Saudi Arabia
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The Future of Space Law

Insights from the ATS, UNCLOS, and ITU Frameworks

White Paper
DECEMBER 2025

Contents

Foreword

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As space activity accelerates, governments and industry face shared challenges: how to maintain stability and safety of space operations, and equitable access to an increasingly complex orbital environment. This paper builds on the Centre for Space Futures' Future of Space Law series by examining practical lessons from established international regimes that govern shared domains and resources beyond national jurisdiction.

Rather than proposing new treaties or a centralized authority, this paper identifies operational tools, transparency mechanisms, registries, coordination procedures, and incentive-based standards that can facilitate the implementation of the Outer Space Treaty. These tools serve as a range of practical options for states to apply the Treaty's principles. We hope this analysis supports lawmakers, policymakers, operators, and researchers working to shape a sustainable and economically vibrant space future.

Executive Summary

This paper expands the Future of Space Law series by applying lessons from established shared-domain governance systems to strengthen the operational effectiveness of the Outer Space Treaty (OST). Benchmarked regimes such as the Antarctic Treaty System (ATS), the United Nations Convention on the Law of the Sea (UNCLOS), and regulatory framework of the International Telecommunication Union (ITU), among others, show that stability and economic confidence arise from practical mechanisms: transparent registries, predictable coordination procedures, and voluntary compliance supported by incentives.

This second edition of the Future of Space Law Series strengthens the Standards and Recommended Practices (SARPs) model proposed in the first edition by incorporating these comparative lessons into three layers:

Tier 1: Legal, Economic and Commercial Foundations establish transparent rules, licensing interoperability, and supervisory benchmarks to create regulatory clarity and market confidence.

Tier 2: Technical Standards provide scalable, mission-appropriate norms for environmental assessment, debris mitigation, collision avoidance, and space traffic coordination.

Tier 3: Operational Protocols define real-time rules of behaviour, emergency coordination, and incentive-aligned conduct to ensure predictable and responsible operations.

The SARPs framework is modular and voluntary. States and operators can adopt individual tiers according to their needs and capabilities. Adoption can be supported by incentives such as market access, insurance differentiation, and operational predictability, strengthening the safety and sustainability of space activities without requiring new treaties or formal enforcement. This approach preserves the full authority of states to regulate their national activities in accordance with international law.

01 Introduction

The global space economy is expanding rapidly, driven by commercial innovation, new entrants, and private investment. The governance framework established under the 1967 Outer Space Treaty (OST) was not designed for today's commercial environment, which requires mechanisms that enable safe and sustainable economic activity within the OST's international legal principles. While the OST remains foundational, it does not include the operational mechanisms needed to translate its principles into processes that support confidence, reduce transaction costs, and enable predictable investment.

This paper builds on Edition 1 (September 2025), which introduced the Multi-Tiered Standards and Recommended Practices (SARPs) framework by examining how ICAO transformed the Chicago Convention's foundational principles into operational systems. Edition 2 extends this approach by examining additional frameworks namely the Antarctic Treaty System (ATS), the United Nations Convention on the Law of the Sea (UNCLOS), and the International Telecommunication Union (ITU), to illustrate how practical mechanisms put into practice high-level international legal principles, showing how similar precedents exist across other global commons.

Comparable precedents exist across other global commons.* In each domain, practical mechanisms, such as transparent coordination, technical standards, and predictable procedures, enable cooperation and support sustainable activity. These examples illustrate how governance transforms uncertainty into opportunity by translating principles into operational tools.

The same logic applies to outer space, a shared domain whose long-term sustainability depends on mechanisms that enhance predictability and reduce operational risks.

1.1

Purpose and Objectives

This white paper examines how established governance frameworks for global commons can inform a practical, operational approach to implementing the OST. It analyzes how these systems translate legal principles into effective mechanisms through institutional design, procedural standards, and incentives. The paper applies these lessons to propose a voluntary, three-tier framework of SARPs for outer space, integrating legal, technical, and operational dimensions of governance. The objective is to transform the OST principles into practical tools that strengthen transparency, safety, and equitable participation, while promoting a predictable, inclusive, and economically sustainable space environment consistent with international law.

*In this paper, the term "global commons" is used in a functional, non-legal sense to refer to physical domains or natural resources (e.g., outer space, the high seas, the radio spectrum) that are accessible to multiple nations and require shared management frameworks. This usage is distinct from the legal concept of "common heritage of mankind" and is intended to highlight governance challenges common to such shared domains beyond national jurisdiction.

