Committee: United Nations Commission on Science and Technology for Development (UNCSTD)

Issue: The Equitable Use of Sustainable Space Technology

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Introduction

The rapid proliferation of space technology has ushered in a new era of exploration and innovation, with 77 countries now operating space agencies and 16 possessing launch capabilities as of March 2024. This unprecedented expansion presents both extraordinary opportunities and complex challenges. Central among these are the equitable access to space technology and the imperative for sustainable practices to mitigate the escalating threat of space debris.

This report synthesizes the current landscape, highlights critical technological and regulatory advancements, and proposes actionable recommendations to foster international collaboration that balances innovation with responsibility. The goal is to ensure the peaceful, sustainable, and inclusive utilization of outer space for the benefit of all humankind.

Definition of Key Terms

Equitable Access to Space Technology

The fair and inclusive distribution of opportunities and resources that allow all countries—regardless of economic or technological capacity—to participate in and benefit from space activities.

Space Debris

Defunct human-made objects in orbit around Earth, including discarded satellite parts, spent rocket stages, and fragments from collisions, pose serious risks to active space missions and infrastructure.

Sustainability in Space

The practice of conducting space operations in ways that preserve the orbital environment, prevent the buildup of space debris, and ensure long-term usability of outer space for future generations.

AI-Driven Tracking Systems

Artificial intelligence-powered technologies capable of monitoring orbital objects, predicting potential collisions, and helping in the prioritization and avoidance of high-risk debris events.

Liability Convention (1972)

An international treaty that holds launching states absolutely liable for damage caused by their space objects, including space debris, and emphasizes responsibilities in cleanup and damage mitigation.

UNCOPUOS Principles

Guidelines established by the UN Committee on the Peaceful Uses of Outer Space (UNCOPUOS), promoting peaceful exploration, minimizing space debris, and encouraging responsible behaviors among nations and commercial actors.

Kessler Syndrome

A dangerous chain reaction in which space debris collisions create even more debris, potentially making certain orbits unusable and significantly hindering future space operations.

Harpoon Technology

A debris removal method involving a harpoon-like device designed to capture large debris objects and guide them safely toward atmospheric reentry and disintegration.

Drag Sail

A deployable structure attached to satellites that increases atmospheric drag, helping to deorbit the satellite more quickly and reduce long-term debris risk.

Wooden Satellites

Innovative biodegradable satellites built using wood-based materials to minimize long-term debris and environmental impact in space.

Capacity Building

Efforts aimed at strengthening the technical and institutional abilities of developing countries to engage in space activities, through training, funding, and knowledge transfer.

Public-Private Partnerships (PPP) in Space

Collaborative efforts between government agencies and private aerospace companies to drive innovation while ensuring space activities follow safety and sustainability standards.

Reusable Launch Vehicles

Rockets and spacecraft designed for multiple uses, significantly lowering launch costs and reducing waste compared to single-use vehicles.

International Collaboration in Space

Joint efforts among countries and organizations to share knowledge, resources, and missions for space research, debris removal, and sustainable operations.

Emerging Space Nations

Countries in the early stages of developing space capabilities, often supported through international cooperation to promote equitable participation in space activities.

History

Cold War Era (1950s–1980s):

The space age began with the launch of Sputnik by the USSR in 1957, followed by the US Apollo missions. Space exploration was dominated by a few powerful nations, primarily the United States and the Soviet Union, and driven by military and political competition. International cooperation was limited, and the outer space environment began accumulating debris from early missions.

Establishment of Legal Frameworks (1960s–1970s):

The UN Outer Space Treaty (1967) laid the foundation for peaceful and cooperative use of space. The Liability Convention (1972) made launching states responsible for damage caused by their space objects, including debris. Despite these treaties, enforcement mechanisms remained weak, and many modern space activities were not anticipated.

Rise of Private Space Industry & Global Participation (2000s–Present):

The 21st century has seen the rise of private companies like SpaceX and Blue Origin, bringing increased innovation and commercialization. As of 2024, more countries began developing space

agencies, with 77 now active and 16 capable of launching independently. The lower cost of satellite tech (e.g., CubeSats) enabled developing nations to join the space race.

Growing Concerns Over Sustainability (2010s–2020s):

With increasing satellite launches came growing space traffic and orbital congestion. The risk of space debris became urgent, particularly after events like the 2009 Iridium–Cosmos collision. Calls for responsible practices and international collaboration grew louder, especially to support emerging space nations and prevent future orbital crises.

