

Review

Examining the Relevance and Adequacy of the Outer Space Treaty as an International Legal Instrument for Space Tourism Entrepreneurship (STE): A Systematic Literature Review

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Abstract: The relevance and adequacy of the 1967 UN Assembly Resolution 2222, XXI, Outer Space Treaty (OST) as a legal framework for Space Tourism Entrepreneurship (STE) are the subjects of ongoing debates in legal research. Utilizing a Systematic Literature Review (SLR), the current study critically examines the OST's effectiveness in regulating STE. A rigorous selection and review of 46 articles reveals three key findings. Firstly, while the OST offers partial relevance for activities like space tourism and commercial exploitation, it falls short in addressing emerging legal, regulatory, and ecological complexities. Secondly, the treaty is deemed inadequate as a legal framework for STE due to its inability to address these complexities effectively. Thirdly, the study suggests that existing provisions can be strengthened through the development of comprehensive space law at international, regional, and national levels to address the evolving challenges in the space tourism industry. These findings underscore the need for policymakers and legal experts to revisit and strengthen existing legal frameworks to better regulate the rapidly evolving field of space technology and space tourism entrepreneurship by developing comprehensive space law that addresses emerging complexities and ambiguities.

Keywords: adequacy, international law, relevance, space tourism entrepreneurship, systematic literature review

1. Introduction

Since the dawn of human civilization, space exploration has remained a timeless and evergreen endeavour driven by curiosity to understand physics and metaphysics, spirituality, and recreational adventure (Almécija, 2023). The ambitious path of space exploration has led to inspiring achievements and profound discoveries in science, technology, and astronomy in modern times (Tucker & Alewine, 2023). Space tourism is a niche sector offering leisure and business travel beyond Earth's atmosphere, yet it remains highly exclusive to a few rich people due to its significant costs. Current options include high-performance jet fighter flights and zero-gravity experiences, while suborbital and orbital space travel remain future possibilities (Henderson & Tsui, 2019). Suborbital space tourism is driven primarily by interpersonal and personal motivations, such as the desire to experience Earth's view from space, weightlessness, and adventure (Musselman et al., 2024).

At present, space tourism relies on rocket-based technology, but long-term advancements are essential for safer, more affordable, and sustainable access. Future innovations may include space elevators, ion propulsion, nuclear-powered spacecraft,

and solar sails. While private ventures continue to drive innovation, space agencies must prioritize research into sustainable and cost-effective alternatives (Pelton, 2010).

This evolving industry not only reshapes commercial aviation but also accelerates technological advancements that could define the future of human space exploration. At some point, space exploration evolved into an unregulated competition between the United States and the Union of Soviet Socialist Republics (USSR), raising concerns about the possible militarization of space through weapons and missiles (Ilia, 2023). To address these concerns and regulate space activities, the United Nations introduced the Outer Space Treaty (OST) in 1967, which aims to legitimize and coordinate space exploration efforts (Svetlichnyj & Levchenko, 2019; Raimi, 2022). Originally, the treaty focused on government-run space programs with peaceful intentions and ignored developments such as commercial space travel (Chang, 2015) and the growing interest in space tourism (Olya & Han, 2023). The emerging field of space tourism, often referred to as space tourism entrepreneurship, is a relatively new development and is aimed at affluent individuals seeking unique experiences such as leisure, recreation, vacation and adventure in space (Carlen, 2016). Due to its significant socio-economic potential, this industry attracts great attention from tourists, entrepreneurs, companies, institutional investors and space scientists. The total value of the space industry is currently estimated at approximately \$400 billion and is expected to grow to \$805 billion by 2030 (Space Ventures Investors Limited, 2020). The space tourism sector alone is expected to reach a market value of \$3 billion by 2030 (Sheetz, 2019). Another report shows that suborbital space tourism alone is predicted by 2032 to generate \$ 1.1 billion (Musselman et al., 2024). Space tourism expeditions by Musk's SpaceX, Jeff Bezos' Blue Origins and Richard Branson's Virgin Galactic, recently launched to much fanfare and acceptance, have confirmed that STE is here to stay forever (Ilia, 2023).

A key question for space experts, venture capitalists, legal researchers, and policymakers exploring the commercial potential of space tourism and space mining is whether the Outer Space Treaty (OST) remains a sufficient and relevant legal framework for Space Tourism Entrepreneurship (STE). Addressing this issue requires historical arguments grounded in doctrinal analytical methods. Williams (1981) pioneered the justification for commercial use of space, asserting that such activities are permissible as long as they do not impede others from engaging in similar ventures. He noted that prior to the OST's ratification in 1967, celestial bodies like the Moon were considered *res nullius* (unowned) with unregulated usage.

