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The Space Security Trilemma: Analysis of Anti-Satellite (ASAT) Weapons of the United States, China, and India

Munazza Khalid[1] & Muhammad Tehsin[2]

Abstract:

In the contemporary strategic environment, outer space has emerged as a critical domain of military competition, complementing the traditional land, sea, and air domains. As reliance on space-based assets continues to expand, major spacefaring nations invest in advanced technologies, including Anti-Satellite (ASAT) weapons, to strengthen their capabilities and secure strategic advantages in space. The United States (US) demonstrated its ASAT capability in 1985, China in 2007, and India in 2019. The emergence of ASAT capabilities among these three states contributed to a complex space security trilemma, in which measures adopted by one state to enhance its security are perceived as threats by others, encouraging reciprocal military responses. ASAT systems, particularly direct-ascent kinetic interceptors, can disable, damage, or destroy satellites during periods of conflict, thereby undermining an adversary's military space support and reducing its operational effectiveness. Against this backdrop, the present study provides a comparative analysis of the ASAT capabilities of the US, China, and India. The analysis is undertaken through the analytical framework of Space-power Theory to assess the strategic motivations, military implications, and security consequences associated with the development of these capabilities.

Keywords: Anti-Satellite (ASAT) Weapons, United States, China, India, space-power theory, space security, space security trilemma

INTRODUCTION

Outer space has evolved into a critical domain of military operations and is widely recognized as the fourth arena of warfare, complementing the traditional land, sea, and air domains. The growing dependence of modern armed forces on space-based infrastructure has transformed space into an indispensable component of national security. Consequently, states increasingly integrate space capabilities with conventional military forces to strengthen both strategic deterrence and operational effectiveness. This integration has encouraged major powers to expand their military space programs to achieve strategic superiority, maintain freedom of action in space, and secure space control.

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[1] PhD Scholar, Area Study Centre for Africa, North and South Africa, Quaid-i-Azam University, Islamabad / Lecturer, Department of Politics and International Relations, International Islamic University, Islamabad, Pakistan. Email: munazzakhalidqau@gmail.com

[2] Chairperson and Professor, Department of Defense and Strategic Studies, Quaid-i-Azam University, Islamabad. Email: tehsin@qau.edu.pk

The rapid militarization of outer space has led to the development of a wide range of space weapon technologies. These include directed-energy weapons (DEW), which employ high-energy lasers or similar technologies to damage satellites without necessarily generating orbital debris; kinetic-energy weapons (KEW), commonly known as Anti-Satellite (ASAT) weapons, which physically intercept and destroy satellites through direct impact; co-orbital systems and microsatellites capable of performing both military and civilian missions, including satellite inspection, intelligence collection, and, when required, offensive operations against other spacecraft; electronic warfare systems designed to jam or interfere with satellite communications and navigation signals; cyber capabilities targeting space-based networks and ground control infrastructure; and fractional orbital bombardment systems that further expand the military application of space technologies.

The pursuit of these capabilities reflects the strategic objective of preserving military superiority in both space and terrestrial theatres. However, as states seek to enhance their own security by acquiring advanced space weapons, their actions often generate concern among potential rivals, encouraging reciprocal military responses. This dynamic contributes to an escalating space arms race in which each technological advancement motivates competing states to pursue similar or more advanced capabilities. Such competitive interactions may produce a security dilemma and, where three major actors are involved, a security trilemma. A security trilemma arises when measures adopted by one state to strengthen its security against another simultaneously increase the insecurity of a third state, compelling it to adopt comparable military measures in response (Koblentz, 2014).

The development of ASAT capabilities by the United States (US), China, and India provides a clear illustration of this strategic dynamic. The US first demonstrated a direct-ascent ASAT capability in 1985 through the successful test of the ASM-135 missile (Sönnichsen & Lambach, 2020). China's perception of the strategic implications of this capability contributed to its own ASAT development efforts, culminating in the successful interception of one of its satellites using the SC-19 system in 2007 (Sankaran, 2014). The Chinese demonstration renewed concerns in Washington and was followed by the US' interception of a satellite using the Standard Missile-3 (SM-3) system in 2008 (Easton, 2009). These developments significantly altered the regional and global strategic environment and generated security concerns for India. Viewing the evolving capabilities of the US and China as potential challenges to its own security interests, India conducted Mission Shakti in 2019, successfully demonstrating its indigenous ASAT capability (Joshi, 2019). With this achievement, India became the fourth country, after the US, Russia, and China, to publicly demonstrate a successful ASAT interception. The acquisition of these capabilities further intensified strategic competition in outer space and extended the dynamics of the space arms race into South Asia.

Against this background, the present study examines the strategic relationship among the ASAT programs of the US, China, and India. It investigates how the competitive development of ASAT capabilities has contributed to the emergence of a space security trilemma, particularly in the South Asian strategic environment. Employing Space-power Theory as its analytical framework, the study provides a comparative assessment of the ASAT capabilities of these three states and evaluates their strategic motivations, technological developments, and implications for regional and international space security.

