which it had begun building in 2011. China has issued four White Papers related to the development of space activities in 2000, 2006, 2011 and 2016, all of which are singularly advocating measures adopted by the state in propelling China to become a space power.

India: The Indian Space Research Organisation (ISRO) was established on August 15, 1969, and with the formation of the Department of Space (DoS) by the Government of India (GoI) in 1972, the Indian space programme gained due momentum.[10] In 2019, the GoI decided to set up the New Space India Limited (NSIL), a wholly owned GoI undertaking/Central Public Sector Enterprise (CPSE), under the administrative control of the DoS to commercially utilise the R&D work of ISRO.[11] Realising the significance of military space, the GoI also raised the Defence Space Agency (DSA) in 2019.[12] In June 2020, the GoI opened the space sector to the private sector, ushering in its participation in the entire gamut of space activities. The Indian National Space Promotion and Authorisation Centre (IN-SPACe) was constituted in June 2020 to boost the private space sector economy in India.[13] With the

10 DoS/ISRO, https://www.isro.gov.in/media_isro/pdf/ResourcesPdf/SpaceIndia/publication(6).pdf. Accessed on August 15, 2023.

11. Space Reforms Booklet, Government of India, 2021/09, https://transformingindia.mygov.in/wp-content/uploads/2021/09/Space-reform-booklet-compressed-1.pdf. Accessed on April 28, 2023.

12. Ministry of Defence, Government of India, *Annual Report* 2018, https://mod.gov.in/annual-report. Accessed on August 15, 2023.

13. n. 11.

The GoI has facilitated the private sector to supplement, complement, partner and even compete with, government agencies such as the IN-SPACe, ISRO and NSIL.

promulgation of the Indian Space Policy 2023, liberalisation of Foreign Direct Investment (FDI) for the space sector (February 21, 2024) and publication of Norms, Guidelines and Procedures (NGPs) (in May 2024) by the IN-SPACe for the authorisation of space activities, the GoI has facilitated the private sector to supplement, complement, partner and even compete with, government agencies such as the IN-SPACe, ISRO and NSIL.

Janapada and Durga

USA: The USA is the world leader in SSA and has the maximum deployed sensors aiding it in the development of a comprehensive COP. As part of its SSA space segment, the 'Block 10 Pathfinder' can observe space objects of the size of $1m^3$ in Low Earth Orbit (LEO), Medium Earth Orbit (MEO) and Geostationary Earth Orbit (GEO) orbits.[14] The Geosynchronous Space Situational Awareness Programme (GSSAP) 1, 2 3 and 4 satellites launched between 2010-16, provide surveillance cover to other US satellite constellations such as Space-Based Infra-Red System used for missile defence and Advanced Extremely High Frequency Constellation.[15] Through its STS-38 space shuttle mission, the US has used the satellite inspector 'Prowler' to approach satellites as close as one foot to observe the target satellite's payload, Radio Frequency (RF) signature, size, frequency, etc. The US has also collaborated with Canada and used its Near-Earth Object Surveillance Satellite (NEOSS) and 'Sapphire' constellations for tracking objects in space.[16] As part of its ground segment, the US maintains the 'Space Fence' located at Kwajalein Islands (which can track objects as small as 5 cm in space), the Ground Electro-Optical Deep Space Surveillance (GEODSS)

14. Pushpinder Bath, "Space Situational Awareness, an Essential Strategic Requirement", Vivekananda International Foundation, December 2020, pp. 1-9.
15. Ibid., pp. 1-9.
16. Ibid., pp. 1-9.

terrestrial network of telescopes situated at Socorro, Diego Garcia, Spain, and Hawaii, and a global network [Orbit Outlook project of the Defence Advanced Research Projects Agency (DARPA)] of scores of space surveillance radars and telescopes integrated with data from amateur observers and major academic institutions, the Falcon telescope network. Additionally, the US Air Force (USAF) has also built a network of 12 observatories in the US, Chile, Germany, Australia, and South Africa. The nerve centre of the space vertical of the US Joint Forces Component Command (JFCC) is the Joint Space Operations Centre (JSpOC). Manned by the USAF, the JSpOC receives inputs from the US Space Surveillance Network (SSN), 50 individual satellite operators, 11 countries and two international inter-governmental organisations.