02 Core Insights from Comparative Governance

2.1

Historical Drivers of Governance in Shared Domains

The governance systems for Antarctica, the high seas, and the radio spectrum emerged from a shared recognition that predictable and cooperative arrangements were essential for maintaining stability, advancing scientific activity, and supporting the equitable and efficient use of shared domains. In Antarctica and under the ATS, practices of scientific collaboration and transparency proved effective in establishing a stable framework for coordinating activity across a remote and unique environment. As scientific presence expanded, states recognized the need for consistent arrangements to avoid overlap and ensure that activities in a shared environment remained coordinated and predictable.[1]

In the maritime domain, expanding trade, emerging technologies, and growing competition over offshore resources made customary law insufficient, prompting states to codify predictable jurisdictions through UNCLOS. This codification was reinforced by shared concerns over environmental protection and the need for an institutional framework to manage activities in the deep seabed, designated as the common heritage of mankind.[2]

In the radio spectrum, growing cross-border use of radio services highlighted the need for coordinated procedures to manage shared frequencies in a global environment. The ITU developed such coordinated procedures that minimized interference by converting technical filings into internationally recognized frequency assignments, creating a predictable framework for reliable and orderly access across jurisdictions.[3]

Across these domains, institutional design emerged in response to structural challenges that are increasingly relevant to space, where the absence of agreed procedures can create operational uncertainty.

Experience across shared domains shows that predictable governance frameworks help support the orderly development of complex activities, including those shaping the space economy.

2.2

Turning Principles into Operational Routines

These regimes endure because they convert broad political principles into repeated operational practices that reduce uncertainty. The ATS maintains stability through inspections and mandatory disclosure of planned activities.[4]

UNCLOS integrates legal norms, technical and scientific procedures, and adjudication to regulate maritime access, seabed activity, and establish jurisdictional boundaries.[5]

The ITU anchors spectrum and orbital coordination in coordinated, notified, and recorded technical filings within the Master International Frequency Register (MIFR), which determine the interference-protection status associated with compliant frequency assignments.[6] This coordination draws on relevant ITU standards such as ITU-R Resolution 8 (WRC-23), which sets tolerances for certain orbital characteristics of space stations deployed as part of non-geostationary-satellite orbit systems in the fixed-satellite, broadcasting-satellite, or mobile-satellite service, and Recommendation ITU-R S.1003-2 on the environmental protection of the geostationary-satellite orbit.

2.3

Limits of Analogy and What is Transferable to Space

None of these regimes can be replicated in outer space because each depends on conditions that do not exist collectively in the orbital environment.[7] Antarctic governance relies on fixed geography and on-site inspections that are not feasible in space, where access is remote and activity is not tied to a stable physical setting. UNCLOS shows how multi-layered institutions blend legal, scientific, and judicial functions to manage areas beyond national jurisdiction, including "the Area" through specialized bodies such as the International Seabed Authority (ISA), International Tribunal for the Law of The Sea (ITLOS), and the Commission on the Limits of the Continental Shelf (CLCS).[8]

This level of institutionalization cannot be applied in outer space, where the non-appropriation principle is preserved without creating equivalent authorities. The ITU manages a divisible natural resource (the radio-frequency spectrum) rather than a physical domain per se, yet its recognition-based procedures effectively coordinate high volume commercial traffic without central enforcement.[9] These limitations clarify that space governance should not copy institutions but rather adapt the mechanisms that consistently reduce uncertainty in non-sovereign and science driven or commercially active environments.

2.4

The Shared Governance Pattern Across All Regimes

These regimes reveal a governance pattern that is more important than their institutional differences. Stability is preserved when access is predictable, when information is validated, when responsibilities are clear, and when incentives align with predictable behavior. The ATS achieves this through consensus and inspections,[10] UNCLOS through contracts, adjudication, and scientific review,[11] and the ITU through filings and technical coordination.[12] Each system demonstrates that legitimacy rests not in centralized authority but in mechanisms that allow states to retain their full authority to regulate national activities in accordance with international law while enabling cooperative functionality. For space governance, where physical observation of activities is limited, activities are mobile, and commercial operators now dominate, these insights point toward a framework that could mirror this functional logic. Predictable coordination, validated registries, structured consultation, and behavioral clarity are not optional features. They are the foundation upon which any viable system of space governance may be built.

Beyond these general patterns, two specific drivers of stability in global commons offer particularly strong lessons for space: the role of scientific cooperation as an engine of inclusive governance, and the integration of environmental sustainability as a prerequisite for long-term economic viability.

ǂ The Area as defined in UNCLOS Article 1 "means the sea-bed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction."

2.5

Fostering Scientific Cooperation and Inclusive Participation

The historical record of the ATS, UNCLOS, and ITU underscores that scientific and technical cooperation is not merely an altruistic endeavor, but a foundational driver of economic participation and institutional legitimacy. The requirement to demonstrate substantial scientific research in order to obtain Consultative Party status has encouraged several states to expand their national polar programs, while the ATS's emphasis on scientific exchange has helped cultivate a shared technical foundation that facilitates diplomatic engagement within the ATS.[13] Similarly, the ISA and ITU anchor their rule-making authority in scientific and technical expert bodies, ensuring decisions are perceived as neutral and credible.[14]

For outer space, this model provides a powerful pathway for inclusive growth. Cooperative mechanisms, such as joint orbital debris characterization missions, shared lunar science infrastructure, or open-data standards for space weather, serve a dual purpose. They lower the cost and technical barrier to entry for emerging space actors, enabling broader economic participation. Simultaneously, they generate the shared data and trusted networks that form the bedrock of effective governance. By designing governance frameworks that actively reward and facilitate scientific collaboration, the international community can foster an ecosystem where inclusivity directly reinforces systemic stability and reduces the risk of geopolitical fragmentation.