Similarly, Crawford (1995) anticipated that the rapid commercial expansion of space activities would necessitate the development of robust institutional and legal structures. Large-scale space initiatives, he argued, would demand international cooperation, including the creation of a global space agency to manage and resolve the complex social and political challenges of long-term space exploration. While STE offers significant opportunities for leisure, science, and economic growth, the OST raises legal, economic, and ethical questions about its adequacy as a regulatory framework for modern commercial space activities (Sachdeva, 2023; Sheer et al., 2023).

Critics argue that the OST, originally designed to foster space technology for scientific and technological advancement, was not intended to govern commercial

activities and was not ratified by United Nations member states with such purposes in mind (Deberdt & Le Billon, 2023). Emerging challenges, such as jurisdictional issues and the possibility of space crimes, underscore the need for reform in international space law (Sachdeva, 2023a; Sachdeva, 2023b). Regulatory and legal complexities surrounding commercial suborbital spaceflight persist due to the lack of international consensus, resulting in fragmented legal regimes for orbital and suborbital activities (Chang, 2015). This absence of a comprehensive legal framework could lead to significant disputes and necessitate mechanisms to protect the rights of stakeholders, including operators, passengers, and launch states (Padhy & Padhy, 2021).

Space Tourism Entrepreneurship (STE), which includes activities such as space tourism and space mining for commercial purposes, is significantly different from traditional space exploration, which formed the basis for the adoption of the Outer Space Treaty (OST). Consequently, there is an urgent need for the international community to either enact new international laws to regulate these activities or to amend the OST to better reflect the legal definition and delimitation of outer space and airspace. These revisions should also consider the ethical and environmental concerns of various stakeholders and nations (Qizhi, 1982; Raimi, 2022). The legitimacy of resource extraction in space is particularly controversial because the OST characterizes the solar system as a common heritage of humanity (Raimi, 2022). A robust framework is essential to prevent space from becoming a battlefield for political disputes and economic conflicts between nations with significant interests in space tourism, which could lead to serious global impacts. Inspired by recent work, such as El Archi et al. (2023), which conducted a systematic literature review analyzing intelligent tourism destinations in the context of sustainable development, the current study aims to assess the relevance and adequacy of the OST (UN Assembly Resolution 1967) as an international legal framework for space tourism. The OST in its current form has significant deficiencies in the regulation of STE. Key issues not addressed include the implementation of space traffic management systems to avoid collisions and congestion in Earth orbit; the introduction of international property rights laws and responsible resource extraction practices; health and medical standards for space tourists; protecting the privacy of space tourists; and the sustainability of space tourism, taking into account the long-term environmental impacts on space resources and habitats (von der Dunk, 2019; Polkowska, 2021). To ensure responsible and sustainable development of STE, these gaps need to be systematically reviewed and addressed through international legal frameworks and regulations. The primary aim of this research is to assess the relevance and adequacy of the UN Assembly Resolution 2222, XXI (OST) as a legal framework for Space Tourism Entrepreneurship. The study focuses on the following research questions:

- i. **Research question 1 (RQ1):** To what extent are the provisions of the OST relevant as an instrument of international law for space tourism entrepreneurship?
- ii. **Research question 2 (RQ2):** To what extent are the provisions of the OST adequate as an instrument of international law for space tourism entrepreneurship?

- iii. **Research question 3 (RQ3):** How can the provisions of the OST be enhanced to serve as an effective international legal framework for space tourism entrepreneurship?

These three research questions are critical to advancing understanding of the relevance, appropriateness, and potential improvements of the space treaty for space tourism entrepreneurship (STE). They contribute to the field by identifying regulatory gaps, informing policy development, and promoting the development of comprehensive frameworks to regulate and sustain new commercial space activities.

2. Methodology

Apart from the preliminary use of common doctrinal analysis, the methodology used in this study is the systematic review, which employs a rigorous and methodical method to comprehensively explore, evaluate and consolidate existing literature on the subject under study. The methodology follows a qualitative approach, aiming to include representative resources from credible publications. As emphasized by Bamiro et al. (2023), Komalasari et al. (2023), Salisu et al. (2024), and Utaminingsih et al. (2023), Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) offers three distinct advantages. First, it assists in formulating specific research questions and enables systematic study. Second, it helps establish inclusion and exclusion criteria. Third, it aims to review a significant amount of scientific material within a defined timeframe. The following sections detail the various stages comprising the research scope.