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Russia: Russia's space surveillance network, managed by the 821st Main Space Reconnaissance Centre, is composed of a variety of telescopes, radars, and other sensors, and is capable of searching for, tracking, and characterising satellites in all Earth orbits.[17] Russian radars are spread over the complete landmass of the erstwhile USSR. However, with bilateral agreements, Russia continues to operate them even today. Russian sensors are primarily ground-based and are also augmented by ship-based sensors. Apart from the Russian mainland, the SSA sensors are deployed in Azerbaijan, Belarus, Kazakhstan, and Tajikistan. There are also a few transcontinental telescopes deployed in Asia, Africa, and South America. In addition, Russia operates the International Scientific Optical Network (ISON), which has approximately 33 facilities (including 29 for space debris observation) in 14 countries with more than 60 telescopes of different classes (aperture from 19 cm to 2.6 m).[18]

17. n. 2.
18. Bath, n. 14, pp. 1-9.

China: China has indigenous SSA capability and leads the Asia-Pacific Space Cooperation Organisation (APSCO).[19] The APSCO oversees a space surveillance project, the Asia-Pacific Ground-Based Optical Space Object Observation System (APOSOS), which has several signatory countries such as Pakistan, Mongolia, Iran, Bangladesh, Turkey, Egypt, etc.[20] China has the Yuanwang space tracking ships,[21] and has also established locations worldwide to aid in Telemetry Tracking and Command (TT&C) of space missions, both around the Earth as well as in cislunar and deep space.

India: For the last few decades, ISRO has been carrying out SSA activities, mainly focussed on launch window clearances and safeguarding India's space assets from impact by debris. Recognising the need for dedicated efforts to tackle the emerging challenges of operating in an exceedingly crowded and contested space domain, the Directorate of Space Situational Awareness and Management (DSSAM) was established at ISRO.[22] Thereafter, the Network for space object Tracking and Analysis (NETRA) project was initiated in September 2019, [23] its main elements being a radar, an optical telescope facility, and a control centre. Consequent to the conclusion of the SSA sharing agreement between India and the USA in April 2022,[24] project 'NETRA', was rechristened as the ISRO System for Safe and Sustainable Space Operations Management (IS^{4}OM) and dedicated to the nation in July 2022. On January 27, 2024, India also concluded a defence space strategic partnership on SSA with France.

19. APSCO, http://www.apsco.int/html/comp1/category/WhatisAPSCO/33-1.shtml. Accessed on August 27, 2023.
20. Ibid.
21. Subhajit Roy, "As its Spy Ship Docks in Sri Lanka Port, Beijing says: 'This is Life'", *The Indian Express*, August 17, 2022.
22. DoS/ ISRO, "ISRO SSA Control Centre Inaugurated by Dr K Sivan, Chairman, ISRO/ Secretary, DoS", https://www.isro.gov.in/ISRO%20SSAControl%20Centre.html. Accessed on June 15, 2023.
23. Madhumati D.S "ISRO Initiates Project NETRA to Safeguard Indian Space Assets from Debris and Other Harm", *The Hindu*, September 24, 2019.
24. Surendra Singh, "At 2+2, India and USA sign new pact for monitoring space objects", *The Time of India*, April 13, 2022.

