ASBMUN 2025

COPUOS Topic 1

Research Report

American School of Bombay

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Edited and revised by the ASBMUN Secretariat.

Forum: ASBMUN 2025

Committee: United Nations Committee on the Peaceful Uses of Outer Space

Topic: Measures to manage and mitigate space debris

Chair: Sarah Zuwairi

Letter from Student Officers

Greetings, delegates! I would firstly like to welcome you all to the annual ASBMUN conference! My name is Sarah Zuwairi and it is my utmost pleasure to serve as your Head Chair for this year's simulation of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS).

The Committee on the Peaceful Uses of Outer Space was created in 1959 by the General Assembly after the first human-made satellite orbited the Earth in 1958. The main goals of the committee are to discuss peaceful uses of space, and therefore prevent any form of injustice within the upper atmosphere. As technology progresses and advances, the topic of outer space becomes more and more relevant to our generation. The exploration of space has been a historical landmark and milestone for humanity, but the proper disposal and consequences of our actions become apparent as we delve deeper into research. A prime example of such a consequence is space debris, a growing concern as space exploration expands.. Thus, it is important to discuss such measures to prevent space debris from further problematizing the future generations to come.

Considering the critical nature of the agendas being discussed, every delegate of the UN Committee on the Peaceful Uses of Outer Space must remember that the decisions they take will have far-reaching consequences and that the opportunity afforded here is to potentially change the world profoundly.

Through the course of the three days of this conference, we trust that you all will discharge your duties aptly and have loads of fun in the process! Never forget that the aim of this conference is to enhance your understanding of the situation worldwide in the most interesting and enjoyable way possible! We look forward to seeing you all in committee and presiding over your deliberations! Good luck!

Sarah Zuwairi

Head Chair of COPUOS
ASBMUN 2024

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Introduction

According to the European Space Agency, there are currently around 34,000 pieces of debris larger than 10 cm circulating around the Earth. This space debris was caused by events such as space collisions between spacecraft and other space objects, defunct satellites with nowhere to be disposed of, and discarded components of rockets. After mankind had launched their first man-made satellite in 1958, further exploration has led to more and more production of debris within the atmosphere. Space debris, or orbital junk, starts to become an issue as it reaches the low Earth orbit. Within that atmosphere, there is a chance for the junk debris to potentially cause a risk for future spacecrafts, which would cause more dangerous collisions as well as more debris. Remaining in low Earth orbit (LEO) would also endanger the planet we reside on as this space junk can hover around the atmosphere at high speeds and may pose a risk to people and property on Earth. The LEO also develops into an ‘orbital graveyard’ which may cause contamination to the Earth’s atmosphere.

There have already been many initiatives to manage space debris, especially inaugurated by government bodies such as the United Nations. Issues begin to arise when private space organizations such as SpaceX begin to independently initiate exploration without national funding. Most countries have guidelines and restrictions on specifically who can enter the upper atmosphere if they were to launch on the country’s ground, which became popular after the UN released the UN Guidelines on Space Debris Mitigation. As more spacecrafts are launched more frequently and by different space exploration organizations, a form of injustice may arise, leading to political tensions if spacecraft from different nations cause damage to one another. Furthermore, it causes an issue of who the responsibility goes to when harm is caused by a spacecraft. This especially becomes exaggerated when private sectors and companies launch satellites as they are not under official national government bodies and therefore, may be able to avoid liability from international guidelines. Similarly, if any accidents cause damage to an international spacecraft, such as the International Space Station (ISS), an abundance of countries and citizens would be threatened. As governmental bodies, there is a need for the prevention of unnecessary space debris but also how to mitigate the space debris whilst it orbits the Earth and can possibly cause harm. Researchers have studied long on how to safely and sustainably discard space debris, so it is the nation's job to facilitate such studies as well as provide possible solutions with funding.