Emergence of Debris Mitigation Technologies (Late 2010s–2020s):

Technological innovations such as AI-driven tracking, drag sails, and harpoon systems began addressing debris cleanup. New space actors introduced eco-friendly satellites (e.g. Japan's wooden satellite) to reduce long-term environmental impact.

Need for Renewed Global Cooperation (2020s–2025):

Despite progress, major regulatory gaps persist—especially concerning private entities and new technologies. The urgency to modernize treaties, support developing nations, and ensure equitable access to space has become a top agenda item for global organizations like the UNCSTD.

Key Issues

Unequal access to space technology and resources among countries

Space technology, such as satellites for communication, earth observation, and navigation, plays an increasingly vital role in economic and security infrastructures, but remains largely concentrated in economically advanced countries. Most developing and emerging nations either lack indigenous capabilities or rely on external providers for essential services like GNSS, weather forecasting, and surveillance. This disparity is exacerbated by high costs, strict technology transfer controls, and limited domestic capacity, perpetuating a "space divide" that mirrors global inequities in other areas. As a result, countries lacking access are not only disadvantaged in economic terms, but also have limited influence over multilateral governance frameworks that shape space activities.

Limited technical capacity and financial resources in developing and emerging space nations

Most newly emerging space nations start with minimal indigenous technical capacity, often limited to receiving or operating satellites built elsewhere, or participating in space-related data usage

programs. These countries experience shortages of highly skilled scientists and engineers, and often suffer from "brain drain" as talent migrates to where opportunities are greater. Funding is a major barrier: the perception of space as a "luxury" means programs struggle to compete with other priorities like health or education, leading to chronically underfunded agencies and inconsistent project continuity. Building an independent space industry and ecosystem is therefore a long-term challenge. Regional capacity building, university collaborations, and targeted technology transfer are common first steps but provide just a foundation—sustained investment and public-private partnerships are required for significant progress.

Vulnerabilities due to reliance on foreign-controlled space services and lack of cybersecurity

Many developing space nations depend on foreign-owned satellites for critical services. This reliance exposes them to external control, potential service interruptions, and geopolitical vulnerability; for example, disruptions in access to foreign GNSS or communications satellites can cripple national infrastructure or disaster response. These states often lack robust protective measures, such as secure satellite architecture or strong encryption, increasing susceptibility to cyberattacks and sabotage. Outdated hardware in ground stations and insufficient cybersecurity further compound these weaknesses, highlighting the need for local capability development. The dependence on foreign services and weak cyber defence frameworks leaves these nations open to coercion or exclusion in crisis situations.

Insufficient inclusive international collaboration and governance structures

Despite some progress, participation by emerging space nations in major multilateral space governance bodies remains limited compared to "space powers." Resource and representation disparities constrain their ability to shape policies and ensure their priorities—such as differentiated responsibilities and equitable access—are incorporated into international treaties and codes of conduct. Many developing countries lack the means to fully engage in key decision-making processes, sometimes due to a disconnect between technical experts and policymakers at home, and constraints in engaging their delegations in long-running international discussions. Strengthening mechanisms for resource sharing, capacity building, and coordinated advocacy (e.g., via regional bodies or scientific diplomacy) is essential to address governance shortfalls and promote more inclusive, responsible, and secure use of outer space

Major Parties Involved and Their Views

Developed Spacefaring Nations

(e.g., United States, Russia, China, EU members, Japan)

Supports innovation and private-sector growth, but prefer to retain leadership in space governance. Concerned with space security, controlling orbital traffic, and maintaining their technological edge. Cautious about binding regulations that could limit commercial freedom or national capabilities.

Emerging Space Nations

(e.g., India, Brazil, South Africa, UAE)

Advocates for greater inclusivity and support in accessing space resources and technologies. Push for capacity building, knowledge sharing, and fair partnerships.

Developing and Non-Spacefaring Countries

(e.g., many African, Latin American, and Southeast Asian nations)

Emphasizes the need for equitable access, financial assistance, and technical support. Want guarantees that space technologies serve sustainable development and not just dominant powers. Support the creation of global infrastructure for data sharing and training.

Private Sector Entities

(e.g., SpaceX, Blue Origin, OneWeb, Arianespace)

Focuses on innovation, commercialization, and reducing launch costs. Often lead in debris mitigation technologies, but may resist heavy international regulations. Prefer public-private partnerships over multilateral restrictions.