Kosha

USA: The US propels its space programmes with exhaustive budget allocations. On March 28, 2022, the White House released the president's Fiscal Year (FY) 2023 budget request for the Department of Commerce, which proposed $87.7 million for the Office of Space Commerce, a $77.7 million increase above the FY 2021 enacted level, to enable significant investment in a civil operational SSA capability that meets the industry's needs.[25]

China: China spent an estimated $16 billion on its space programme in 2021, second only to the US' space budget of $60 billion. The research firm Euroconsult estimates that China spent roughly $12 billon on its space programme in 2022. This $12 billion per year of funding would likely be insufficient for China to fund both the Tiangong LEO station and a $100 billion plus lunar programme, though it is possible that more is currently being spent in opaque budgets.

India: The Indian space programme is one of the world's fastest growing, attributable to which India is moving towards increasing its capacity and capabilities of using space technology products and services not only for societal applications but also to support commercial space activities and pursue diplomatic and security objectives. This is resonated by the increase in budget allocations to the DoS/ISRO over the past five years.[26]

Danda

USA: The US Standard Missile 3 (SM-3) series of ballistic missile interceptors and ground-based interceptors are designed to destroy incoming missiles in LEO. The SM-3 is fitted on naval cruisers and destroyers, giving the US a global reach, while the ground-based interceptors are stored in silos in Alaska and California. The US demonstrated a DA-ASAT capability using SM-3 in 2008 by intercepting a non-functional reconnaissance satellite. While the US does not have a structured co-orbital Anti-Satellite (ASAT) programme, it has tested and developed many of the underlying technologies which can

25. US Office of Space Commerce, https://www.space.commerce.gov/fy23-budget-proposes-87-7m-for-office-of-space-commerce/. Accessed on June 10, 2024.
26. Shuvrajit Das Biswas, "Budget 2023", *Deccan Herald*, January 18, 2023.

be employed to produce a co-orbital ASAT system. The US Navy's Mid-Infrared Advanced Laser (MIRACL) has been used as a DEW to shoot down drones, missiles, and artillery rockets. Additionally, the USA's Tactical High Energy Laser (THEL) system offers a similar capability. In September 2014, the US Army tested the High Energy Laser Mobile Demonstrator (HELMD) which is seen as a step towards developing a 100KW (KiloWatt) class laser system to target hostile objects in space.

Russia: Russia is in the process of developing and testing a mobile missile defence complex referred to as Nudol, which Russian sources describe as capable of destroying ballistic missiles and low-orbiting satellites. Although Russia publicly describes Nudol as a ballistic missile defence system, it has an inherent counter-space capability. In 2018, the then Deputy Defence Minister Yuri Borisov said that Nudol is a "counter-space attack complex" for the Russian military.[27] Russia is also reportedly developing an air-launched ASAT weapon called the Burevestnika, for targeting spacecraft in LEO. This system is based on the Soviet-era system called 'Contact' that was designed for launching an ASAT missile from a MiG-31 fighter aircraft. In July 2020, Russia undertook a test involving the Russian satellite, Cosmos 2542, which had a smaller satellite attached to it, labelled the Cosmos 2543. The Cosmos 2542 ejected the Cosmos 2543 and fired a small projectile close to the Cosmos 2535. In addition to the movements of the Cosmos satellites, the Russian satellite Luch contributed to co-orbital activities in 2020. The Luch has been consistently moving around in the GEO belt since its 2014 launch and continues to perform Rendezvous and Proximity Operations (RPOs).

China: China has developed jammers for countering the enemy Synthetic Aperture Radar (SAR) payloads, Global Positioning System (GPS), and Satellite Communication (SATCOM). China undertakes cyber espionage against foreign space entities, consistent with broader state sponsored industrial and technical espionage. China has developed and deployed DEWs to disrupt, degrade and damage satellites. In 2007, China demonstrated ASAT capability

27. n. 2.

and undertook land-based missile interceptor tests in January 2013. Chinese satellites have undertaken co-orbital manoeuvres in 2008, 2010 and 2013.[28]

India: On March 27, 2019, India became the fourth nation (the USA, China and Russia are the other three) to have demonstrated the capability to intercept a satellite in outer space. India to-date has no demonstrated space-based counter-measure systems and neither are civilian commercial assets being deployed for defence counter-measures.[29]

Relative Strengths vis-à-vis India: The *Prakritis* analysed in the preceding paragraphs (from the SSA perspective) are pictorially represented below in Table 6 (40 per cent dark gray indicative of satisfactory and 20 per cent light gray indicative of moderate vis-à-vis other countries).