The theme of this year’s ASBMUN Conference is Sustainable Development Goal 16: Peace, Justice, and Strong Institutions. This topic ties into this theme as such measures require international collaboration and therefore, will facilitate and encourage peace between national space exploration bodies. Managing space debris is not an issue that can be dealt with by only one organization or country, as it requires the cooperation of many countries such as member states of the United Nations. Hence, it

will also motivate justice with responsibility for sustainable development of space exploration.

Definition of Key Terms

Space debris

Artificial material produced by humans from means such as defunct satellites that continue to orbit around the Earth but aren't functional.

Spacecraft

A vehicle that was constructed to be operated in outer space for reasons including space travel and/or operations within space outside of Earth's inner atmosphere.

Celestial bodies

A naturally occurring physical object, structure, or organization within space. This is relevant to this topic as it acts as naturally occurring space debris and may potentially worsen the production of space debris or may get damaged by the debris itself.

Low Earth Orbit (LEO)

As the name suggests, it is an orbit of an object that is considered to be relatively low and close to the Earth's surface. According to the European Space Agency, It is normally at an altitude of less than 1000 km but could be as low as 160 km above Earth.

Satellite

Often referring to artificial satellites, an object, typically a spacecraft, that was manufactured with the intention of orbiting a larger object in space or other celestial bodies. This term can also refer to smaller celestial bodies that orbit around others of larger size.

Space junk

Any piece of machinery or discarded parts of spacecrafts that remain in orbit. This term is used to refer specifically to man made space debris from man made creations.

Uncontrolled Reentry

The unguided entry of space junk back into the Earth's atmosphere. These are often unplanned

and unpredictable and may pose a threat on land.

Background Information

Space debris first began to accumulate after the launch of Sputnik 1 in 1957, the first human made satellite and therefore the first creation of artificial orbital debris. As space exploration was still new to the time and researchers had only focused on achieving their goal of reaching space in the first place, there was a lack of focus on long-term sustainability within space. A realization soon came afterwards to focus on the surveillance of space junk which could potentially pose an issue later on. As for the already existing debris, most were planned to simply initiate uncontrolled reentry which could be to be more threatening rather than beneficial. These pieces of debris also move at an extremely fast speed with reports of speeds of 18,000 miles per hour. As a result of this, space debris became very hard to avoid but there wasn't much existing debris circulating yet. Researchers had now considered sustainability as an important factor of space exploration subsequent to technology advancing and space travel becoming more frequent.

The issue of justice in space had been brought up during the Cold War space race where a diplomatic problem on earth had reached all the way to outer space, where the Soviet Union and the United States wanted to prove their superiority. Throughout their conflict, more satellites were released into the upper atmosphere and thus, more debris was created. Whilst events of major satellite and debris collisions are rare, there have been a few instances. For example, China had launched a rocket in 2024 which ended up breaking apart and creating a cloud of debris in the LEO. This event caused anxiety within the population as there was a risk of these pieces of debris hitting Earth and causing harm to people or property.

To combat this issue, most satellites currently utilize a system which helps them to maneuver out of the path of moving debris. This system has so far avoided many collisions, and even bigger spacecrafts such as the ISS have used this system to maintain the safety of its astronauts onboard. A more recently occurring issue within mitigation of space debris is the abundance of mega-constellations. These larger spacecraft systems tend to produce a lot of debris due to their larger size, and they can also cause space congestion due to their abundance and requirement of a large amount of satellites. Collisions with debris can often cost governments and organizations billions of dollars, especially with the risk of safety involved. As more technology is developed to combat these collisions and unnecessarily eliminate space debris, the cost will naturally increase and long-term sustainability will become a major concern.

Major Countries and Organizations Involved

UNOOSA (United Nation Office for Outer Space Affairs)

Universally recognized for their efforts on peace in space, this office was founded along with the COPUOS to handle international issues within outer space. They value the importance of sustainability especially within space travel but also work towards accessibility to space for all countries, developed or not. An important pursuit of theirs that is relevant to this topic is their management of the Space Debris Mitigation Guidelines which was endorsed by the General Assembly in 2007 and continues to be refined by the UNOOSA to this day.