2.6

Integrating Environmental Sustainability into Economic Development

A critical lesson from comparative regimes is that robust environmental and technical safeguards are not antagonists to economic development, but are essential preconditions for long-term viability. The MARPOL[‡] convention, for instance, did not stifle global shipping; by setting uniform pollution standards, it created a predictable, cleaner, and more efficient global market.[15] Similarly the ITU's global spectrum coordination framework prevents harmful interference and ensures that satellite networks can operate reliably which underpins the scale and stability of the modern satellite telecommunications economy.[16]

This logic applies with even greater force to outer space, where sustainability failures, such as the Kessler Syndrome of cascading orbital debris or the contamination of pristine scientific sites on the Moon, carry irreversible and economically catastrophic consequences[17] Therefore, sustainability cannot remain an aspirational goal; it could be operationalized through measurable, interoperable standards that are integrated into the core of mission design and operations.

Far from being a burden, leading in space sustainability is increasingly a source of competitive advantage. Insurers are developing premium models that reward debris-mitigation compliance. Investors are scrutinizing environmental, social, and governance (ESG) criteria for space ventures. Operators adhering to the highest safety and sustainability standards will benefit from lower capital costs, preferential market access, and enhanced reputational value. The governance framework for space could therefore be designed to codify this principle, creating a clear pathway where responsible environmental stewardship translates directly into economic reward, ensuring the space economy grows not just rapidly, but sustainably.

‡ The International Convention for the Prevention of Pollution from Ships.

2.7

Insurance as a Governance Mechanism in Shared Domains

Maritime law demonstrates that insurance functions not only as financial compensation but as a governance tool that shapes operator behavior by tying coverage to compliance with safety and environmental standards.[18] This dynamic is particularly evident in high-risk shared domains such as the high seas, where insurers effectively incentivize responsible conduct through underwriting requirements that reflect collision risk, pollution exposure, and adherence to international maritime regulations.[19]

This logic translates naturally to outer space, which, like the high seas, is a non-appropriable environment where multiple operators share exposure to operational hazards such as collisions, debris generation, and loss of control. Under the Liability Convention and the principles of the Outer Space Treaty (Articles VI and VII), states remain internationally responsible and liable for their operators, making insurance a rational mechanism for distributing risk and promoting compliance with technical and operational norms adopted at the national or international level.[20]

Space insurance literature shows that insurers increasingly differentiate premiums based on a spacecraft's technical risk profile including collision probability, reliability, and the operator's operational track record. This market-based differentiation can operate as an informal governance mechanism by making lower-risk mission profiles financially advantageous and higher-risk profiles more costly, even in the absence of supranational enforcement. However, its effectiveness is tempered by structural information constraints; insurers often lack full access to detailed technical and operational data due to export-control regulations, proprietary information restrictions, and the limited statistical base of space missions, which makes fine-grained risk differentiation difficult.[21] In jurisdictions where third-party liability insurance is mandated by national law, the requirement functions as a state-anchored incentive structure that embeds risk considerations directly into licensing and operational decision-making.

Integrating this logic into SARPs would create a supportive governance structure. Operators aligned with SARPs could benefit from lower premiums and improved insurability, while high-risk missions would face increased financial exposure. This mirrors the maritime experience, where insurance contributes to the stability of shared environments and encourages sustainable behavior, suggesting that insurance can play a similar governance-supporting role in the commercial space sector.

03 The Synthesized Governance Blueprint

Comparative governance systems across Antarctica, the high seas, and the radio spectrum show that stability and operational predictability can be supported when international legal principles are complemented by practical mechanisms that reduce uncertainty. These systems show that principles alone are often insufficient to sustain coordinated activity; predictability is reinforced through procedures, registries, notification rules, coordination pathways, and shared technical practices. In the case of Antarctica, where commercial exploitation is historically restricted, the framework demonstrates how structured processes can maintain stability and facilitate cooperation, even in the absence of economic activity.

It is important to recognize that each regime faces its own limitations and ongoing challenges. Enforcement constraints, varying levels of compliance, bureaucratic complexity, and differing national priorities mean that no system is entirely seamless. Nonetheless, these experiences offer valuable insights for other domains, such as space, suggesting that practical mechanisms can translate high-level principles into routine coordination, while remaining adaptable to evolving circumstances.

The regimes examined converge on a powerful governance blueprint for shared domains. This blueprint reveals that durable stability is not a product of centralized control or universal enforcement, but of structured processes that convert high-level principles into routine operational practices.

This blueprint can be distilled into five recurring design features:

1. Functional Specialization

Distributing governance functions across multiple bodies or processes (e.g., scientific review, technical coordination, dispute resolution) accommodates diverse interests, prevents bottlenecks, and ensures no single actor dominates the regime.

2. Procedural Neutrality

Relying on transparent, rules-based procedures for filings, inspections, and reviews insulates cooperation from shifting geopolitical dynamics and builds legitimacy through predictability rather than political alignment.

3. Verification through Transparency

Compliance is achieved through mechanisms of transparency, mandatory reporting, peer review, data exchange, and technical validation, rather than through a supranational enforcement authority. Trust is generated by predictable documentation and the ability to verify claims.