2.1. Article Pooling

The initial articles for this systematic study were collected from databases such as **Google Scholar and Scopus**. The search strategy involved using relevant phrases along with Boolean operators "OR" and "AND" to narrow down the search results. Different combinations of keywords that were employed to retrieve pertinent publications from reputable research databases are: "Relevance and Adequacy of the Outer Space Treaty", "Adequacy of the Outer Space Treaty", "Other Space Laws" AND "Outer Space Treaty", "International Legal Instrument for Space Tourism", "Space Tourism" AND "Orbital Travel", "Space Tourism Entrepreneurship" AND "Space Tourism Business".

2.2. Inclusion and Exclusion Criteria

To comprehensively assess the relevance and adequacy of the Outer Space Treaty as an international legal instrument for Space Tourism Entrepreneurship, this study utilized a wide range of scholarly sources, including peer-reviewed articles, book chapters, and other relevant publications. By considering all available literature related to the study topic, the researcher was able to thoroughly explore and examine the subject matter from various perspectives. Additionally, the inclusion of articles from different years ensured that the study encompassed a comprehensive review of the literature, allowing for a more in-depth analysis and understanding of the topic at hand. For the exclusion criteria, this study incorporated a diverse array of scholarly sources;

however, articles deemed irrelevant to the study's research question were excluded from consideration as depicted in Figure 1.

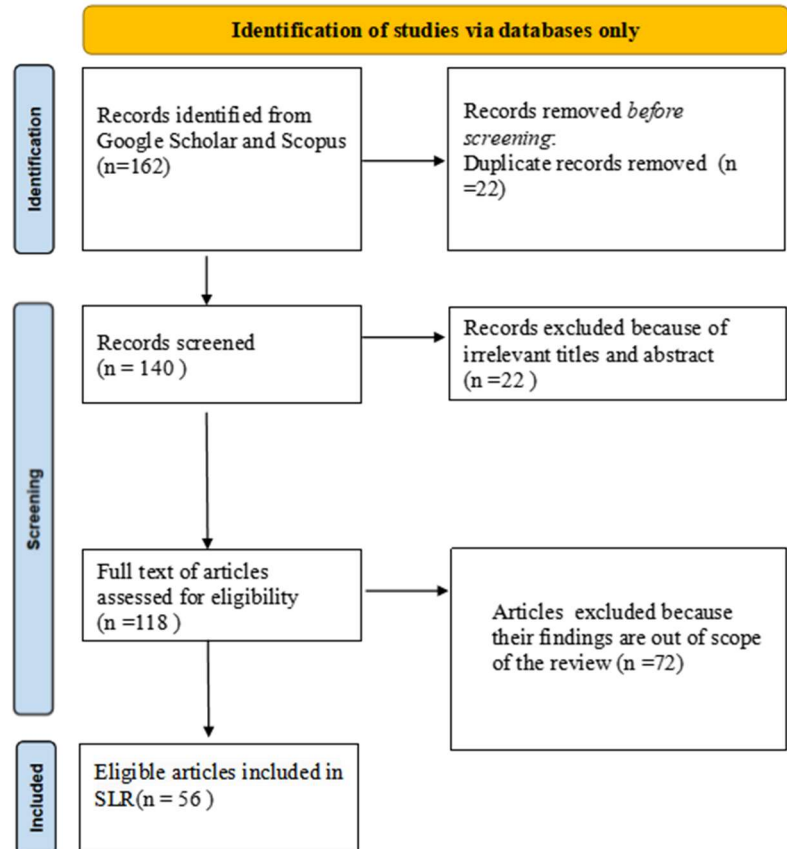


Figure 1. PRISMA flow diagram (Source: Author's own contribution).

3. Data Extraction Table and Analysis

Table 1 below provides a detailed list of the 46 articles selected for inclusion in this systematic review on which this study is based. The most important information in the SLR protocol includes the author's name, year of publication, research methodology, journal title and country.

Table 1. Data Extraction Table.

S/N	Author's Name and Year	Methodology	Country	Journal
1	Freeland (2006)	Qualitative	Australia	International Institute of Space Law --- International Astronautical Congress
2	Hobe (2007)	Qualitative	USA	Nebraska Law Review
3	Johnson (2012)	Qualitative	USA	Global Space Exploration Conference