United States

Many important space organizations are based in the United States and therefore a lot of restrictions and guidelines have been put in place. Notable organizations include the National Aeronautics and Space Administration (NASA) which is well-known for their advances in space travel and the US Space Force, a branch of the US Armed Forces which focus on protecting US' interests in outer space.

ESA (European Space Agency)

This is Europe's main space travel organization with 23-member nations. Their initiatives on the mitigation of space debris include having specific guidelines and a new policy for space debris mitigation in order to include stricter restrictions during their missions which will allow more control in managing the creation of space debris. Additionally, the Clear Space initiative guarantees sustainable research and exploration of space travel.

IADC (Inter-Agency Space Debris Coordination Committee)

The IADC is an international governmental forum that primarily focuses on cooperation of activities to reduce space debris internationally. There are 13 member governmental bodies from all over the world, and the forum is a platform for coordination and worldwide communication. They also released the IADC Space Debris Mitigation Guidelines in 2002 which served as a basis for the United Nations version which was released in 2007.

China

China is often a nation of many technological developments and advancements, so it is no surprise that they have also played a big role in space exploration. However, their advancements unfortunately have

held a negative relevance within the topic. There have been multiple instances of China causing major amounts of space debris, such as in 2007 where a weather satellite was destroyed by a missile, causing debris from both objects.

Timeline of Events

Date	Description of Event
October 4th, 1957	The launch of Sputnik 1, the first ever man made satellite
January 27th, 1967	The UN's first major space law, the Outer Space Treaty, is signed by 110+ countries
March 29th, 1972	Convention on International Liability for Damage Caused by Space Objects occurs
September 1st, 1993	Formation of the Inter-Agency Space Debris Coordination Committee (IADC)
January 11th, 2007	China destroys their own weather satellite with a missile and creates 3,000 pieces of debris. This sparks controversy about lack of regulations with the creation of space debris, a potential risk to people inland.
February 7th, 2008	UN Publishes Space Debris Mitigation Guidelines
February 10th, 2009	U.S. satellite Iridium-33 collides with Russian satellite Cosmos-2251 over Siberia and generates over 2,000 debris fragments, worsening orbital congestion.
November 15th, 2021	Russia destroys the defunct Cosmos-1408 satellite using a missile and creates over 1,500 debris fragments, endangering the International Space Station (ISS). This leads to renewed calls for a binding international treaty on space debris and ASAT weapons.

Relevant UN Treaties and Events

- **Outer Space Treaty, 1967** - Adopted by the United Nations General Assembly under Resolution 2222 (XXI), the Outer Space Treaty (OST) is one of the most fundamental legal frameworks governing space activities. It establishes that outer space is free for exploration and must be used for peaceful purposes, prohibiting the placement of nuclear weapons or other weapons of mass destruction in orbit. While it establishes that outer space must be used for peaceful purposes and prohibits the placement of weapons of mass destruction in orbit, it does not

explicitly address space debris. However, the treaty assigns state responsibility for all national space activities, including those conducted by private entities, making governments liable for damage caused by their satellites or debris. This principle of liability creates a broad framework for accountability, but it lacks enforcement mechanisms or clear guidelines on preventing debris generation. As space activity has evolved dramatically since the treaty's adoption, its failure to address the modern challenge of orbital congestion and debris mitigation makes it insufficient for contemporary space sustainability needs. Reform efforts could focus on updating the treaty to include specific obligations for debris management, such as requiring nations to monitor and actively mitigate debris from their satellites and spacecraft, with penalties for noncompliance.