The principal aim of this study is to examine the strategic dynamics underlying the development and demonstration of ASAT capabilities by the US, China, and India. Unlike the majority of existing studies, which interpret counter-space competition through the conventional bilateral framework of the security dilemma, primarily emphasizing the strategic rivalry between the US and China or between the US and Russia, this research adopts a trilateral perspective. By employing Space-power Theory as its analytical framework, the study seeks to explain how the interaction among the three states has generated a space security trilemma in which the security measures adopted by one actor simultaneously influence the threat perceptions and strategic responses of the other two. Through this approach, the research offers a broader understanding of contemporary military competition in outer space and its implications for regional and global strategic stability.

This study focuses on these questions: In what ways did the strategic competition between the US and China in developing ASAT capabilities contribute to the conditions that preceded India's Mission Shakti in 2019? Can the sequence of ASAT tests conducted by the US, China, and India be interpreted as evidence of a space security trilemma within the analytical framework of Space-power Theory? What implications does the emergence of a trilateral ASAT competition have for strategic stability and security in South Asia? To what extent was India's ASAT capability influenced by China's military space advancements, and to what extent did it reflect a broader effort to emulate the strategic status of major space powers, particularly the US? What policy measures can be proposed to reduce the risks associated with the evolving ASAT competition and promote long-term stability in outer space?

LITERATURE REVIEW

Stroikos (2023) examines the ASAT tests conducted by China in 2007 and India in 2019 through an eclectic theoretical framework. His analysis combines structural factors, domestic political considerations, and issues of state identity to explain why both countries pursued counter-space capabilities. Stroikos argues that strategic pressures within the international system, together with internal political dynamics, played an important role in shaping the decisions of both states to acquire ASAT technologies. Although this approach provides a multidimensional explanation of the two programs, it gives comparatively limited attention to the broader security dynamics generated by strategic interaction among major space powers. In particular, the study does not comprehensively examine how competitive security perceptions and reciprocal military responses contributed to the sequential development of ASAT capabilities. The present research addresses this limitation by analyzing ASAT development through the concept of a space security trilemma within the framework of Space-power Theory.

Sönnichsen and Lambach (2020) analyze India's ASAT program through the perspective of the Social Construction of Technology (SCOT). Their study challenges the conventional assumption that China's and India's ASAT tests were primarily driven by an escalating space arms race. Instead, they contend that India's demonstration of ASAT capability was largely motivated by aspirations for international recognition, technological prestige, and membership among the leading space powers. According to their argument, outer space is becoming increasingly characterized by civilian and commercial cooperation, thereby reducing the likelihood of sustained military confrontation. They further suggest that expanding international collaboration in lunar exploration and deep-space missions reflects growing emphasis on prestige and scientific advancement rather than strategic competition. While this perspective highlights the importance of symbolic and status-related motivations, it places relatively less emphasis on the security environment within which India's strategic decisions were made.

Stickings (2023) argues that contemporary counter-space operations are gradually shifting away from traditional kinetic direct-ascent missile systems toward a wider range of non-kinetic and dual-use technologies. She highlights capabilities such as laser dazzling, high-powered microwave systems, cyber operations, and rendezvous and proximity operations (RPOs), all of which enable states to interfere with satellites while reducing the visibility and attribution associated with direct military attacks. Stickings further argues that technological diffusion has expanded access to these capabilities beyond the traditional major space powers, enabling emerging spacefaring states and other actors to develop increasingly sophisticated counter-space technologies. She also observes that existing international legal instruments, particularly the 1967 Outer Space Treaty (OST), provide only limited regulation of these evolving technologies, thereby contributing to the gradual normalization of ASAT capabilities within the international system. Although this study offers valuable insights into technological evolution and the limitations of existing legal regimes, it does not specifically examine the strategic motivations that encourage states to acquire ASAT capabilities or explain the sequential interaction among the US, China, and India.

Pravesh (2025) explained that space is used for active and passive military purposes. States develop and deploy satellites to enhance intelligence, surveillance, reconnaissance, navigation, and communication capabilities. But the main source of concern is the ASAT weapons that have enhanced the prospects of weaponization of outer space and would complicate the nature of future conflicts. ASAT test resulted in space debris that could collide with satellites and damage them. International regimes are unable to address this ASAT weapon issue properly. OST forbids the deployment of nuclear weapons in space and failed to curb the use and deployment of conventional weapons. But still, the Prevention of an Arms Race in Outer Space (PAROS) negotiations are stalled.