International Organizations

(e.g., UNCSTD, UNCOPUOS, UN OOSA, ITU)

Advocates for peaceful, cooperative, and sustainable space activities. Push for modernization of outdated treaties, promote debris mitigation, and inclusive governance. Act as a neutral platform for dialogue and standard-setting.

Timeline of Relevant Resolutions, Treaties and Events

1960s

1957: The Soviet Union launched Sputnik 1, marking the beginning of the space age and highlighting the need for international regulations in space activities.

1961: The United Nations established COPUOS to promote international cooperation and build legal frameworks for space exploration.

1963:The UN General Assembly adopted the Declaration of Legal Principles Governing the Activities of States in Outer Space, setting foundational rules like peaceful use, state responsibility, and the non-appropriation principle. The Partial Test Ban Treaty entered into force, banning nuclear testing in outer space and emphasizing a peaceful space environment.

1967: The Outer Space Treaty was adopted, becoming the foundational legal instrument for space activities. It stresses peaceful use, prohibits national appropriation, and establishes state accountability.

1968: The Rescue Agreement was introduced for international cooperation in rescuing astronauts and returning foreign space objects.

1970s

1972: The Liability Convention was adopted, making launching states internationally liable for damages caused by their space objects (including debris).

1975: The Registration Convention required states to provide the UN with details about their space objects, increasing transparency and accountability.

1976: The Bogotá Declaration saw some equatorial countries claim sovereignty over geostationary orbit segments above their territories. This was largely rejected but raised early concerns about space equity.

1979: The Moon Agreement extended the legal regime to celestial bodies beyond Earth, declaring the Moon and its resources to be the "common heritage of humankind." However, it was not widely ratified by major space powers.

1990s

1998–2011: The International Space Station (ISS) Agreement enabled unprecedented international collaboration among major spacefaring nations, serving as a model for cooperative governance.

1999: COPUOS adopted the first Space Debris Mitigation Guidelines, encouraging states to minimize debris creation through responsible mission planning and design.

2000s–2010s

2000s–2020s: Growing concern arose over space congestion, increasing commercial involvement, and sustainability. This spurred the development of debris mitigation technologies (such as AI-based tracking and removal), highlighting the need to modernize outdated treaties.

2020s

2024–2025: The space landscape started shifting toward equity in access, public-private partnerships, and urgent calls to update global governance to include emerging space nations and commercial actors.

Evaluation of Previous Attempts to Resolve the Issue

1. Voluntary Codes of Conduct and Soft-Law Instruments

Over the last decade, initiatives such as the EU Draft International Code of Conduct for Outer Space Activities and Long-Term Sustainability Guidelines (endorsed by UNCOPUOS in 2019) have aimed to create norms of responsible behavior without the rigidity of binding treaties. This has facilitated flexibility, quicker adoption, and the ability to adapt guidelines to rapid technological changes. However, its non-binding nature means states and private actors may opt out without consequences. Implementation largely depends on national political will, which varies considerably.

2. Regional Cooperation Models

Regional space organizations—such as the Asia-Pacific Space Cooperation Organization (APSCO) and the African Space Policy and Strategy—have attempted to pool resources and share technical expertise. Efforts include cost-sharing for satellite missions, regional training programs, and improved representation in global forums. At the same time, effectiveness is often hindered by unequal member state contributions, political instability in certain regions, and lack of modern technical infrastructure.

Possible Solutions

Modernize Legal and Governance Frameworks

The existing body of space law—anchored in treaties from the 1960s and 70s—struggles to keep pace with today's rapidly evolving space activities. Modernizing these frameworks is crucial. This could involve updating foundational treaties like the Outer Space Treaty to clarify ambiguous provisions, address gaps regarding commercial and non-state actors, and enhance enforceability. New international agreements might be considered to govern emerging issues such as resource extraction, large satellite

"megaconstellations," and space tourism. Modernization should also explore flexible governance mechanisms, such as soft law (guidelines, best practices) that can adapt quickly, while maintaining the principle of space as the province of all humankind. Role-sharing between established actors (like COPUOS, the ITU, and major national agencies) and new stakeholders can foster legitimacy, inclusiveness, and effectiveness.