Table 6: *Prakriti* Visualisation: SSA Perspective

Prakritis	USA	Russia	China	India	France	Inference (India perspective)
Swamin and Amatya						Strong political will seeks autonomy and adherence to a rules-based order
Janapada						Moderate vis-à-vis the USA, Russia, China, and France. Needs expediting intrinsic space programmes and Friendly Foreign Country (FFC) collaboration
Durga						Moderate vis-à-vis China. Recent SSA agreements with the US and France to strengthen space-based Intelligence, Surveillance, and Reconnaissance (ISR)

28. Ibid., pp. 17-18.
29. Mission Shakti e-book, DRDO, https://www.drdo.gov.in/mission-shakti-ebook. Accessed on June 16, 2023.

Prakritis	**USA**	**Russia**	**China**	**India**	**France**	**Inference (India perspective)**
Kosha						Moderate vis-à-vis the USA and China. Space reforms wef 2020 bolstering private sector and foreign participation in Indian defence sector
Danda						India, USA, Russia, and China all have ASAT capabilities and non-kinetic means

KAUTILIYAN FOREIGN POLICY CONSTRUCT

Kautilya's foreign policy analysis is essentially theoretical: it does not deal with a particular state, but with the state as a concept.[30] The following facets of the *Arthashashtra* enable us to obtain solutions in respect of specific situations:

(a) Relative power.
(b) Deviations (e.g. calamities affecting the *Vijigishu* or his enemy).
(c) Classification by type of motivation (state vigour to pursue conquest/ consolidation).
(d) Influence of the intangible and the unpredictable.

The guiding principles of the Kautilyan foreign policy are:[31]

(a) A state must be graduated by the *Vijigishu* (through a campaign of conquest) to a progressive status through resource and power augmentation.
(b) The enemy/*Ari* must be eliminated.
(c) One who offers help is a *Mitra*/friend.
(d) Peace is preferred over war.
(e) The king's behaviour in victory and in defeat must be just.

30. Rangarajan, n. 5, p. 506.
31. Ibid., p. 510.

INDIA'S OUTER SPACE FOREIGN POLICY: KAUTILYAN PRISM

1947-69: A newly independent India, through its non-alignment policy (NAM—Non-Aligned Movement), engaged with both the USA and Russia to derive technological benefits. Lacking infrastructure and training to develop indigenous scientific products, India's outer space foreign policy was driven by necessity, forcing it to forge cooperative alliances, without compromising on autonomy. Viewed from the Kautiliyan prism, India had adopted *Samshraya* (seeking alliance) as its outer space foreign policy.

1969-93: The Indo-Pakistan War of 1971, wherein India witnessed the US military assistance to Pakistan and its subsequent diplomatic recognition of nuclear China permanently altered India's foreign policy calculus. India signalled its embrace of realism by the nuclear tests of 1974 and forged strategic alliances with Russia. Under Russia's Intercosmos programme, Squadron Leader Rakesh Sharma became the first Indian to go to outer space. India was subjected to sanctions by the US-led Missile Technology Control Regime (MTCR) during 1980-90, thereby denying it critical cryogenic engine technology to launch geostationary satellites. Viewed from a Kautiliyan prism, India adopted *Samavaya* (strategic partnership) with Russia and *Samdhaya Asana* (being quiet and preparing) with the USA (despite the sanctions) as its outer space foreign policy.