Wójtowicz (2025) provided a comparison of technological infrastructures, direct-ascent capabilities, and rendezvous and proximity operations (RPOs) of the US, Russia, and China. China's 2007 kinetic test, Russia's 2021 destruction of Cosmos-1408 using the PL-19 Nudol system, and the US' deployment of extensive SM-3 interceptors alongside RPO programs and the Geosynchronous Space Situational Awareness Program (GSSAP) have complicated the international politics of space and pose a menace to space security. This study concludes that ASAT weapons will remain weapons of last resort. The main gap in the study is that it failed to address the Indian Mission Shakti program (Wójtowicz, 2025).

THEORETICAL FRAMEWORK: SPACE-POWER THEORY AND ITS APPLICATION

This study employs Space-power Theory as its principal analytical framework to examine the strategic competition surrounding the development of ASAT capabilities by the US, China, and India. The theory provides a useful lens for understanding how military power is projected through outer space and why states increasingly regard space superiority as an essential component of national security. It explains the relationship between military space capabilities, strategic competition, and the pursuit of dominance in an environment where space-based assets have become indispensable to modern warfare.

Scholars such as John J. Klein (2004) and Bowen (2019) argue that the central objective of space-power is the achievement of command of space. In this context, command of space refers to a state's ability to utilize the space domain for its own military and strategic purposes while preventing or restricting an adversary from doing the same. According to this perspective, command of space is achieved through three interrelated functions: space control, space denial, and space blocking. Space control enables a state to operate freely in the space environment, space denial limits an opponent's ability to exploit space capabilities, and space blocking restricts the movement of information or physical systems between Earth and space whenever military necessity requires.

The strategic importance of command of space has also been emphasized by James Oberg (1999), who argues that effective control of the space domain constitutes the foundation upon which national space-power is built. Similarly, Michael V. Smith (2002) views outer space as a distinct strategic environment whose military significance requires dedicated capabilities for both space control and space weaponization. From this perspective, space is no longer merely a supporting domain for terrestrial operations but has become an independent arena in which states compete for strategic advantage. Consequently, the development of military space technologies is regarded as a prerequisite for establishing credible deterrence and maintaining national security.

Klein (2004) further argues that space power is fundamentally linked to the broader concept of national power. Since terrestrial military operations increasingly depend on space-based infrastructure, the effectiveness of armed forces is directly influenced by the security and availability of satellites. Space and terrestrial operations therefore function as mutually reinforcing systems rather than separate spheres of military activity. States capable of commanding the space domain gain significant operational advantages in communication, intelligence, navigation, surveillance, and precision targeting, whereas those lacking such capabilities become strategically disadvantaged. Thus, spacefaring nations seek to develop both offensive and defensive military space capabilities in order to preserve freedom of action while deterring potential adversaries.

Within this theoretical framework, the development of ASAT weapons represents a practical mechanism for achieving space control and space denial. By possessing the capability to disable, degrade, or destroy an opponent's satellites during armed conflict, a state can significantly reduce the effectiveness of the adversary's military operations. Satellites provide essential services for command and control, communications, computing, intelligence, information sharing, surveillance, reconnaissance, remote sensing, positioning, navigation, timing, and battlefield management. The disruption of these capabilities can undermine an opponent's decision-making process, reduce operational coordination, and weaken overall combat effectiveness. Consequently, the acquisition of ASAT capabilities by the US, China, and India can be understood as an effort to secure strategic advantages in both the space and terrestrial domains.

Space-power Theory also suggests that command of space has direct implications for military power on earth. States capable of protecting their own space infrastructure while denying similar advantages to their adversaries are better positioned to influence the outcome of terrestrial conflicts. This relationship helps explain why major powers increasingly invest in a broad range of counter-space technologies beyond kinetic ASAT weapons. For example, co-orbital satellites and microsatellites are capable of conducting inspection missions, rendezvous and proximity operations, and, under certain circumstances, offensive counter-space activities. China's Shijian (SJ) satellite series, which has demonstrated rendezvous and proximity operations, illustrates the growing strategic importance of such dual-use technologies (Bingen et. al., 2023). Likewise, DEWs have emerged as another important component of modern counter-space capabilities because they can temporarily or permanently disable satellites without creating the large quantities of orbital debris associated with kinetic interceptions.

From the perspective of Space-power Theory, the continuous pursuit of advanced counter-space capabilities inevitably intensifies strategic competition among spacefaring states. Measures adopted by one state to strengthen its security and preserve its freedom of action in space are frequently interpreted by others as potential threats, prompting reciprocal military responses. This action-reaction cycle accelerates technological competition, encourages the expansion of military space programs, and increases the likelihood of enduring space arms race. In the case of the US, China, and India, the sequential acquisition of ASAT capabilities illustrates how efforts to achieve space superiority have generated mutual insecurity and contributed to the emergence of a space security trilemma. Accordingly, Space-power Theory provides a comprehensive framework for explaining both the strategic motivations behind ASAT development and its broader implications for regional stability, military competition, and the future governance of outer space.