- **United Nations Space Debris Mitigation Guidelines, 2007** - Recognizing the increasing risk posed by space debris, the United Nations Office for Outer Space Affairs (UNOOSA) and COPUOS introduced the Space Debris Mitigation Guidelines in 2007. These guidelines are designed to minimize the creation of new debris and promote responsible space practices and were based on recommendations from the Inter-Agency Space Debris Coordination Committee (IADC). Some of the key recommendations include ensuring that satellites deorbit within 25 years of mission completion, reducing debris generation during rocket launches, and limiting in-orbit explosions that could worsen space congestion. While these guidelines provide a crucial framework for reducing future debris, their non-binding nature has resulted in inconsistent implementation. Some space agencies, such as NASA and ESA, have incorporated them into national policies, but many commercial satellite operators and emerging space nations lack strong incentives to comply. The guidelines are also outdated, as they do not account for modern challenges like mega-constellations, commercial spaceflight, or private space station development. A necessary reform would be to convert these recommendations into legally binding international regulations, ensuring that all spacefaring entities—both governmental and private—follow standardized debris mitigation practices.
- **UN Resolution on the Prevention of an Arms Race in Outer Space, 2022** - The growing threat of space militarization and destructive anti-satellite (ASAT) tests has led the United Nations General Assembly to adopt multiple resolutions aimed at preventing an arms race in outer space (PAROS). The 2022 UN Resolution on PAROS reinforces the principle that space must remain a peaceful domain, urging nations to refrain from developing or testing ASAT weapons, which are a major contributor to space debris. Past ASAT tests, such as China's 2007 destruction of the Fengyun-1C satellite and Russia's 2021 Cosmos-1408 test, created thousands of debris fragments, threatening satellites and even forcing astronauts on the ISS to take emergency shelter. This resolution calls for the creation of legally binding agreements to ban the deliberate

destruction of satellites and enhance space security. While it has been supported by many nations, some major space powers, including the U.S., Russia, and China, have resisted binding commitments, highlighting the difficult balance between national security interests and global space sustainability.

Previous Attempts to Solve the Issue

- ### International Treaties and Legal Agreements

One of the earliest frameworks for space sustainability was the 1967 Outer Space Treaty (OST), which established general principles for space activities but did not specifically regulate space debris. The 1972 Liability Convention held nations accountable for damages caused by their space objects, but it also failed to impose proactive debris mitigation measures. In 2007, the United Nations COPUOS Space Debris Mitigation Guidelines were introduced, recommending best practices such as: post-mission disposal of satellites and rocket stages, deorbiting within 25 years after a satellite's operational lifetime, and minimizing in-orbit explosions to prevent debris fragmentation.However, these guidelines were non-binding, meaning nations and private companies could choose whether to follow them, limiting their effectiveness.

- ### National Policies and regulations

After the creation of the UN Space Debris Mitigation Guidelines, governmental bodies and space agencies began to create their own policies and reinforcement to prevent the creation of space debris from the national perspective. The United States, for example, has developed orbital debris mitigation standards through NASA and the Federal Communications Commission (FCC), requiring satellite operators to ensure responsible end-of-life disposal. The European Space Agency (ESA) has similarly emphasized sustainability, with policies aimed at minimizing debris creation and initiatives such as ClearSpace-1, a planned 2026 mission to actively remove debris from orbit. Meanwhile, China has updated its space laws to include debris mitigation measures, but its past actions, such as the 2007 ASAT test that shattered the Fengyun-1C satellite into thousands of fragments, have contributed significantly to the debris crisis. A key issue with these national regulations is that they apply only to the countries enforcing them, meaning there is no universal standard ensuring all space agencies comply.

- ### Active Debris Removal Technology

Alongside policy efforts, there have been attempts to develop active debris removal (ADR) technologies. Some experimental missions have been launched to test methods of capturing and

removing debris from orbit. Japan's KITE experiment in 2017 explored the use of electrodynamic tethers to slow down and deorbit space debris. ESA's ClearSpace-1, planned for 2026, aims to use robotic arms to capture and deorbit a defunct satellite. Astroscale's ELSA-d mission, launched in 2021, tested magnetic capture technology to remove debris. While these projects represent promising advancements, they remain expensive and in early stages of development, making large-scale implementation difficult.