4	Kramer (2014)	Qualitative	USA	Space Policy
5	Chang (2015)	Qualitative	Taiwan	Acta Astronautica
6	Lyall & Larsen (2016)	Qualitative	Australia	Routledge
7	Chang & Chern (2016)	Qualitative	China	Acta Astronautica
8	Liu & Tronchetti (2016)	Qualitative	China, USA	Space Policy
9	Blount (2016)	Qualitative	USA	North Carolina Journal of Law & Technology
10	Bruhns & Haqq-Misra (2016)	Qualitative	USA	Space Policy
11	Marina, Sergei, & Anna (2017)	Qualitative	USA	BRICS Law Journal
12	Su (2017)	Qualitative	China	International and Comparative Law Quarterly
13	Forganni (2017)	Qualitative	France	Space Policy
14	Xu & Su (2018)	Qualitative	China	Space Policy
15	Morozova (2018)	Qualitative	Russia	Oxford Research Encyclopedia of Planetary Science
16	Zhao (2018)	Qualitative	China	Oxford Research Encyclopedia of Planetary Science
17	Feichtner (2019)	Qualitative	Germany	Leiden Journal of International Law
18	Martinez et al. (2019)	Qualitative	South Africa	Space Policy
19	Marboe (2019)	Qualitative	Austria	Oxford Research Encyclopedia of Planetary Science
20	Boley & Byers, (2020)	Qualitative	Canada	Science
21	Friel (2020)	Qualitative	Italy	Current Issues in Tourism
22	Bulgakova (2020)	Qualitative	China	Legal Horizons
23	Deplano (2021)	Qualitative	UK	International and Comparative Law Quarterly
24	Padhy & Padhy (2021)	Qualitative	India	Acta Astronautica
25	Peeters (2021)	Qualitative	France	The International Journal of Space Politics & Policy
26	Lamine et al (2021)	Qualitative	Canada	Strategic Entrepreneurship Journal
27	Ruhaeni, et al. (2022)	Normative Juridical method	Indonesia	Atlantis Press

28	de Araújo et al. (2023)	Qualitative	Spain	Journal of Travel Medicine
29	Crawford (1995)	Qualitative	UK	Space Policy
30	Brown (2004)	Qualitative	UK	Tourism Recreation Research
31	Casini (2006)	Qualitative	Italy	Space Policy
32	Lyall (2010)	Qualitative	Italy	Acta Astronautica
33	Masson-Zwaan & Freeland (2010)	Qualitative	Netherland, Australia	Acta Astronautica
34	Von der Dunk (2011)	Qualitative	USA	Space Policy
35	Ferreira-Snyman (2014)	Qualitative	Netherlands	Potchefstroom Electronic Law Journal
36	Weeks & Faiyetole (2014)	Qualitative	USA, Nigeria	Acta astronautica
37	Martinez (2019)	Qualitative	USA	Global Sustainability
38	Aglietti (2020)	Qualitative	New Zealand	Frontiers in Space Technologies.
39	Toivonen (2020)	Qualitative	Finland	Journal of Sustainable Tourism
40	Freeland & Ireland-Piper (2022)	Qualitative	USA	Journal of International Law and Foreign Affairs
41	Baciu (2022)	Qualitative	Romania	Cactus Tourism Journal
42	Drobnik et al. (2023)	Qualitative	Thailand	Emerging Science Journal
43	Bower & Lantis (2023)	Qualitative	UK, USA	Emerging Science Journal
44	Marino & Cheney (2023)	Qualitative	UK	Space Policy
45	Popova (2023)	Qualitative	USA	Brill
46	Tepper (2023)	Qualitative	USA	Maryland Law Review

3.1. Research Categorized by Methodology

The methodological analysis examines the research methods used in all articles included in this systematic review. The analysis shows that 98% of the articles use the qualitative method (46 articles), while one study used the normative legal method, which is a specific approach within legal research and analysis that focuses on the interpretation and application of legal norms, principles, and rules. This method is not fundamentally qualitative or quantitative. This distribution is shown visually in the figure below (Figure 2).

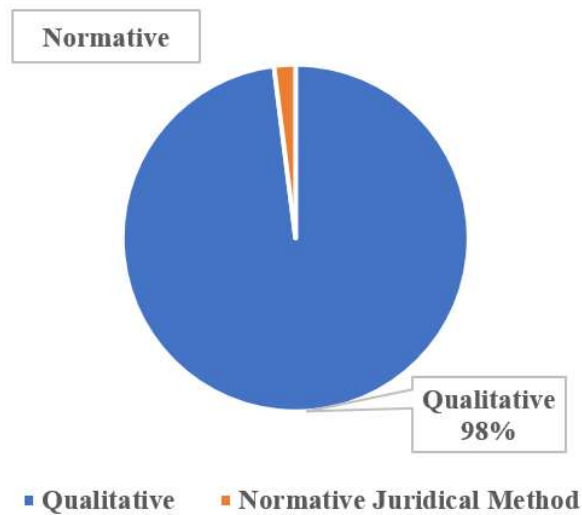


Figure 2. Research Methodology Chart.

3.2. Publication by Year

Concerning the number of publications by year, Figure 3 illustrates that a total of 6 articles were published in 2023, followed by 5 articles each published in 2016 and 2020. In 2014, 2017, 2018 and 2022, 3 articles were published. Two articles were published in 2006 and 2010, while 1 article was published in 1995, 2004, 2007, 2011, 2012 and 2015. Overall, recently published articles were mostly used.