RESEARCH METHODOLOGY

This study employs a qualitative research methodology supported by descriptive, analytical, and theory-oriented approaches to examine the evolution of ASAT capabilities among the US, China, and India. A comparative case study design is adopted to facilitate a systematic assessment of the strategic motivations, technological developments, and security implications associated with the ASAT programs of the three states. The comparative framework enables the identification of common patterns as well as differences in their approaches to military space development within the broader context of strategic competition.

Given the highly sensitive and classified nature of military space programs, direct access to official operational information is inherently limited. To address this challenge, the study relies on data triangulation, integrating evidence obtained from multiple unclassified primary and secondary sources. These sources include government policy documents, official military statements, international treaties, reports published by research institutes, scholarly books, peer-reviewed journal articles, and reputable open-source databases related to military space activities. The use of diverse sources enhances the credibility and reliability of the analysis while reducing dependence on any single body of evidence.

In addition to documentary analysis, the study incorporates expert interviews that provide contextual understanding of contemporary developments in military space competition and assist in interpreting the strategic significance of ASAT capabilities within the framework of Spacepower Theory. The findings generated through documentary evidence and expert opinion are comparatively analyzed to explain the emergence of a space security trilemma among the US, China, and India.

ADVENT OF ANTI-SATELLITE (ASAT) WEAPONS OF THE UNITED STATES, CHINA, AND INDIA

Military space programs generally consist of two complementary dimensions: passive and active capabilities. Passive military space capabilities focus on the development, deployment, and operation of satellites that support military activities through command and control, communications, computing, intelligence, information gathering, surveillance, reconnaissance, and remote sensing (C4I2SR2) (Aliberti et. al., 2019). Collectively, these capabilities enhance situational awareness, battlefield management, precision targeting, and decision-making, thereby improving the overall effectiveness of military operations. By contrast, active military space programs emphasize the development of offensive and defensive space systems designed to deny, degrade, disrupt, or destroy an adversary's space assets during periods of conflict. Such capabilities can significantly reduce an opponent's ability to employ space-enabled military functions and weaken its terrestrial combat operations.

This section surveys the ASAT capabilities of the three states, i.e., the US, China, and India. It is followed by an analysis of the emergence of the Space Security Trilemma with its far-reaching implications for international peace and security as well as Pakistan. The section also provides policy options and recommendations that underscore the need for stronger international efforts and an effective legal framework to regulate military activities in outer space.

Anti-Satellite (ASAT) Capabilities of the United States

The US has played a pioneering role in the development of direct-ascent Anti-Satellite (DA-ASAT) technology and has conducted numerous ASAT-related tests over several decades. Although it does not currently maintain an operationally deployed dedicated ASAT system, the US retains significant counter-space capabilities and possesses extensive technological expertise derived from more than two dozen ASAT experiments and demonstrations. The evolution of these programs reflects the country's long-term objective of preserving strategic superiority in the space domain.

American interest in counter-space technologies can be traced to the late 1950s with Project Thor, a concept that proposed the deployment of tungsten rods in orbit to deliver high-velocity kinetic strikes against terrestrial targets without the use of conventional explosives. Although the project was never operationalized, it represented one of the earliest efforts to explore the military potential of space-based kinetic weapons (Hostbeck, 2015).

During the 1960s, the US initiated Program 437, also known as Nike Zeus or Project Mudflap, which constituted one of its first operational ASAT initiatives (Hostbeck, 2015). The system relied on nuclear-tipped interceptors launched from Kwajalein and Johnston Atoll to engage satellites in Low Earth Orbit (LEO) and Medium Earth Orbit (MEO) (Day, 2024). In parallel, other military programs, including Project Excalibur and Project Starfish Prime, examined the strategic implications of employing nuclear technology in the space environment (Hostbeck, 2015). High-altitude nuclear detonations conducted under these initiatives demonstrated the severe impact that such explosions could have on satellites, communications networks, and the near-Earth space environment. The destructive consequences of these experiments contributed to the negotiation of major international agreements, including the Partial Test Ban Treaty (PTBT) of 1963, which prohibited nuclear testing in outer space, and the Outer Space Treaty (OST) of 1967, which banned the placement of nuclear weapons in orbit (Jankowitsch, 2015).

The US entered a new phase of ASAT development during the 1980s with the introduction of the ASM-135 air-launched missile system. Carried by a modified F-15 fighter aircraft, the missile successfully intercepted and destroyed the Solwind P78-1 satellite at an altitude of approximately 555 kilometers on 13 September 1985 (Hostbeck, 2015). This demonstration represented a major milestone in the evolution of American counter-space capabilities and confirmed the feasibility of direct-ascent kinetic interception. Despite its technical success, the program was terminated in 1988 because of changing strategic priorities and growing concerns regarding orbital debris.