4. Incentive-Aligned Participation

Stability is built by making cooperation the natural choice. Regimes offer tangible benefits, such as predictable market access, reputational credibility, technical assistance, and risk reduction, that align with actors' self-interest, driving voluntary adherence to shared norms.

5.

Integration of Science and Sustainability

Scientific cooperation and environmental safeguards are embedded as core operational requirements, not optional add-ons. They serve as both a foundation for credible decision-making and a prerequisite for long-term economic viability, creating a virtuous cycle where responsible stewardship enhances systemic resilience and market value.

Lesson for Space:

For the orbital environment which is characterized by remote operations, commercial dynamism, and the foundational principle of non-appropriation, this blueprint is profoundly instructive. It suggests that the path toward a stable and prosperous space domain lies not in attempting to recreate the specific institutions of Earth-bound commons, but in adapting their underlying functional logic.

The challenge for space governance is therefore to design a framework that provides:

- Clarity

Through transparent rules and registries.

- Predictability

Through standardized technical and operational interfaces.

- Incentives

That reward sustainable behaviour and practices.

- Inclusivity

That leverages scientific and technical cooperation to lower barriers to entry and build shared stakes in system stability.

Such a framework should be modular and voluntary, allowing states and operators with diverse capabilities and interests to engage incrementally. By focusing on the operationalization of principles, transforming the OST's "due regard" into specific consultation triggers, or the "freedom of use" into predictable coordination protocols, governance can reduce transaction costs, unlock economic potential, and proactively manage the risks of congestion and conflict.

The following sections apply this comparative blueprint directly to the identified gaps in space governance, proposing a multi-tiered architecture of SARPs designed to provide this missing operational layer.

04 Operational Gaps in Current Space Governance

While the OST establishes foundational principles, it does not include the operational mechanisms needed to support a commercially active and increasingly congested space ecosystem. Several implementation gaps limit predictability, raise transaction costs, and create uncertainty for both states and operators.

Gap 1

Freedom of Use: No Allocation of Coordination Rules

The principle of free exploration and use of outer space lacks accompanying procedures for transparent allocation, operational coordination, or deconfliction. This limits predictability as activity increases, especially in priority regions such as the lunar poles and congested Low Earth Orbits (LEO).

Gap 2

Non-appropriation: No Site-Management Mechanisms

While the principle of non-appropriation prohibits claims of sovereignty by any means, the OST provides no mechanisms for site management or shared-use protocols. This creates risks of de facto control, operational interference, and escalating competition for key lunar or orbital locations.

Gap 3:

Due Regard: Undefined Notification and Consultation Standards

The obligation of "due regard" to the interests of other spacefaring states, imposed by Article IX of the OST on states parties, lacks measurable triggers, consultation pathways, coordination thresholds, or structured processes. This creates ambiguity, especially for states authorizing private actors.

Gap 4:

Responsibility, Risk and Liability: Limited Link to Operator Behavior

State responsibility under Article VI of the OST and liability under the Liability Convention are not sufficiently linked to specific operator conduct or risk profiles in operational practice. There is no widespread mechanism to differentiate between responsible operators and those who increase risks, limiting the role of incentives, insurance markets and accountability.

Gap 5

Registration: Limited Operational Value

The United Nations Register of Objects launched into Outer Space provides legal identification but lacks the technical, real-time, validated data needed for operational coordination and safety functions such as Space Traffic Management (STM), conjunction assessment, and debris mitigation.

These gaps show that the OST principles could be implemented through practical mechanisms, to enhance transparency, reduce uncertainty, and enable a predictable environment for sustainable space activities.

05 Deriving the Multi-Tiered SARPs Model from Comparative Regimes

The comparative analysis across the ATS, UNCLOS, and ITU regulatory framework reveals a consistent pattern: effective governance in shared domains is achieved not through a single mechanism but through coordinated layers that address different dimensions of activity. None of these regimes rely on one institution or one process alone. Instead, each separates legal foundations, technical expectations, and operational practice into distinct functions that complement one another.

This structural pattern is highly relevant for space, where activities involve diverse actors, capabilities and mission types, and where responsibilities differ across states, commercial operators, and multilateral bodies. Adapting this logic to space governance requires a framework that organizes responsibilities into clear layers, ensuring that principles, standards, and behavior operate in a coherent sequence. This is the rationale for the Multi-Tiered SARPs Model.

Tier 1

Addresses the legal-institutional layer

clarifying responsibilities, defining information-sharing expectations, and establishing baseline procedures (beyond the core OST requirements of authorization and continuing supervision) that allow states to oversee commercial activity without new legal obligations.

Tier 2

Addresses the technical layer

creating scalable, mission-appropriate standards that enable interoperability, safety, and coordinated activity across an increasingly crowded and diverse operational environment.

Tier 3

Addresses the operational layer

enabling sustainable in-space conduct, predictable interactions, and practical coordination mechanisms that reduce uncertainty for all actors.

Much like Edition 1, these tiers are not hierarchical; they are interdependent. Tier 1 establishes the legal and procedural basis on which technical standards (Tier 2) can be implemented; and Tier 2 enables the operational stability (Tier 3) that market actors and states require. The benchmarked regimes show that when these layers support one another, cooperation becomes predictable and scalable without imposing centralized enforcement burdens.