- **Bans on Destructive ASAT Tests**

Another major concern is the intentional creation of debris through destructive ASAT tests. Recognizing the long-term hazards these tests pose, the United Nations adopted Resolution 76/231 in 2021, urging countries to refrain from deliberate satellite destruction. The United States became the first nation to announce a voluntary ban on ASAT tests in 2022, with other countries, including Canada, Germany, and Japan, following suit. However, key space powers such as China, Russia, and India have not made similar commitments, leaving the possibility of future ASAT tests open and undermining global efforts to prevent further debris generation.

Possible Solutions

One potential solution to managing space debris is the implementation of legally binding international regulations that require all spacefaring nations and private entities to follow strict debris mitigation practices. While the UN COPUOS Space Debris Mitigation Guidelines exist, they are non-binding, meaning compliance is voluntary. To enhance enforcement, the international community could establish a treaty under the United Nations Office for Outer Space Affairs (UNOOSA) that mandates responsible satellite disposal, limits ASAT tests, and enforces strict liability for debris creation. Countries and private companies that fail to comply could face economic sanctions or restrictions on launching new satellites. Additionally, a unified global tracking system managed by an international body, such as the International Telecommunication Union (ITU) or UNOOSA, could monitor compliance and enforce penalties for violations. By turning space debris mitigation from a recommendation into a legal obligation, this solution could significantly reduce the number of defunct satellites and debris-generating incidents in Earth's orbit.

Another promising approach is the development and deployment of large-scale Active Debris Removal (ADR) technologies to clean up existing space debris, incorporating advanced robotic and

autonomous systems. Several ADR methods have already been tested, including robotic arms, harpoons, nets, and electrodynamic tethers, each designed to capture and deorbit debris in different ways. The European Space Agency's ClearSpace-1 mission (2026) plans to demonstrate the use of robotic arms to seize and deorbit a defunct satellite, while Japan's KITE experiment (2017) tested electrodynamic tethers that generate a current through Earth's magnetic field to gradually slow down debris for atmospheric reentry. Meanwhile, Astroscale's ELSA-d mission (2021) explored magnetic docking technology, where a servicing satellite uses magnets to attach to debris and guide it to safe disposal. Despite these promising innovations, ADR technology remains expensive, complex, and difficult to scale, requiring substantial investment. By improving ADR technology, refining cost-effective deployment strategies, and integrating financial incentives, space agencies could actively reduce the amount of dangerous debris currently orbiting Earth, making long-term space sustainability more achievable.

A third possible solution is the adoption of sustainable satellite design and end-of-life disposal mechanisms to prevent new debris from accumulating. Many current satellites are not equipped with propulsion systems or deorbit mechanisms, meaning they remain in orbit indefinitely once their operational lifespan ends. Governments and international organizations could implement policies requiring all new satellites to include self-deorbiting technology, such as thrusters or drag sails, to ensure they return to Earth's atmosphere and burn up upon mission completion. Additionally, companies launching large satellite constellations, such as SpaceX's Starlink or Amazon's Project Kuiper, could be required to integrate collision avoidance AI systems and maintain strict deorbiting schedules. By designing satellites with built-in debris mitigation strategies, this solution would prevent the problem from worsening and ensure that future space missions do not contribute to the growing space junk crisis.

Connection to ASBMUN Theme: SDG 16 Peace, Justice, and Strong Institutions

The topic of managing and mitigating space debris is of course an issue of safety and security for people on Earth. Yet, this topic also encourages and reinforces SDG 16 in many ways. Space exploration often requires cooperation and international collaboration, further motivating peace between governmental bodies as well as individual space agencies.

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