Interest in kinetic ASAT technology re-emerged in 2008 during Operation Burnt Frost, when the US launched a Standard Missile-3 (SM-3) interceptor from the USS Lake Erie to destroy the malfunctioning USA-193 reconnaissance satellite at an altitude of roughly 270 kilometers. Although the operation was publicly justified on safety grounds, it also demonstrated the precision and effectiveness of American ASAT technology. The interception generated approximately 175 trackable debris fragments, highlighting the environmental consequences associated with kinetic counter-space operations (Samson, 2025).

Beyond direct-ascent interceptors, the US continues to invest in a broad range of advanced counter-space capabilities. These include space surveillance systems, missile defense technologies, and reusable orbital platforms such as the X-37B, which enhances operational flexibility and contributes to greater space domain awareness. Recent American counter-space strategy has increasingly emphasized non-kinetic technologies, including DEWs, electronic warfare systems, cyber capabilities, and satellite-jamming technologies. These alternatives are viewed as more sustainable because they can temporarily or permanently disable adversary satellites while minimizing the creation of long-lived orbital debris.

Overall, the evolution of the US' ASAT program illustrates a gradual transition from reliance on kinetic interception toward a broader portfolio of counter-space capabilities. While the successful ASM-135 interception remains one of the most significant milestones in American ASAT development, subsequent concerns regarding debris generation and the long-term sustainability of the space environment have encouraged greater emphasis on non-destructive methods of achieving space control and denial.

Anti-Satellite (ASAT) Capabilities of China

China's pursuit of ASAT capabilities reflects its broader objective of strengthening military space power and reducing strategic vulnerability in an increasingly competitive space environment. The country's counter-space program has evolved progressively through a series of technological demonstrations that have significantly expanded its ability to challenge adversary space assets across multiple orbits.

China's initial attempts to demonstrate a DA-ASAT capability in 2005 and 2006 were unsuccessful. However, a major breakthrough occurred in January 2007, when China successfully destroyed its defunct Fengyun-1C (FY-1C) weather satellite in LEO using the SC-19 interceptor. This event marked China's emergence as a major counter-space power and demonstrated its ability to conduct precision kinetic interceptions against satellites in orbit. The test also generated a substantial quantity of orbital debris, prompting widespread international concern regarding the long-term sustainability of the space environment.

Following the 2007 demonstration, China continued to expand and refine its counter-space capabilities through a series of subsequent tests conducted in 2010, 2013, 2014, 2015, and 2018. These tests reflected continuous technological progress and indicated sustained investment in increasingly sophisticated interception systems. Different missile variants were employed to evaluate performance across various orbital altitudes and mission profiles.

Among these systems, the SC-19 interceptor has served as the foundation of China's DA-ASAT capability and has been associated with several of the earlier tests. The DN-2 system has generally been linked to missions intended to engage targets located in higher orbits, whereas the DN-3 interceptor is widely regarded as capable of reaching satellites positioned in Geostationary Earth Orbit (GEO). Collectively, these systems provide China with the potential to threaten satellites operating in LEO, MEO, and, potentially, GEO, thereby broadening the operational scope of its counter-space architecture (National Air and Space Intelligence Center (NASIC), 2018).

In addition to dedicated ASAT systems, China has integrated elements of its missile defense program into its broader counter-space strategy. The HQ-19 anti-ballistic missile has been assessed as possessing potential ASAT applications and has reportedly contributed to several Chinese missile-interception experiments. Likewise, the DF-21 missile family has been identified in strategic assessments as having potential utility within China's evolving counter-space capabilities. The integration of missile defense and counter-space technologies reflect China's effort to develop a flexible and layered military space strategy capable of supporting both defensive and offensive operations.

China's sustained investment in ASAT technologies demonstrates its determination to enhance space control and strengthen strategic deterrence. The expansion of these capabilities has not only altered the military balance in outer space but has also intensified strategic competition among major space powers. Consequently, China's counter-space program has become an important factor shaping the evolving security dynamics examined in this study through the framework of Space-power Theory and the concept of the space security trilemma.

Table 1: China's Anti-Satellite (ASAT) Tests

Type	Year	Weapon	Attempt
ASAT	2005	SC-19	Failed
ASAT	2006	SC-19	Failed
ASAT	Jan 11, 2007	SC-19	Successfully destroyed the inactive weather satellite Fengyun-1C at approximately 865 km altitude
Missile Test Suborbital	2010	SC-19	Successful
Missile Test Suborbital	2013	SC-19	Successful
ASAT	2013	DN-2	Successfully target in GEO
ASAT	2014	SC-19	Successfully tested ground-based ASAT
ASAT	2015	DN-3	Successful land-based ASAT
Missile Defense Test	2017	DN-3	Failed
Missile Defense Test	2018	DN-3	Successful

(Source: Harrison, Johnson, Roberts, & Young, 2020)

Microsatellites as Co-Orbital Anti-Satellite (ASAT) Weapons of China

China has significantly expanded its development and deployment of microsatellites as part of its broader military space program. These satellites are designed to perform a wide range of missions that support both civilian and military objectives. Their dual-use nature enables them to contribute to peaceful space operations while also providing capabilities that could be employed for offensive counter-space missions during periods of conflict. Consequently, many analysts regard these systems as an important component of China's evolving co-orbital ASAT architecture.