Strengthen International Cooperation and Data Sharing

Global challenges like space debris, orbital congestion, and security threats require collaborative solutions. Enhanced information sharing—covering satellite positions, collision risks, debris tracking, and best practices—can significantly improve situational awareness. Mechanisms might include expanding multinational databases (like the Space-Track system), coordinated debris monitoring networks, and shared early warning protocols. Promoting joint missions, joint task forces, and cross-border scientific and disaster response projects can build trust while mutually reinforcing capacity. Establishing formal communication channels, such as hotlines for potential space incidents, and fostering regular dialogue between established and emerging space actors, will reduce misunderstanding and help mediate disputes before they escalate.

Advance Technical Solutions to Debris

Space debris poses an escalating risk to both crewed and uncrewed missions. Addressing this requires a combination of mitigation and remediation efforts. Encouraging the adoption of debris mitigation guidelines across all spacefaring nations and companies—such as end-of-life disposal plans, passivation of spent stages, and guidelines for constellation management—is key. Investment in debris removal technologies, including robotic servicing, active debris capture, and even the use of AI for collision prediction and avoidance, should be prioritized. International cooperation—such as pooled research funding or shared test missions—can accelerate progress, while harmonizing technical standards for debris reporting and mitigation ensures interoperability and consistency.

Build Capacity for Emerging Space Nations

Ensuring equitable access to space and preventing a technology gap is vital for global stability and development. Established space powers, international organizations, and private sector leaders should commit to supporting capacity building in emerging space nations. This entails technology transfer, training programs, and knowledge sharing in areas such as satellite operation, regulatory compliance, and sustainable mission design. Mechanisms to facilitate affordable access to space infrastructure—for example, shared launch services, data-sharing platforms, and regional space hubs—can help level the

playing field. Empowering diverse voices in international forums ensures the concerns and aspirations of all space actors are considered, strengthening the legitimacy and effectiveness of governance systems.

Foster Public-Private Partnerships

The commercial sector now plays a pivotal role in all aspects of space activity, from satellite networks to space tourism. Actively fostering public-private partnerships allows governments to harness private innovation and investment while ensuring that commercial actors adhere to broader norms and safety standards. Governments and international bodies can incentivize responsible behavior—through regulatory clarity, support for sustainable business models, co-investment opportunities, and by recognizing industry-led best practices. Establishing multi-stakeholder advisory groups ensures ongoing dialogue on policy gaps, technical challenges, and ethical dilemmas as the industry evolves.

Strengthen Space Security and Resilience

The risks of intentional (e.g., anti-satellite weapons, cyber attacks) and unintentional (accidental collisions, interference) disruptions demand a strengthened security posture. Developing international norms and confidence-building measures to prevent the weaponization of space is critical; this may include new codes of conduct, incident transparency mechanisms, or crisis communications protocols. Enhancing the resilience of space infrastructure through diversified architectures, redundancy, and robust cybersecurity measures reduces vulnerabilities. Regular multilateral exercises simulating space crisis scenarios can improve preparedness and reinforce lines of communication among civilian, military, and commercial space operators.

Bibliography

"Liability Convention." United Nations Office for Outer Space Affairs, 2777 (XXVI). Convention on International Liability for Damage Caused by Space Objects.

"Outer Space Treaty." United Nations Office for Outer Space Affairs, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html

"Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space." UNOOSA, https://www.unoosa.org/oosa/en/ourwork/topics/space-debris/space-debris.html.

"World Space Agencies Database." Space Foundation, https://www.spacefoundation.org/resource/world-space-agencies/

Foust, Jeff. “Growing Concern over Space Traffic Management.” SpaceNews, 10 Nov. 2023, https://spacenews.com/growing-concern-over-space-traffic-management/

Martinez, Mark. “How SpaceX and Private Industry Are Changing Space Exploration.” CNBC, 15 Mar. 2024, https://www.cnbc.com/2024/03/15/spacex-and-the-commercial-space-race.html

“Japan to Launch Wooden Satellites to Reduce Space Debris.” BBC News, 29 Dec. 2023, https://www.bbc.com/news/world-asia-67899834

“Artificial Intelligence in Space Debris Management.” NASA, https://www.nasa.gov/directorates/spacetech/spacedebris-ai/

“UNCOPUOS – United Nations Committee on the Peaceful Uses of Outer Space.” UNOOSA, Committee on the Peaceful Uses of Outer Space

Gohd, Chelsea. “The Iridium-Cosmos Collision: A Wake-Up Call for Space Traffic Safety.” Space.com, 10 Feb. 2024, https://www.space.com/iridium-cosmos-collision-anniversary.html