1993 Onwards: Improving its internal state elements, India achieved technological self-reliance. The success of its Polar Satellite Launch Vehicle (PSLV), Chandrayaan 1 and 3 missions and Mars Orbiter Mission (MOM) have catapulted it as a leading space-faring nation. Learning from the Kargil conflict, India also extended outer space benefits to its military strategic programmes. Once a recipient of space technology from the developed countries, India has achieved self-reliance in space transportation, satellite manufacturing and assembly, launch and telemetry control, and has leveraged its satellites for Humanitarian Assistance and Disaster Response (HADR) operations also. India has collaborated with leading space-faring

nations of the world for symbiotic capacity-building as well as launching operations. A few examples include the following:

(a) USA: NASA-ISRO Synthetic Aperture Radar (NISAR).
(b) France: Megha-Tropiques and SARAL satellites.
(c) Israel and EU: Launch operations of satellites by the Indian PSLV rocket.
(d) India's launch of the GSAT-9, the South Asian satellite in 2017, is its most high-profile initiative, which promoted space diplomacy as part of its neighbourhood policy to help Bangladesh, Bhutan, the Maldives, Nepal, and Sri Lanka boost their telecommunication and broadcasting services.

Viewed from the Kautiliyan prism, India adopted *Samdhi* (peace) and *Samavaya* (strategic partnership) with its allies (irrespective of their bargaining potential). To offset Chinese influence and provide a benign alternative to its neighbouring countries, India responded by the GSAT-9. Further, it also established a civilian and military satellite tracking and imaging centre in Vietnam in 2016. To exhibit its ability of offensive defence and technological autonomy/advances, India undertook an ASAT test in 2019 (Mission Shakti) and successfully accomplished the landing of a rover at the south pole of the Moon (Mission Chandrayaan-3) in August 2023. India, by its smart and benign outer space foreign policy choices in the relative context of its regional neighbours, demonstrated *Atisamdhana* (outmanoeuvring), whereby it projected itself as a technologically potent, benign, and promising alternative vis-à-vis China.

SADGUNYAS (FOREIGN POLICY) AND *UPAYAS* (POLITICAL OPTIONS)

The *Arthashashtra* formulates six foreign policy options for an active and expanding state in a multi-state setting when confronted with a hostile state. Application of these policies is intertwined with the various stages

through which a state progresses (status quo, decline, progress) and, hence, reflects the state of *Prakritis*, the constituent elements. Apropos, the *Sadgunyas* relate to *Saptanga*, as the correlation of relative strength dictates the choice of foreign policy.[32] Alongside the six policies, there are four *Upayas* (*Saman, Dana, Bheda* and *Danda*), which are the means for overcoming opposition[33] and guiding the selection of foreign policy. *Upayas*, along with *Sadgunyas*, sum up the ways to achieve *Yogakshema* (end goal) by utilising the means of *Prakritis* and *Anvikshiki*. Confronted with China and Pakistan as inimical neighbours, which, in most circumstances, might join forces or provide aid to each other, should there be a conflict with India, a ranked multi-pronged outer space foreign policy approach is proposed:

India, as a leading space power in the world, needs to factor in the distribution of outer space global public goods (e.g. GPS by the USA) for the benefit of the developing and underdeveloped countries, especially in the immediate neighbourhood.

Priority 1: *Samdhaya Asana, Vigrhya Asana and Samavaya* (cooperation, collaboration and strategic partnerships). This recommended approach is fulcrummed on the Kautilyan principle of 'present and future gain'. The *Arthashashtra* suggests that one should consider the overall benefit which includes immediate gain as well as potential future gain, whilst even foregoing any apparent benefits. India, as a leading space power in the world, needs to factor in the distribution of outer space global public goods (e.g. GPS by the USA) for the benefit of the developing and underdeveloped countries, especially in the immediate neighbourhood. In accordance with the tenets of the *Arthashashtra*, internal security and stability are necessary prerequisites for concentrating efforts on foreign

32. Kajari Kamal, *Kautilya's Arthashashtra: Strategic Cultural Roots of India's Contemporary Statecraft*, (New York: Routledge, 2023), pp. 20-21.
33. Kangle, n. 3, p. 255.