In peacetime, Chinese microsatellites are capable of conducting numerous activities, including satellite inspection, orbital servicing, debris removal, and technological experimentation. They are also designed to support On-Orbit Servicing, Assembly, and Manufacturing (OSAM) missions, which involve repairing, relocating, or servicing spacecraft already operating in orbit (Goswami, 2023). In addition, these satellites can perform close-proximity inspections and gather technical information from other satellites, thereby enhancing China's space situational awareness. However, the same technologies can potentially be adapted for military purposes, including electronic surveillance, intelligence collection, interference with satellite operations, or the physical capture and disabling of an adversary's spacecraft. This dual-use capability makes it difficult to distinguish between civilian and military activities, thereby increasing strategic uncertainty in outer space.

Among China's most prominent dual-use satellite programs is the Shijian (SJ) satellite series. Several satellites in this family have demonstrated sophisticated orbital maneuvering capabilities that are directly relevant to co-orbital counter-space operations. For example, SJ-06F and SJ-12, launched in 2010, demonstrated advanced maneuverability and close-proximity operations (Goswami, 2023). Similarly, SJ-17 and SJ-21, deployed in GEO, have further expanded China's ability to conduct complex orbital missions. During 2021 and 2022, China successfully carried out a series of Rendezvous and Proximity Operations (RPOs) using Shijian satellites, demonstrating precise orbital navigation and the capability to approach, inspect, and maneuver around other space-crafts (Bingen et. al., 2023). Although these operations have legitimate civilian applications, they also possess clear military relevance because similar techniques could be employed to interfere with or neutralize hostile satellites during armed conflict.

China has also developed the Shiyan (SY) experimental satellite series, which serves as a platform for testing advanced space technologies. These satellites are believed to support a variety of missions, including electronic warfare experiments, satellite inspection, and technologies potentially applicable to co-orbital ASAT operations. Their experimental nature allows China to evaluate emerging counter-space capabilities while simultaneously advancing its broader space technology program.

Another notable development is the Roaming Dragon spacecraft, which has been designed primarily for orbital debris removal and the recovery of non-functional satellites. Such technologies contribute to improving the long-term sustainability of the space environment by reducing orbital debris. Nevertheless, because they possess robotic manipulation and close-proximity capabilities, they also have the potential to be adapted for military purposes. A spacecraft capable of capturing or relocating inactive satellites could, under different operational circumstances, be employed to seize, disable, or remove an adversary's satellite. This illustrates the inherent dual-use character of many contemporary space technologies.

International attention was also drawn to China's maneuverable satellite capabilities in 2008, when one of its nanosatellites reportedly approached the vicinity of the International Space Station (ISS). Although such maneuvers may support scientific research and technology demonstrations, they also underscore the strategic significance of precision orbital maneuvering. The ability to approach another spacecraft with a high degree of accuracy can support activities such as inspection and servicing, but it may equally facilitate offensive counter-space operations. Consequently, China's continued investment in microsatellite and co-orbital technologies has become an important element of the evolving military competition in outer space and reinforces concerns regarding the emergence of a space security trilemma among major spacefaring states.

Table 2: China's Co-Orbital Anti-Satellite (ASAT) Capabilities

Weapon/operation name	Type	Notes
Shijian (SJ) SJ-06F and SJ-12 microsatellites.	Dual use co-orbital ASAT space weapons.	These were deployed in 2010
SJ-17 and SJ-21 microsatellites	Dual use co-orbital ASAT space weapons.	These are deployed in GEO.
Rendezvous and Proximity Operations	Space operation in which SJ satellites were tested as ASAT weapons	In 2021 and 2022, China has conducted "Rendezvous and Proximity Operations by utilizing Shijian (SJ) satellites.
Shiyan series (SY) experimental satellites	Dual use co-orbital ASAT space weapons	Deployed in space as co-orbital space weapon
Roaming Dragon small craft	Dual use co-orbital ASAT space weapons	Used for debris cleaning and ASAT weapons.

(Source: Developed by the researcher)

China has also invested in advanced technologies beyond kinetic and co-orbital counter-space systems. One notable example is the development of a quantum communication satellite, intended to demonstrate highly secure space-to-ground communications that are resistant to conventional cyber intrusion and interception. Together with its expanding portfolio of direct-ascent, co-orbital, cyber, and electronic counter-space capabilities, these developments reflect China's broader strategy of strengthening its position as a major space power.