Applying this logic to space provides a structured pathway for strengthening the implementation of the OST while preserving its openness, flexibility and state-based design.

06 Unified Comparative Governance Matrix

The comparative matrix below distills how specific operational tools from the ATS, UNCLOS, and the ITU regulatory framework can help implement the principles of the OST. Rather than replicate other regimes, the matrix identifies the functional mechanisms that can be adapted to space and maps them to the three-tiered SARPs.

The resulting structure provides a usable reference for policymakers: each OST implementation gap links to relevant global commons mechanisms, the governance function they perform, and the SARPs tier through which they can be adopted in practice.

Table 1 Unified Comparative Governance Matrix: Comparative Lessons

OST Gap	Comparative Precedent (ATS / UNCLOS / ITU)	Functional Mechanism from Precedent	Adaptable Tool for Space Governance (SARPs)	SARPs Tier	Incentive Lever
Non-appropriation (Art. II)	ATS	Sovereignty claims are frozen; peer inspections; transparent operations	Time-limited site-use protocols; activity zones; cooperative monitoring	Tier 1	Recognition of preferred operational windows by peers
Responsibility for operators (Art. VI)	UNCLOS	Sponsoring-state oversight; due-diligence duties; compliance chain	Peer-audited licensing benchmarks; clear supervision standards	Tier 1	Reciprocal license recognition; lower compliance friction
Registration & identity (Art. VIII)	ITU regulatory framework	Validated filings; MIFR; technical verification	Interoperable, validated technical registry with real-time updates	Tier 2	Market access; interference protection; verification benefits
Due regard (Art. IX)	ATS + UNCLOS	Prior notification rules; Environmental Impact Assessments (EIAs); navigation norms	Standardized consultation triggers; mission-scaled EIAs; safety perimeters	Tier 2	Insurance discounts; coordination priority
Liability (Art. VII)	UNCLOS + ITU	Linking rights and benefits to verified compliant behavior	Differentiated insurance and liability premiums tied to verified compliance and safe behavior (complementing the fault-based framework of the Liability Convention)	Tier 3	Premium reduction; investor confidence
Interference / Collision avoidance	ITU	Stepwise coordination; administrative dispute resolution	Adaptive conjunction thresholds; Space Traffic Management (STM) aligned data submission	Tier 2	Access to combined Space Situational Awareness (SSA) datasets
Environmental protection	ATS + UNCLOS	EIAs; protected zones; monitoring cycles	Graduated debris / contamination thresholds; lunar heritage areas	Tier 2	Streamlined licensing; sustainability credits
Equitable participation	UNCLOS (ISA)	Capacity-building; contractor training; access mechanisms	Filing support, shared tools, capacity-building fund for emerging states	Tier 1	Reduced fees; access to shared infrastructure
Transparency & reporting	ATS + ITU	Public registries; inspections; filings	Standardized reporting schema; transparent operational status updates	Tier 1	Reputational benefit; procurement eligibility
Dual-use ambiguity	UNCLOS + ATS	A normative framework that separates activities by: (1) declared peaceful/ commercial purpose, leading to (2) distinct, transparent behavioral norms for those activities, enforced through (3) voluntary transparency and peer verification.	Civilian-mission operational norms; voluntary safety protocols; contract-based transparency	Tier 1	Fast-track reviews; export facilitation; reputational credit; reduced scrutiny

The matrix provides a functional bridge between international precedents and the Multi-Tiered SARPs structure. It shows how specific mechanisms, such as notification rules, zonal approaches, technical filings, and due diligence duties, can be adopted to address known implementation gaps in space governance. By connecting each gap to a corresponding SARPs Tier, the matrix offers policymakers a structured way to implement the OST through voluntary, scalable mechanisms that enhance predictability and reduce operational risks.

07 Multi-Tiered SARPs Framework

The Multi-Tiered SARPs framework provides a structured set of voluntary mechanisms that states can adopt to enhance predictability, reduce operational risk, and align commercial activity with the principles of the OST. This section sets out the practical tools contained within each tier. Comparative precedents and gap alignments are provided in the Unified Comparative Governance Matrix (Table 1), allowing this section to focus exclusively on the operational mechanisms available to states and industry.

7.1 Tier 1: Legal, Economic and Commercial Foundations

Tier 1 strengthens national supervision and commercial confidence by establishing clear procedures for licensing, responsibility, and transparency. These mechanisms reduce regulatory uncertainty and create predictable conditions for investment, market access, and cross-border coordination.

Tier 1 Mechanisms

1. **Licensing Transparency**

- Publication of mission authorizations identifying the operator, responsible state, mission category, and supervisory authority (where not restricted for national security reasons).
- Access to shared public-facing registry of licensed missions, modeled on recognition-based filing systems.

2. **Basic Disclosure Requirements**

- Advanced filing of launch parameters, mission profile, orbital insertion windows, and planned end-of-life method.
- Post-launch updates for orbital maneuvers, anomalies, mission status changes, and disposal activities.