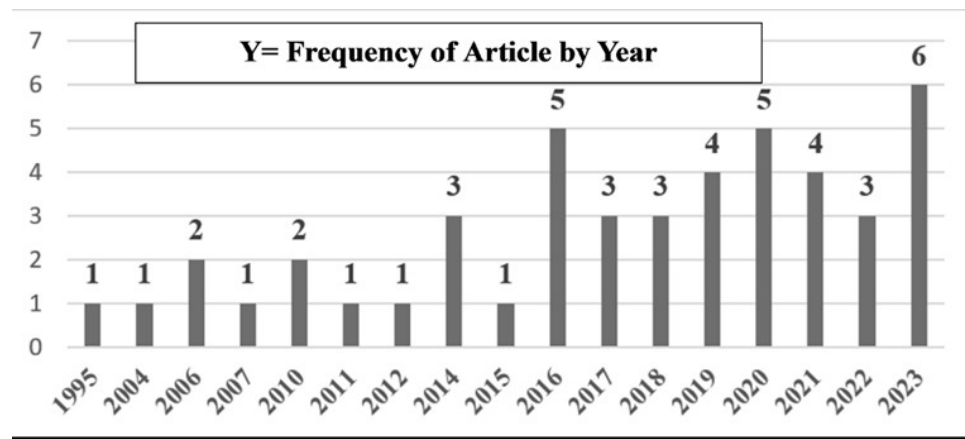


Figure 3. Article Distribution by Year.

3.3. Research Country Affiliation

The topic studied has a global perspective and the inclusion criteria for this study were designed to exclude no country. The research as depicted in Figure 4 includes a country affiliation analysis showing the contributions of each country to the study under review and the number of articles contributed by each country. The United States leads with 14 items, followed by China with 6 items and the United Kingdom with 5 items. These results illustrate the significant contribution of the United States to assessing the effectiveness of the Outer Space Treaty as an international legal framework for space tourism entrepreneurship.

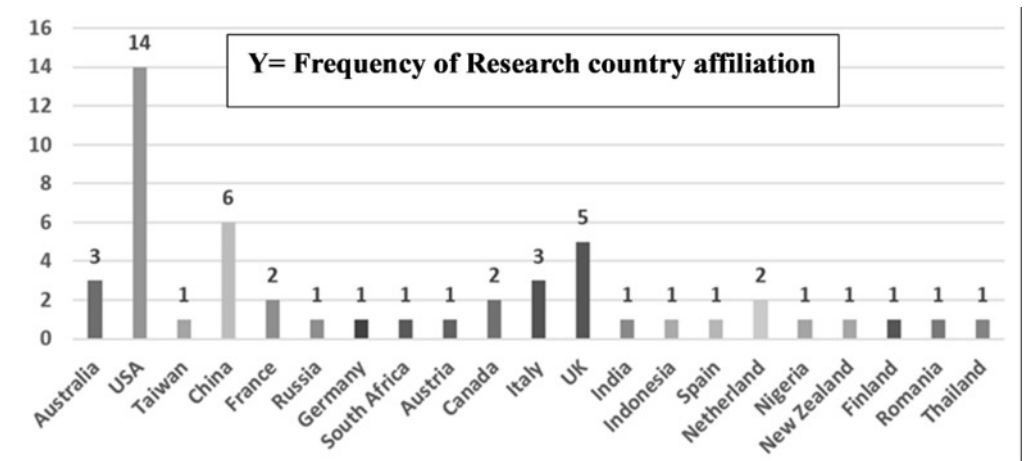


Figure 4. Research country affiliation.

3.4. Author's Country Affiliation

Checking the country affiliation of the authors in Figure 5 shows which countries each author of all the articles discussed belongs to. The majority of authors come from the USA with 17 authors, followed by the United Kingdom with 8 authors and China with 6 authors. These data illustrate the contributions of authors from the United States, the United Kingdom, and China in assessing the effectiveness of the Outer Space Treaty as an international legal framework for space tourism entrepreneurship. This information is presented visually in the following figure.