From the perspective of Space-power Theory, China's military space modernization is directed toward achieving space control, preserving freedom of action in the space domain, and limiting an adversary's ability to exploit space-based assets during periods of conflict. These capabilities enhance China's potential to deny, degrade, disrupt, or disable an opponent's satellite infrastructure, thereby affecting critical military functions such as communications, intelligence, surveillance, reconnaissance, navigation, and command and control. At the same time, the continued expansion of China's counter-space capabilities contributes to growing strategic competition in outer space, encouraging reciprocal military responses by other spacefaring states and reinforcing the dynamics of the emerging space security trilemma.

India's Mission Shakti: The Development of Anti-Satellite (ASAT) Capability

India's pursuit of an indigenous ASAT capability culminated in Mission Shakti, marking a significant milestone in the country's military space program. Before its successful demonstration, India reportedly attempted an interception on 12 February 2019; however, the effort did not achieve its intended objective. A second attempt was carried out successfully on 27 March 2019, when India intercepted and destroyed its Microsat-R satellite, which had been launched on 24 January 2019 into LEO at an altitude of approximately 300 km (Biswas et. al., 2019).

The successful execution of Mission Shakti established India as the fourth country, after the US, Russia, and China, to publicly demonstrate an operational ASAT capability. Indian policymakers presented the test as an essential component of the country's national security strategy, arguing that the capability would strengthen strategic deterrence and provide a credible response to the expanding military space capabilities of China. From New Delhi's perspective, Mission Shakti was intended to safeguard India's space-based assets and reinforce its position as an emerging major space power.

Despite these stated objectives, the strategic implications of India's ASAT capability extend beyond Sino-Indian competition. Within the South Asian security environment, concerns have been raised that such capabilities could also influence the regional strategic balance by providing India with the potential to target space-based systems that support Pakistan's military C4I2SR2 capabilities during a future conflict. From this perspective, the development of India's ASAT program has introduced an additional dimension to regional deterrence dynamics and has generated new security concerns regarding strategic stability in South Asia.

The Emergence of a Space Security Trilemma

The evolution of ASAT capabilities among the US, China, and India demonstrates the emergence of a space security trilemma, in which the security measures adopted by one state increase the perceived insecurity of the other two, encouraging successive military responses. Rather than representing isolated technological developments, the ASAT programs of these three countries illustrate a sequential pattern of strategic interaction that has intensified competition in the space domain.

The origins of this competition can be traced to the US' early efforts to develop military space capabilities during the Cold War. Initial initiatives, including Project Thor, Program 437, Project Mudflap, Project Excalibur, and Project Starfish Prime, reflected the strategic rivalry between the US and the former Soviet Union. Although these programs differed in purpose and technological maturity, they collectively established the foundation for American counter-space capabilities. A major milestone was achieved on 13 September 1985, when the US successfully demonstrated the ASM-135 DA-ASAT system. More than two decades later, following China's successful ASAT interception in 2007, the US conducted another kinetic interception using the SM-3 during Operation Burnt Frost in 2008, reaffirming its advanced counter-space capabilities.

China's ASAT program evolved within this changing strategic environment. Following unsuccessful attempts in 2005 and 2006, China successfully intercepted the FY-1C weather satellite on 11 January 2007 using the SC-19 interceptor. This event marked a turning point in contemporary military space competition and demonstrated China's ability to challenge space assets in LEO. China subsequently expanded its counter-space program through additional tests involving the SC-19, DN-2, and DN-3 systems between 2010 and 2018, while simultaneously investing in co-orbital technologies such as the Shijian (SJ) satellite series, Shiyan (SY) experimental satellites, and the Roaming Dragon spacecraft. The successful execution of Rendezvous and Proximity Operations (RPOs**)** during 2021 and 2022 further highlighted China's growing expertise in advanced orbital maneuvering and dual-use counter-space technologies.

The expansion of Chinese military space capabilities significantly influenced India's strategic calculations. As competition between the US and China intensified, India increasingly perceived the need to develop an indigenous capability capable of protecting its national interests in space. This strategic environment ultimately led to the successful demonstration of Mission Shakti on 27 March 2019, following an earlier unsuccessful attempt in February of the same year. By acquiring an operational ASAT capability, India entered the group of states possessing demonstrated counter-space capabilities, thereby extending the strategic competition into South Asia.

The sequential acquisition of ASAT capabilities by the US, China, and India illustrates the action-reaction dynamics central to the concept of a space security trilemma. Each state's effort to strengthen its own security generated new strategic concerns for the others, encouraging reciprocal investments in military space technologies. Consequently, the pursuit of deterrence and strategic advantage by one actor contributed to heightened insecurity across the broader regional security environment.