India is well established as a space-faring nation. With respect to its adversaries (China and Pakistan), India has relatively less but not insignificant outer space power vis-à-vis China; Pakistan is quite inconsequential at this stage.

policy options. Therefore, a prosperous and peaceful neighbourhood is a prerequisite for India's economic growth, national security, and its ascension in the global political order. However, its neighbourhood consists of some of the least advanced countries facing an acute infrastructure deficit. India, by using outer space for establishing both physical and data connectivity in the region, can alleviate this situation effectively and propel its own economic growth, given the geography of the subcontinent (*Samavaya* or strategic partnership). Through projects such as GSAT-9, Indian Regional Navigational Satellite System (IRNSS), Megha-Tropiques, Oceansat-1, setting up Ground Earth Stations (GES) in the Southeast Asian nations, subsidised launch costs for satellites, assistance in development of satellites and adapting regional projects such as ISRO's 461 village resource centre programme to also benefit the immediate neighbourhood, India could showcase itself as a benign alternative to the hegemonic approach of China.

When evaluated through the *Saptanga* matrix, India is well established as a space-faring nation. With respect to its adversaries (China and Pakistan), India has relatively less but not insignificant outer space power vis-à-vis China; Pakistan is quite inconsequential at this stage. However, India needs to be cautious about the China-Pakistan relationship, as Pakistan has the potential of being used as a vassal by China against India. Thus, India needs to be '*en-garde*' and diligently engage with superior and friendly space powers such as the US towards elevating the extant strategic partnerships (e.g. SSA and real-time exchange of imagery and electronic intelligence) to classified levels. In addition, India must continuously pursue the development of the following capabilities (*Asana*) as part of its defence posturing and enhancing its foreign policy bargaining power (*Samdhaya Asana*).

Table 7: Offensive Defence Capacity and Capability Development

Ser. No.	Type of Action (What to Do)	How to Do
(a)	Build cyber resilience capability in all its space infrastructure (ground and space).	Developing intrinsic capability through private industry-academia and government collaboration to obviate foreign dependencies and associated vulnerabilities.
(b)	Develop the Quick Response Mechanism (QRM), through Launch on Demand (LoD) capability to replace damaged satellites.	Aid other countries in quick launch by using its Small Satellite Launch Vehicles (SSLVs) and use launch ports of other nations for replacement satellites.
(c)	Undertake, as a strategy, deployment of satellite constellations, to obviate complete loss of services due to damage of one satellite.	Remote sensing and SATCOM can be requested from other countries in the event of damage to own satellite.
(d)	Sharing of SSA data.	SSA data (classified and unclassified) needs to be shared on near real-time basis amongst friendly nations to develop a Common Operational Picture (COP).
(e)	Develop ASAT capability for the entire LEO range of 2,000 km.	Using the intrinsic resources of the government, academia, and industry.
(f)	Undertake development of Co-orbital ASATs. These are orbital craft that can damage satellites through RPOs.	Using the intrinsic resources of the government, academia, and industry.
(g)	Undertake development of DEW and EW operations.	Using the intrinsic resources of the government, academia, and industry.

Priority 2: *Sambhuya Yana* (marching together). The advantages that space provides will have spin-offs in the technology getting proliferated and becoming accessible to nations. Some of these nations may harbour inimical intent (*Aribhavin)* against India or may act as vassals for India's enemies. Therefore, apart from establishing bilateral strategic partnerships, India needs to also strengthen its position through pluralistic constructs towards obviating any attempt by a state to exercise its monopoly in space. A few examples by which India can augment its pluralistic approach are:

(a) **QUAD**: The revival of the Quadrilateral Security Dialogue (QUAD) in 2017 led to the creation of a space working group amongst the four countries. During the QUAD leaders summit in May 2022, the four countries agreed to establish the Indo-Pacific Partnership for Maritime Domain Awareness (IPMDA), which involves sharing of satellite data to track illegal activities (e.g. fishing) by China on the seas. India must leverage the QUAD to enhance technology and capability exchanges, strategic utilisation of geographical locations for space monitoring, launches, training, and space exercises.

