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Advancing Space Governance:
A Space Monitoring System

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Introduction

Adopting a multilateral strategy for space governance is essential to address the complex challenges posed by orbital congestion, resource competition and sustainability in space. Drawing lessons from existing frameworks like the EAGLE Report and utilizing the foundational principles of the Outer Space Treaty (OST), the international community must establish a comprehensive governance system that ensures equitable access, minimizes conflict and promotes the sustainable use of space resources (Madubuko & Chitsungo, 2024).

This brief proposes the following actions:

1. Amending the Outer Space Treaty (OST): Amend the OST to incorporate more comprehensive debris mitigation measures, expanded transparency of private-sector operations, and binding resource-sharing agreements to guarantee fair participation and access.
2. Creating a Global Space Monitoring System (GSMS): Design a unified monitoring platform based on digital diplomacy and other advanced technologies, like artificial intelligence. In this way, the GSMS will increase transparency and accountability and will form a cornerstone for effective space governance.
3. Advancing Science and Economic Diplomacy: Promote cooperation, especially with and among developing nations, for the reduction of disparities in space

Highlights

Amend the Outer Space Treaty (OST) to include enforceable debris mitigation measures, increased transparency in private-sector space operations, and binding resource-sharing agreements to ensure fair participation.

Establish a unified, AI-driven platform for tracking space activities, preventing collisions, and fostering transparency to enhance cooperation and accountability in space governance.

Encourage international collaboration—especially with developing nations—through joint scientific missions, economic partnerships, and shared technological advancements to promote inclusive space exploration.

Develop mechanisms such as a Space Conflict Tribunal, modelled after the UNCLOS, to mediate disputes over satellite operations, orbital congestion, and resource claims, ensuring peaceful cooperation.

Leverage satellite technologies for global climate monitoring, emission tracking, and sustainability efforts, aligning space policies with international environmental commitments.

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exploration and use. This should be through economic and scientific partnerships to ensure inclusive global participation.

4. Integrating Space Governance with Climate Goals: Align space activities with international climate objectives by employing satellite technologies for global monitoring, emission tracking and sustainable development efforts.

These recommendations are fundamental to ensuring an inclusive and collaborative space environment, and they are critical for securing a future characterized by peaceful exploration and shared global benefits. Accordingly, through strategic alignment and international collaboration, space can become a domain of collective progress and not a contention for humanity.

Challenges in Space Governance

The rapid expansion of space activities has outpaced the development of governance frameworks, exposing gaps that threaten outer space's sustainability and equitable use. Although foundational, the Outer Space Treaty (OST) lacks the enforceable mechanisms necessary to confront pressing challenges such as orbital congestion, unregulated resource extraction and the increasing proliferation of space debris. These shortcomings are worsened by geopolitical divides, which hinder international collaboration and the growing influence of private sector actors operating with limited oversight.

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Environmental concerns compound these issues, with the unchecked accumulation of orbital debris (currently on Earth and potentially in the future in other celestial bodies) and increasing rocket emissions posing risks to orbital and terrestrial ecosystems. As space becomes more accessible, the strain on existing governance structures intensifies, undermining principles of fairness and cooperation on celestial bodies and their orbits.

The current trajectory indeed runs the risk of turning space from a domain of peaceful exploration, as intended by the OST, into a contested arena of rivalry and conflict. The assertions in the lines that peace cannot be assumed without a military presence in space by military forces highlight a true and significant deviation from the OST's original intent (Pope, 2021). Comprehensive reforms are required by strengthening international governance frameworks. The original vision of the OST needs to be upheld, and space should continue to be a common heritage for humankind that nurtures innovation, sustainability, and peaceful cooperation for generations to come.

Approaches for Space Monitoring

1. Modernizing Space Governance: Lessons and Opportunities

The rapid growth of space activities underscores the urgent need to modernize governance frameworks to address emerging challenges. By drawing lessons from international frameworks such as the United Nations Convention on the Law of the Sea (UNCLOS), the Artemis Accords and the Outer Space Treaty (OST), we can adapt principles of resource sharing, environmental protection and transparency to meet the unique demands of the space domain.

UNCLOS provides a strong model for resource sharing in shared commons, like international waters. The principles of its equitable distribution and benefit-sharing provide valuable lessons that can be applied to the management of resources obtained from the Moon and asteroids. The distribution of wealth created by future extraterrestrial mining should be equitably apportioned, especially to developing nations, to create an inclusive space economy. Similarly, UNCLOS's enforceable environmental protections offer lessons for addressing the critical space issue of debris and orbital congestion. Rigorous and binding debris mitigation guidelines developed within a modernized OST could be effective in compelling compliance by states and private actors to safeguard sustainability in space (United Nations, 2024).

The Artemis Accords emphasize the importance of transparency and voluntary participation, principles that are also equally important for space governance. To reduce the

potential for conflicts, transparent data-sharing practices for satellite operations, available orbital paths, and resource extraction should be encouraged. As introduced in the Accords, concepts such as safety zones for lunar operations could help manage competing interests and the safety of operations to ensure cooperative and secure resource use (Secure World Foundation, 2024).