The growing diffusion of ASAT technologies has also intensified concerns regarding the long-term sustainability of outer space. Kinetic interceptions generate orbital debris that poses persistent risks to operational satellites, crewed spacecraft, and space stations, thereby affecting both military and civilian activities. At the same time, the increasing deployment of dual-use co-orbital systems, microsatellites, cyber capabilities, electronic warfare technologies, and other counter-space assets has made attribution more difficult and further complicated strategic stability. As leading spacefaring nations continue to expand their military space capabilities, the interaction among the US, China, and India illustrates how competition for space superiority has evolved into a multidimensional security challenge with significant implications for South Asian stability and the future governance of outer space.

Table 3: Comparative Analysis of ASAT Capabilities of the US, China, and India

Country	ASAT Tests	Number of Confirmed Tests	Typical Target Altitudes
United States	(1985, 2008)	2 major destructive tests	around 555 km (1985), Low/Medium LEO (2008)
China	(2007)	1 confirmed destructive test; several interceptor tests since then	around 865 km (Fengyun-1C)
India	(2019)	1 destructive test; 1 earlier failed attempt	Low Earth Orbit (LEO) at 300 km (Microsat-R)

(Source: Developed by the researcher)

Policy Options and Recommendations

The findings of this study indicate the need for stronger international efforts to regulate military activities in outer space. Existing legal frameworks provide only limited guidance on emerging counter-space technologies, particularly those involving dual-use systems, cyber operations, DEWs, and co-orbital capabilities. Greater international cooperation aimed at developing confidence-building measures, transparency mechanisms, and effective space arms control arrangements could contribute to reducing the risk of misunderstanding, escalation, and the creation of long-lived orbital debris.

From Pakistan's perspective, India's demonstrated ASAT capability has introduced new strategic considerations into the regional security environment. These developments have generated debate among Pakistani strategic analysts regarding appropriate responses to evolving counter-space capabilities. Some experts argue that Pakistan should gradually strengthen its indigenous space security and counter-space technologies to preserve strategic deterrence and reduce potential vulnerabilities. Others emphasize that any future capability development should take into account technical feasibility, financial sustainability, and the potential consequences for the long-term security of the space environment. In this context, non-kinetic counter-space capabilities, including directed-energy technologies, electronic warfare systems, cyber capabilities, and advanced space situational awareness, are frequently discussed as alternatives that may avoid the extensive orbital debris associated with kinetic ASAT tests.

Interviews conducted during this research also reflect differing expert assessments of Pakistan's future policy options. Air Commodore Khalid Banuri emphasized that Pakistan may eventually need to develop indigenous counter-space capabilities; however, he stressed that such efforts would require sustained investment, technological development, and effective public-private partnerships to address existing financial constraints (Khalid Banuri, personal communication, June 2, 2026).

Similarly, Dr. Zafar Nawaz Jaspal observed that India's Mission Shakti has important implications for Pakistan's strategic planning and argued that the country should continue strengthening its space and missile capabilities while carefully balancing national security requirements with broader economic priorities (Zafar Nawaz Jaspal, personal communication, June 2, 2026).

Overall, the study concludes that maintaining long-term stability in outer space will require a combination of national capability development, regional confidence-building measures, and renewed international efforts to establish effective norms governing military activities in the space domain. Such initiatives would contribute not only to reducing strategic uncertainty among major spacefaring states but also to preserving the sustainable use of outer space for future generations.

CONCLUSION

Outer space has become an increasingly contested strategic domain in which major powers seek to strengthen their military capabilities and secure freedom of action. As modern armed forces depend heavily on space-based infrastructure for C4I2SR2PNT, and battlefield management. The protection of these assets has become an important component of national security. Consequently, many spacefaring states have invested in counter-space technologies designed to protect their own space systems while limiting an adversary's ability to exploit similar capabilities during periods of conflict.

This study demonstrates that the development of ASAT capabilities by the US, China, and India reflects an evolving pattern of strategic competition that can be interpreted through the analytical framework of Space-power Theory. The US' successful demonstration of the ASM-135 ASAT system in 1985 established an important milestone in military space operations. China's successful interception of the Fengyun-1C satellite in 2007 significantly altered the strategic landscape by demonstrating an indigenous kinetic ASAT capability. The subsequent American interception using the SM-3 in 2008 reaffirmed the continued importance of counter-space technologies within U.S. military strategy. Against this background, India's successful Mission Shakti test in 2019 reflected its determination to establish an independent counter-space capability and strengthen its position among the world's leading space powers.

The sequential development of ASAT capabilities by these three countries illustrates the dynamics of a space security trilemma, whereby measures adopted by one state to enhance its security generate new security concerns for others, encouraging reciprocal military responses. This competitive interaction has accelerated the militarization and weaponization of outer space and expanded the scope of strategic competition beyond the traditional terrestrial domains. At the same time, the continued development of kinetic and non-kinetic counter-space technologies raises important concerns regarding strategic stability, crisis escalation, and the long-term sustainability of the space environment. Accordingly, the findings of this study suggest that military competition in outer space is likely to remain a significant feature of contemporary international security.

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