3. **Responsibility Benchmarks (Art. VI Alignment)**

- Voluntary adoption of shared supervisory expectations for safety, technical compliance, and operator performance formulated through multilateral consultations.
- Harmonized criteria across states to reduce divergence in national licensing processes.

4. **Mutual Recognition and Streamlined Review**

- Optional recognition of licensing decisions from states meeting SARPs benchmarks.
- Reduced administrative duplication for operators licensed in multiple jurisdictions.

5. **Technology and Mission Classification**

- Functional classification framework (e.g. “routine commercial”, “transport”, “surface operations”) to support coordination without assessing intent.

6. **Capacity-Building and Participation**

- Technical assistance programs, shared licensing templates, and training for emerging states to promote inclusive participation under the OST.

Tier 1 Incentives:

- Reciprocal licensing fast-track options.
- Preferential access to shared SSA, debris monitoring, and coordination services.
- Eligibility for collaborative demonstration missions.
- Insurance and financing benefits for operators based on Tier-1-aligned jurisdictions.

Potential Economic Effect:

Tier 1 reduces regulatory uncertainty, improves investor confidence, and enables fair competition by ensuring that transparency and accountability form the basis for all market transactions.

Implementation Example:

States adopting Tier 1 could establish pre-launch registration modeled on ITU's advance publication. Operators file orbital parameters and deorbiting plans 6-12 months before launch through a standardized registry. This enables early coordination and interference assessment. Tier 1-compliant states could mutually recognize licenses, reducing regulatory duplication, so an operator licensed in one jurisdiction receives expedited approval in others.

7.2

Tier 2: Technical Standards

Tier 2 provides interoperable technical expectations that reduce collision risk, interference, and environmental impact. These standards are voluntary, scalable, and adaptable to mission class and technology maturity.

Tier 2 Mechanisms

1. **Mission-Scaled Technical Reviews**

- Graduated environmental and operational assessments tailored to mission complexity.
- Streamlined requirements for routine LEO operations, enhanced review for novel or high-impact missions.

2. **Conjunction Assessment and Manuever Coordination**

- Standardized data formats for orbit determinations, covariance, and planned maneuvers.
- Shared thresholds for conjunction assessment and risk communication.

3. **Debris Mitigation and End-of-Life Protocols**

- Mission-class-specific requirements for passivation, disposal timelines, deorbit trajectories, and re-entry notifications.

4. **Operational Data Registration**

- Unified technical registry containing essential parameters: spacecraft mass, maneuverability, propulsion type, failure modes, and disposal method.

5. **Congested Zone Coordination (LEO and Lunar Surface)**

- Optional coordination templates for high-density altitudes, lunar polar resource areas, or surface operation zones.

6. **Adaptive Updates**

- Mechanisms to revise technical standards without treaty amendment, reflecting technological evolution and operational lessons learned.

Tier 2 Incentives:

- Priority in launch slots, spectrum coordination windows, or high-demand orbital shells.
- Reduced insurance premiums for operators meeting SARPs technical standards.
- Preferential financing or export-credit terms for aligned missions.

Potential Economic Effect:

Tier 2 lowers operational risk and enhances interoperability, supporting more stable insurance markets and enabling high-volume commercial activity with reduced uncertainty.

Implementation Approach:

Drawing from the Antarctic environmental assessment experience, a graduated approach could categorize missions according to their operational characteristics: routine activities such as LEO satellites under 500 kg might utilize streamlined compliance processes, while missions involving novel technologies or complex operations could benefit from comprehensive technical consultation. This differentiated approach would focus resources effectively while facilitating routine activities.

7.3

Tier 3: Operational Protocols

Tier 3 focuses on predictable behavior during real-time operations. These protocols reduce uncertainty, prevent escalation, and support reliable commercial and civil activity without addressing military intent or security activities.

Tier 3 Mechanisms

1. **Proximity Operations and Rendezvous Norms**

- Recommended procedures for approach distances, maneuver timing, notification requirements, and collision-avoidance coordination.

2. **Emergency Coordination**

- Shared protocols for anomaly reporting, fragmentation events, re-entry predictions, loss of control and interference incidents.

3. **Risk and Crisis Communication Channels**

- Dedicated communication pathways for time-critical alerts regarding threats, hazardous debris, maneuver failures, or solar event disruptions.

4. **Conduct-Based Differentiation**

- Voluntary safety audits or behavior-based performance indicators to demonstrate sustainable operations.

5. **Cooperative Operational Arrangements**

- Access to shared logistics, pooled ground-segment services, or emergency response capabilities to increase operational resilience.

6. **Insurance-Aligned Behavior Standards**

- Framework enabling insurers to differentiate premiums and coverage terms based on demonstrated safety performance.

Tier 3 Incentives:

- Faster regulatory approvals for reliable operators.
- Access to shared emergency and coordination services.
- Preferential terms for insurance, financing, and collaborative missions

Potential Economic Effect:

Tier 3 enhances market predictability and reduces operational friction, benefiting insurers, financiers, and operators while supporting sustainable long-term operations.