(b) **Artemis Accords**: India signed the 'Artemis Accords'[34] on June 21, 2023. By signing the accords, India has signalled its divergence from ratifying the Moon Agreement, to which it has been a signatory since 1982. Under the Artemis framework, India will undertake collaboration with other space agencies, enable its private sector to work with other Artemis members, and develop legislation that encourages space activities. The Indian Space Reforms 2020 and recent New Space Policy 2023, provide the much-needed platform for India's private space sector to capitalise on, and develop, innovative and cost-effective solutions to complex space problems, thereby symbiotically benefiting the Indian civil and defence space sectors.

34. The Artemis Accords are a set of non-binding guidelines that underpin the Artemis programme to place humans in space, build a space camp there, and carry out deep space exploration.

(c) **Sharing of SSA Data**: On the sidelines of the India-US 2+2 ministerial level talks in April 2022, both countries signed the SSA agreement.[35] The agreement involves collating data on orbiting satellites, debris, collision avoidance and conjunction warnings. While the SSA data sharing is not of a classified nature (wherein the payload characteristics can also be deciphered), India can graduate to seeking classified SSA collaboration with the USA, France, European Space Agency (ESA), etc. on lines similar to the Five Eyes Project,[36] and form a conglomerate of nations which can pool in space and ground-based resources (radars, telescopes, GES, satellites) to counter the Chinese led APOSOS. The common SSA pool can be modelled on the Indian Navy's Information Management and Analysis Centre, Information Fusion Centre-Indian Ocean Region (IMAC, IFC-IOR), which has representatives from other nations participating in building and sharing the global Marine Domain Awareness (MDA) picture.

Priority 3: *Vigraha* (waging hostilities)**.** The space battlefield and associated threat continuum have been elucidated in the preceding paragraphs. The *Arthashashtra* explains that the conqueror must control the members of the *Rajamandala* by using the four methods of the *Upaya* cluster (*Saman, Dana, Bheda and Danda*). The text further amplifies that the use of force by means of open, deceptive, or secret war is to be the last resort and is to be preceded by conciliation, gifts and dissension.[37] Any satellite system is associated with at least three segments, i.e. space segment (satellite and its payload), ground segment (users and ground Earth stations) and link segment (networks). A country undertaking hostility would attempt to disrupt all/some of these

35. Surendra Singh, "At 2+2, India, US Sign New Pact for Monitoring Space Objects", *The Times of India*, April 13, 2022.
36. An intelligence alliance of five countries, namely Australia, Canada, New Zealand, UK and USA.
37. Kangle, n. 3, p. 425.

segments. The *Arthashashtra* expounds on the three kinds of *Yuddha* (war)[38] as shown in Table 8.

Table 8: Kinds of War

Ser. No	Type of *Yuddha*	Description
(a)	*Prakasa-Yuddha* (Open Fight)	The war is fought at a predetermined place and time
(b)	*Kuta-Yuddha* (Concealed Fighting)	Involving the use of tactics on the battlefield, taking the enemy by surprise, and using ingenious ways in attack.
(c)	*Tusnim-Yuddha* (Silent Fight)	Involving secret agents and occult practices.

India is one of four space powers (the USA, Russia and China being the other three) to have demonstrated the ability to successfully undertake an ASAT test. In alignment with its preference for legally binding instruments in space, India rejected the US proposed ASAT test ban moratorium in April 2022. This signalled the Indian government's intent to keep its offensive options open, developing a common interpretation of the outer space legal framework and obviating a norms-based approach taking precedence. In the contemporary world order, threats arising from non-kinetic means (cyber attack, co-orbitals, directed energy weapons, spoofing, etc.) hold a higher probability of occurrence vis-à-vis kinetic threats such as the launch of an ASAT missile. This alludes undertaking *Tusnim-Yuddha* by the adversary as a preference, building resilience against which and undertaking a counter-offensive, thereby, becoming necessary and inescapable. The recommended actions which India must undertake, when confronted with any of the three types of *Yuddha* are shown in Table 9.