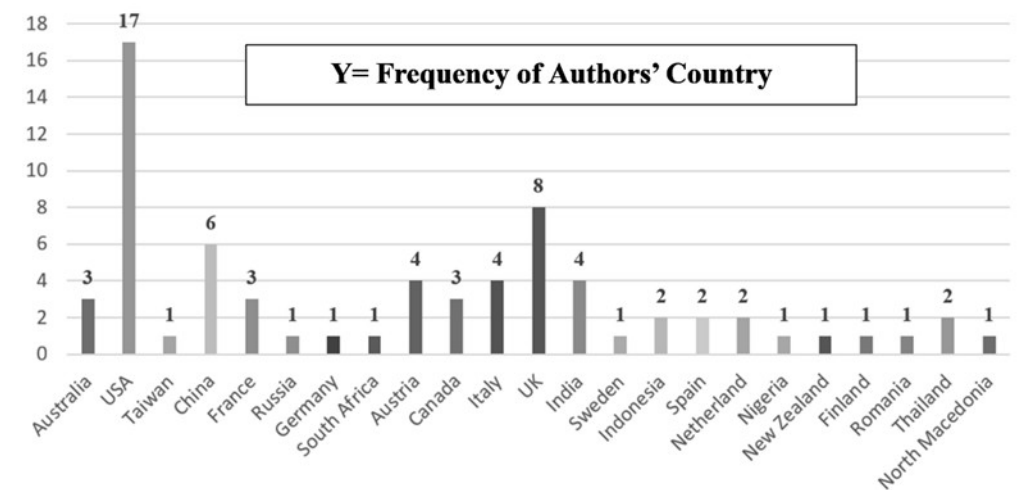


Figure 5. Authors' Country Affiliation.

4. Finding and In-depth Discussion

Research question 1: To what extent are the provisions of the OST relevant as an instrument of international law for space tourism entrepreneurship?

Finding 1: Based on the analysis of the scientific articles summarized in Table 2, the Outer Space Treaty (OST), adopted in 1967 by UN Assembly Resolution 2222, XXI, provides partial relevance to emerging activities such as space tourism,

commercial exploitation, and space mining, collectively referred to as Space Tourism Entrepreneurship (STE). Scientific evidence shows that the OST is primarily focused on scientific exploration by nations, rather than the commercial ambitions of private companies under international space law. The classification of the OST as partially relevant is supported by doctrinal arguments from several scholars who recognize its importance as a fundamental piece of international space law. It facilitates space tourism when considered together with other UN space treaties, including the Salvage Agreement (1968), the Liability Convention (1972), the Registration Convention (1976) and the Moon Agreement (1979), as well as various UN General Assembly resolutions. However, the OST was originally designed to prioritize scientific exploration by states, rather than the commercial ventures emerging today. Consequently, there is an urgent need to develop new legal instruments or improve the OST to address the legal challenges posed by technological advances in the STE, including orbital space tourism and space mining. Such developments are crucial to ensure the sustainable and responsible exploration and commercialization of space, in line with modern principles of responsible consumption and production.

The expert viewpoints cited in Table 2 highlight the legal, regulatory and environmental complexities associated with the applicability of the OSTs to space tourism, space mining and other commercial activities. While the OST partially accommodates commercialization and colonization initiatives such as Mars colonization, its limitations are obvious. These include a lack of clarity on key issues such as the delimitation of airspace and outer space, licensing procedures for space tourism, spacecraft registration, passenger liability and third-party claims. Furthermore, the OST fails to address international legal concerns related to the use of force in resolving conflicts and rivalries in space activities. Despite these gaps, the OST remains a cornerstone for preventing the militarization of outer space and upholding the principles of free exploration and use of outer space under international law. However, specific provisions are lacking for two key types of space tourism: Orbital Space Tourism and Suborbital Space Tourism. This inadequacy highlights structural challenges in addressing safety, operational feasibility, stakeholder rights (including operators, passengers and launching states) and legal authorization. In terms of innovation, the limitations of OSTs have led to the development of additional regulatory frameworks, such as the Commercial Space Launch Competitiveness Act (CSLCA) and the Artemis Convention, to address gaps in space laws and regulations. While the OST complements other UN treaties to provide a general framework for space governance, it does not comprehensively address critical issues such as property rights, ethical safeguards, liability and compensation mechanisms in space activities. From an operational perspective, the OST's relevance is further diminished by its inability to effectively address the modern challenges and opportunities associated with space exploration and commercialization. This highlights the need for updated or new legal instruments to ensure that the legal framework evolves in parallel with advances in space technology and commercial efforts.

Table 2. Author's data extraction template for the test of relevance.