Implementation Approach:

A graduated insurance framework might offer differentiated structures based on demonstrated operational performance assessed from agreed implementation data. Operators demonstrating peer-reviewed safety compliance, participation in collaborative data sharing, and sustainable operational records could benefit from favorable terms. Where multiple states are involved, compliance assessment would respect the licensing state's standards while recognizing shared oversight through transparent arrangements. This approach parallels established maritime practices where safety performance informs commercial terms, creating market-based incentives for sustainable conduct.

7.4

SARPs Tier Integration

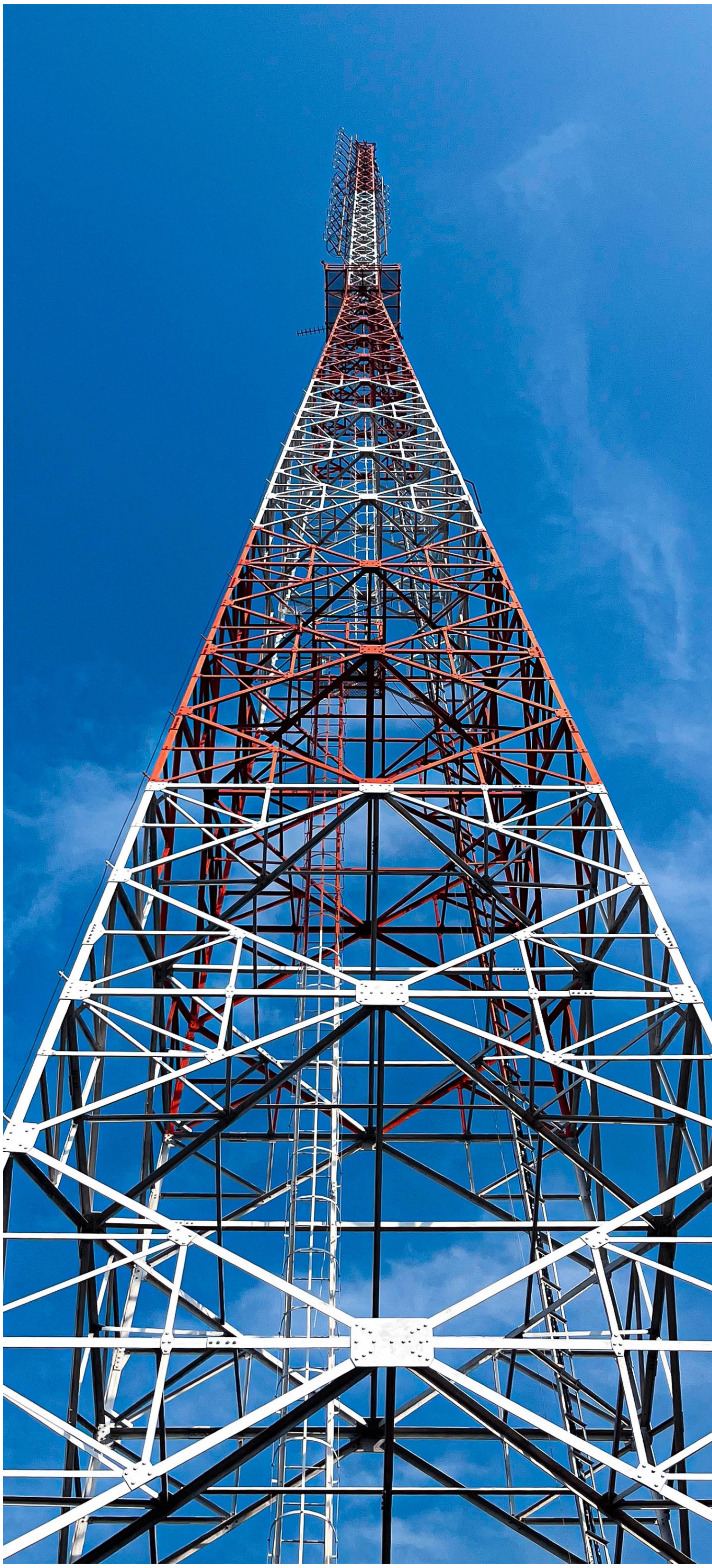
As shown in the Unified Comparative Governance Matrix (Table 1), each tier responds to a distinct OST implementation gap and draws on functional mechanisms demonstrated across global commons. The SARPs tiers provide a practical pathway for states and operators to enhance safety, predictability, and commercial confidence in outer space, while preserving states' authority to regulate national activities. Participation remains entirely voluntary, enabling states to adopt any combination of Tier 1, Tier 2, or Tier 3 mechanisms consistent with their national priorities and capacity.

08 Key Takeaways

The analysis presented in this paper demonstrates that the central challenge in space governance is not the adequacy of the OST principles, but the absence of a structured, practical system to translate those principles into daily operations. Comparative experience across other global commons shows that durable governance does not emerge from new supranational authorities, binding rules, or enforcement powers alone, but from layering responsibilities, technical standards, and predictable behavioral practices in ways that reduce ambiguity and build trust.

The Multi-tiered SARPs Framework offers this missing structure: a flexible, voluntary architecture that converts high-level obligations into workable tools for states and operators without altering legal commitments or constraining national discretion. Its strength lies in aligning incentives with sustainable conduct, giving industry, insurers, and emerging space actors a clear pathway to cooperate, compete fairly, and scale activities safely. As commercial activity accelerates and more states enter the space domain, the need for clarity, interoperability, and predictable behavior will only grow.