Although the OST remains a foundational treaty, its provisions need to be strengthened to reflect modern realities. While spacefaring nations and non-state actors have been able to develop certain space norms, enforceable debris mitigation measures should be mandated, including end-of-life disposal plans, restrictions on debris creation and penalties for non-compliance. While there may always be a limit on transparency with dual-use space crafts, transparency in private-sector activities is another critical area. Requiring companies and states to disclose detailed mission plans and resource extraction activities through a global registry would enhance accountability. This would be akin to the International Telecommunications Union registry for Geostationary orbits. Lastly, the OST should also include equitable resource-sharing frameworks that make space a global common for the benefit of all humanity, just like the principles found in UNCLOS (Martinez, 2022).

Joint scientific missions also force cooperation and reduce tensions. Other examples, like the International Space Station (ISS), show how space collaboration can rise above geopolitics, once again underlining the use of science for diplomacy. Continued investment in collaborative projects could redefine space as a domain of trust-building rather than competition (Secure World Foundation, 2022).

Adding the non-state actors will further enrich the evolving governance landscape. Public-private partnerships, such as NASA working with SpaceX, epitomize the innovation possible from the private sector within an international normative framework. In turn, NGOs may support the cause of sustainability by bringing forward the voices of developing countries and ensuring diversity of representation in global space policy (Bhattacharjee, 2024).

The modernization of space governance is a policy imperative but also an opportunity to reimagine international cooperation. By integrating lessons from established frameworks, fostering transparency, and embracing multilateral collaboration, humanity can ensure that space remains a domain of peace, innovation, and shared benefit. This balance reflects the aspirations of a united global community and offers a deep opportunity to shape the future of space exploration and stewardship.

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2. Mechanisms for Space Conflict Resolution

The rapid expansion of space activities increases the risk of disputes over orbital zones, satellite operations and resource claims. Addressing these challenges requires the development of effective conflict resolution mechanisms that prioritize cooperation and transparency while discouraging escalation. Drawing from established international models, a Space Conflict Tribunal inspired by the UNCLOS offers a promising framework. While the International Tribunal for the Law of the Sea (ITLOS) has faced some challenges, such as some state's noncompliance, it has overall been considered a success.9 Such a tribunal would provide an impartial forum for mediating disputes related to satellite collisions, orbital congestion and resource exploitation. By emphasizing mediation and arbitration over adversarial litigation and operating under United Nations oversight, the tribunal could ensure fairness and foster trust among spacefaring nations (Cutie et al., 2023).

Science diplomacy also serves as a critical tool for mitigating conflicts in space. Joint scientific missions, like those to the Moon or asteroid mining, foster collaboration rather than competition for limited resources. Success with the ISS underlines how cooperative ventures have the potential to decrease geopolitical tension and build mutual trust. In such a way, collaborative efforts align nations toward shared goals and prove that scientific discovery can transcend rivalry, paving a path for unified progress in space (International Space Science Institute, 2023).

Non-state actors, from private enterprises to NGOs, likewise will be key players in the pursuit of equitable and sustainable

space practice. It is here that examples have been seen, where this type of public-private partnerships-between NASA and SpaceX-drives technological innovation and norms upholding international governance through a concern for debris mitigation and resource-sharing agreements between members. NGOs can further enable a better quality of governance since some of such organizations help Global South countries' voices to be heard (Marwala, 2024).

In addition, the GSMS would have a supporting role in the practice of digital diplomacy, enabling inclusive participation. It would provide developing nations with access to essential tools and expertise for responsible space stewardship and foster equity on a global scale. The GSMS would also encourage private-sector compliance with international norms, aligning commercial activities with principles of sustainable and peaceful space exploration.

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This implies that emphasizing transparency, collaboration, and inclusivity lays a solid groundwork in the GSMS for such a sustainable and cooperative framework in the governance of space. This is the way forward for humanity towards behaving responsibly within shared space commons.

3. The Role of the Global Space Monitoring System (GSMS)

Creating a Global Space Monitoring System (GSMS) could serve as a centralized platform dedicated to tracking and regulating space activities, such as satellite operations, debris management, and resource utilization within Earth's orbits, celestial bodies and beyond. The GSMS could offer real-time monitoring capabilities to foresee potential collisions, enhancing safety and ensuring compliance with international agreements. More importantly, the GSMS governance could facilitate the allocation of orbits in outer space, safety zones and others in celestial bodies (Bosquillon, 2023).

The GSMS should provide a unified platform for global data sharing, the system would promote accountability and cultivate trust among governments and private entities. It would minimize the risks associated with miscommunication and disputes by delivering accurate insights into orbital or celestial body congestion and potential environmental implications. Such transparency is required to encourage cooperation in an increasingly congested and competitive space environment.

It would also enhance international cooperation in a coherent global context, consolidating regional space monitoring initiatives now being independently developed within major space-faring nations: the European Union, United States, Russia, China, and others. The system would ensure fair distribution of important information for all space-faring countries, including new actors, with increased coordination and fewer duplications of effort. Through the harmonization of different systems, the GSMS could foster a more harmonized and non-discriminatory principle for space traffic management (United Nations Office for Outer Space Affairs, 2023).

Conclusion

A collaborative approach to space governance is essential for ensuring sustainability, equity and conflict resolution in this rapidly evolving domain. A monitoring system strengthened by updates to treaties such as the Outer Space Treaty (OST) and the integration of an innovative mechanism like a Global Space Monitoring System (GSMS) and climate-aligned policies can offer practical pathways to address existing gaps while anticipating future challenges. By prioritising inclusivity, transparency and accountability, the international community can preserve space as a shared realm of peace, innovation and opportunity for all humanity.

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