SN	Author & Year	Findings on OST's Relevance	Policy and Legal Implications
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1	Freeland (2006)	The scope of is operationally limited, particularly regarding clarity on international law issues like the use of force in space-related conflicts.	There is a need for new or amended international laws that are more inclusive and detailed.
2	Hobe (2007, 2013)	OST as a legal instrument struggles with legal issues such as defining the boundary between airspace and outer space, space tourism authorization, spacecraft registration, and passenger liability.	New legal frameworks or amendments are necessary to legitimise STE and address all the observed gaps.
3	Johnson (2012)	The 1967 OST is highly relevant for preventing the militarization of space by players.	The OST as it currently stands requires amendments to serve as a modern legal framework.
4	Kramer (2014)	While the OST and Moon Treaty contain vague provisions, they are partially effective for regulating scientific and commercial space activities.	An updated version of the OST is urgently needed to meet contemporary opportunities and operational challenges.
5	Abeyratne & Abeyratne (2015)	The OST is indeed relevant as it establishes the principle of equal exploration and use of space under international law, prohibiting national claims over celestial bodies.	The OST provisions support both scientific and commercial space applications.
6	Chang (2015)	OST partially addresses space tourism but leaves legal gaps in safety, operations, and regulation. Although the U.S. has laws for suborbital tourism but not for orbital tourism.	Comprehensive international regulations for orbital and suborbital tourism are needed.
7	Lyall & Larsen (2016)	Space law is still evolving, and the OST is partially relevant due to regulatory gaps caused by advancements in space technology outpacing existing legal developments.	Addressing the observed limitations would enhance OST's relevance to STE.
8	Chang & Chern (2016)	The OST has provided a good foundational legal framework for space tourism since 1954, but progress in the sector has been inconsistent.	While relevant for STE, space tourism's fluctuating progress requires legal adjustments.
9	Liu & Tronchetti (2016)	The OST is relevant for maintaining peace in space, strengthened by resolutions like "No First Placement of Weapons in Space."	It supports STE but requires specific provisions for private sector involvement in space exploration.
10	Blount (2016)	Due to ambiguities, the OST is inadequate as a comprehensive space tourism law. U.S. legislation like the CSLCA provides a framework for commercial property rights.	A new international legal instrument is required to address these gaps.
11	Bruhns & Haqq-Misra (2016)	Commercial space activities and Mars colonisation are not excesses; they largely align with the OST's principles.	OST is partially relevant for supporting STE and commercial activities like space mining.
12	Marina, Sergei, & Anna (2017)	The OST was drafted decades ago and has operational limitations that make it less suitable for addressing modern challenges in outer space activities.	OST's relevance to STE improves with legal updates addressing its limitations.
13	Su (2017)	OST does not explicitly prohibit unilateral resource exploitation by powerful nations, aligning with the principle of freedom of use for the common good.	An international regulatory framework is urgently needed for effective coordination and sustainable resource use.
14	Forganni (2017)	The OST's framework is not aligned with the realities of modern space tourism and commercial challenges.	A dedicated and comprehensive legal framework for STE is recommended over modifying the OST.
15	Hobe & de Man (2017)	The OST partially addresses resource exploitation as a legitimate form of outer space use but lacks sufficient legal detail.	Further legal elaboration is required to prevent territorial claims on celestial bodies.

16	Xu & Su (2018)	OST remains relevant across space activities and can further be bolstered by resolutions like PAROS for fostering global cooperation in space exploration.	Proper collaboration among stakeholders would enhance its relevance for STE.
17	Morozova (2018)	OST gains relevance for space tourism when combined with complementary treaties like the Rescue Agreement, Liability Convention, and Moon Agreement.	A synergistic implementation and application with other international rules would strengthen the OST's relevance.
18	Zhao (2018)	The OST at present forms the basis for space industry governance when integrated with complementary treaties under the UN framework.	It clearly establishes a legal foundation for emerging space commercialization.
19	Feichtner (2019)	The OST currently lacks comprehensive regulations for commercial space activities, creating opportunities for wealthier nations to dominate and exploit extraterrestrial resources.	A new or revised international legal framework is necessary.
20	Martinez et al. (2019)	The OST is partially relevant to STE but combined with initiatives like UNISPACE+50, it offers opportunities for global space governance.	The relevance of OST can be improved when integrated with complementary legal instruments.

Research question 2: To what extent are the provisions of the OST adequate as an instrument of international law for space tourism entrepreneurship?