38. Ibid., pp. 258-259.

Table 9: Actions During Hostilities

Ser. No	Type of *Yuddha*	Type of Action
(a)	*Prakasa-Yuddha* (Open Fight)	• Undertake destruction of enemy ground and space infrastructure by kinetic (ASAT, co-orbital, etc.) and non-kinetic means (cyber-attack, DEWs, jamming and spoofing).
(b)	*Kuta-Yuddha* (Concealed Fighting)	• Having built own system resilience, use FFCs for verification of hostile actions. • If own system (space/ground) compromised, use FFCs for sustenance of space-based services through interoperability. • Use international bodies such as the UN to underpin the hostile states. • Undertake radar and optical network resource sharing amongst FFCs for early warning and taking evasive actions through manoeuvring of satellites. • Use SSA picture to ascertain inimical satellite blind spots and undertake offensive action against the adversary.
(c)	*Tusnim-Yuddha* (Silent Fight)	• Having ascertained the adversary's intent of undertaking undeclared deliberate and deniable attacks on own space/ground segments reciprocate with '*quid pro-quo*'. For example, one can demonstrate the use of a robotic arm on a satellite for grabbing space debris, which can also be used to offset a satellite from its orbital path. • Probe the adversary's space/ground system vulnerabilities through deliberate cyber-attacks/ any other means approved by the government. • Continuous assessment of the adversary's actions in sync with the intelligence agencies of friendly foreign countries to anticipate and obviate inimical actions

CONCLUSION

SSA is an inherently cooperative domain, which cannot be achieved holistically by any one nation alone, given its cost intensive (sensors) nature

and the geographical limitations of placing sensors. In this context, the *Arthashashtra* expounds the key elements of a kingdom (*Saptanga*), to ascertain relative bargaining power and through a sound understanding of calamities (*Vyasanas*) and own comprehensive national power (*Shakti*), ascertain the appropriate foreign policy (*Shadgunyas*) to be implemented in a dynamic environment (*Rajamandala*). The *Arthashashtra* is also distinct in its approach as one examines the concept of power fulcrummed on following *Dharma* as it also factors in the well-being of subjects. Governed by his *Dharma*, when the king undertakes *Raksha* (protection of the state from external aggression) and *Palana* (maintenance of law and order within the state), he strives for attainment of *Yogakshema* for his subjects.[39] From an outer space SSA perspective pivoted on the foundations of *Arthashashtra*, India needs to adopt a multi-pronged approach wherein it needs to develop intrinsic SSA capability and simultaneously get integrated with the FFCs for a global SSA data sharing mechanism on a G2G basis. Attributable to the development of own SSA surveillance network being cost prohibitive, it may also be prudent to examine the suitability of existing radars/optical telescopes for SSA, and thereafter integrating them into a national grid. Further collaboration with the industry/startups for indigenous SSA software development and 'SSA Data as Service' can also be explored towards balancing our security needs in a dynamic new space world order. Additionally, it is necessary to train and equip the man behind the machine. Towards this, the uniformed personnel need to be integrated with the DoS for optimising the existing capability and generating a trained human resource for undertaking effective military space operations by using credible SSA data. The ancient Indian statecraft of *Arthashashtra* with its concepts of *Prakritis*, *Sadgunya* and *Rajamandala*, etc. is still relevant in the contemporary times and can be gainfully utilised towards articulating foreign policy options for India in outer space. The article has attempted to expound its various linkages for a global common such as outer space through suitable modifications and analogies.

39. Ibid., p. 118.