SARPs provides a future-oriented blueprint for implementing the OST through practice rather than treaty reform, supporting sustainable growth in a diverse, multipolar space environment.



09 Conclusion

The evolution of space activity has outpaced the operational structures needed to manage it, and the choices made in the coming decade will determine whether space remains a stable, accessible, and economically productive domain. This paper offers a practical way forward: not by reopening foundational treaties or attempting to engineer consensus on new legal obligations, but by providing a coherent framework through which states and operators can align their practices voluntarily and incrementally.

The value of the SARPs model lies in its realism. It recognizes that sovereignty, commercial competition, and national security considerations will continue to shape space activity, and cooperation remains possible when tools focus on clarity rather than constraint. By organizing existing practices, industry capabilities, and comparative lessons into a shared structure, SARPS creates a common reference point that can be adopted at different speeds and for different purposes.

What emerges is a governance approach that is both pragmatic and scalable. States can strengthen oversight without burdening innovation; operators can reduce uncertainty without sacrificing competitiveness; and the international community can improve safety without altering existing treaties. This is the kind of progress that is achievable now, through decisions that improve transparency, harmonize technical expectations, and support sustainable conduct.

Since space is an essential layer of the global economy, governance must evolve in a way that matches its complexity and pace. The approach outlined here is a step toward that future: a structured, incentive-aligned pathway that enhances stability, supports inclusive participation, and prepares the space domain for the next generation of activity. It shows that meaningful governance need not be imposed, it can be built gradually and collectively, through practical mechanisms that serve the interests of all who rely on space.

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Endnotes

1. Berkman P A (2011) President Eisenhower the Antarctic Treaty and the Origin of International Spaces in Science Diplomacy Science Antarctica and the Governance of International Spaces.

2. Nguyen L A T and Dang V H (2024) Viability of UNCLOS amid Emerging Global Maritime Challenges Springer.

3. Frieden R (2020) Win Lose and Draw Outcomes from the 2019 World Radio Conference SSRN Electronic Journal.

4. Berkman P A (2011) See note 1.

5. Nguyen L A T and Dang V H (2024) See note 2.

6. International Telecommunication Union (2023) ITU-R: Managing the Radio-Frequency Spectrum for the World (Backgrounder) Available at: https://www.itu.int/en/mediacentre/backgrounders/Pages/itu-r-managing-the-radio-frequency-spectrum-for-the-world.aspx

7. Scientific Committee on Antarctic Research SCAR (2011) Inspection Checklists and Station Reports in SSAG Proceedings 1-7 and 55-58.

8. International Seabed Authority (2023) The Current Status of Deep-Sea Mining Governance sections outlining administrative technical and regulatory functions 27-46. See also Tladi D et al (n.d.) Common Heritage of Mankind and the Governance of the Area 1-8.

9. Frieden R (2020) See note 3.

10. Makanse Y (2024) Contextualising Antarctic Tourism Diversification The Polar Journal 14(1) 270-313. See also Triggs G (2011) The Antarctic Treaty System A Model of Legal Creativity and Cooperation Science Diplomacy 40-51.

11. International Seabed Authority (2023) The Current Status of Deep-Sea Mining Governance at the International Seabed Authority ISA Report. See also Tladi D et al (n.d.) Common Heritage of Mankind and the Governance of the Area CHM Governance Paper.

12. Frieden R (2020) See note 3.

13. Hughes K A Gray A D and Ager B J (2024) Attainment of Consultative Status by Parties to the Antarctic Treaty Past Present and Future The Polar Journal 14(2) 560-591. See also Gray A D and Hughes K A (2016) Demonstration of “Substantial Research Activity” to Acquire Consultative Status under the Antarctic Treaty Polar Research 35(1).

14. See note 6 for ITU. See also note 11 for ISA.

15. Riadh M (2024) Evaluating the Environmental and Economic Impacts of MARPOL Compliance Collaborate Engineering Daily Book Series 2(2) 98-104.

16. International Telecommunication Union (2024) WEF 2024 ITU Secretary-General Outlines an Inclusive Digital Future. Available at: https://www.itu.int/hub/2024/01/wef-2024-itu-secretary-general-outlines-an-inclusive-digital-future/

17. Kessler D J and Cour-Palais B G (1978) Collision Frequency of Artificial Satellites The Creation of a Debris Belt Journal of Geophysical Research 83 2637-2646. See also COSPAR (2021) COSPAR Planetary Protection Policy Committee on Space Research.

18. Harrington A (2020) Insurance as Governance for Outer Space Activities Astropolitics 18 99–121.

19. Harrington A (2020) See note 18.

20. Harrington A J (2021) Space Insurance and the Law Edward Elgar Publishing Cheltenham.

21. Malinowska K (2017) Risk Assessment in Insuring Space Endeavours: A Legal Approach Air & Space Law 42(3) 329-348. See also Malinowska K (2020) Risk Management and the Insurance of On-Orbit Servicing: The Insurance Industry as a Driver of Risky Space Innovation IAC-20.E6.4.10.

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