Finding 2: Based on the analysis of the scientific articles summarized in Table 3, the Outer Space Treaty (OST), adopted in 1967 by UN Assembly Resolution 2222, XXI, is considered an inadequate legal framework for new activities such as space tourism, commercial exploitation, and space mining (collectively referred to as Space Tourism Entrepreneurship or STE). Its inability to address the legal, regulatory and environmental complexities of modern space economies underscores its inadequacy within the broader framework of international space law. The passage of national laws such as the Commercial Space Launch Competitiveness Act (CSLCA) and the Artemis Accords by the United States, as well as similar laws in other countries, underscores the urgent need for a comprehensive and innovative international legal framework to regulate and manage commercial space ventures effectively. The expert and academic perspectives in Table 3 highlight the diverse legal, regulatory and environmental challenges posed by the shortcomings of OSTs in addressing STE. Scholars widely agree that the OST is ill-suited to function as an appropriate international legal instrument for modern space activities. Large-scale commercialization of space, including space tourism and development, requires robust institutional and legal frameworks supported by international cooperation. In addition, there are concerns about STE's focus on space colonization and not just providing recreational opportunities for tourists, which poses risks to global stakeholders in the absence of appropriate legislative measures. Although the commercialization of space offers potential social and economic benefits, it poses significant challenges due to gaps in the legal framework for space activities. For example, the OST provides limited clarity on critical international law issues such as the use of force and the resolution of conflicts in outer space. Furthermore, legal ambiguities in areas such as authorization, liability and registration of space activities remain unresolved, highlighting the need for comprehensive international regulations tailored to these challenges.

One of the main shortcomings of the OST lies in its outdated provisions, which were drafted decades ago without considering the modern realities of space activities

such as space tourism and mining. The Treaty was originally intended to facilitate scientific progress, but its scope and relevance are insufficient to meet current commercial and technological developments. These deficiencies have led to growing calls for the OST to be revised and updated to reflect the legal and operational complexities of today's space exploration landscape. While some private companies have initiated space tourism, the lack of robust regulatory frameworks raises significant concerns about safety, environmental sustainability and equal access. Space tourism is now expanding its scope to include resource extraction, but the OST does not contain detailed provisions for such activities. In particular, the increasing interest in space mining highlights the urgent need for a transparent legal framework and effective dispute resolution mechanisms and underlines the importance of international cooperation and accountability. Another critical issue is the competing principles enshrined in existing space laws, including the OST. These conflicting principles create uncertainty and hinder enforcement, further highlighting the need for clearer legal guidelines and enforcement mechanisms. Overall, the growing complexity of modern space exploration and commercialization requires a holistic approach to international space law that ensures safety, sustainability and fairness for all parties involved.

Table 3. Author's data extraction template for the test of adequacy.

SN	Author & Year	Findings on OST's Inadequacy	Policy and Legal Implications
1	Crawford (1995)	Finding indicates that large-scale commercialisation of space exploration and space industry development requires more robust institutional and legal frameworks, along with international cooperation.	The establishment of a space agency is essential to address social and political challenges related to STE.
2	Brown (2004)	Although there is potential for STE through suborbital flights and orbital hotels, the primary goal seems to be space colonisation rather than tourism.	The OST is weak and insufficient for regulating STE and addressing the hidden agendas of colonisation.
3	Casini (2006)	While STE promises social and economic benefits, it also poses serious risks due to inadequate legal frameworks governing space activities.	A new legal regime and collaborative efforts among spacefaring nations are necessary.
4	Freeland (2006)	The OST lacks clarity on international legal issues, particularly regarding conflict resolution and the use of force in outer space.	A revised or entirely new international legal framework is required.
5	Hobe (2007, 2013)	Legal gaps exist in the OST regarding airspace and outer space boundaries, authorisation for space tourism, and liability for passengers and third parties.	New legal instruments or thorough amendments of the provisions are needed to properly legitimise STE.
6	Lyall (2010)	The OST's definition of astronauts is not consistent when applied to commercial space tourism, highlighting inadequacies in provisions for STE.	New or amended international laws are necessary to address modern challenges in STE.
7	Masson-Zwaan & Freeland (2010)	The OST was developed without considering modern space activities like STE, creating significant gaps in legal clarity that must be urgently addressed.	A new international legal framework tailored to space tourism is required.
8	Kopal (2010)	As an international legal framework, the OST is inadequate for modern space activities and requires improvement through UN initiatives.	Comprehensive legislation under the guidance of the United Nations is necessary to properly regulate space tourism activities.

9	Von der Dunk (2011)	The OST fails to adequately regulate private spaceflight and tourism due to missing clauses on authorisation, liability, registration, and certification.	Development of an inclusive international law for space tourism is needed, potentially incorporating air law.
10	Yuliantiningsih (2011)	While the OST provides protections for astronauts, it lacks regulatory frameworks for the growing commercial space tourism sector.	Proper international regulations are needed to address legal gaps in space tourism.
11	Johnson (2012)	The OST focuses on scientific exploration by states and is inadequate for addressing private commercial activities in space.	An updated version of the OST is required to serve as an effective legal instrument for STE.
12	Wagner (2014)	Legal challenges in commercial space tourism highlight the OST's inadequacy and the lack of time for negotiating binding agreements.	Soft law guidelines should be adopted temporarily while a binding framework is developed.
13	Kramer (2014)	The OST's vague and unenforceable provisions are insufficient for addressing environmental impacts and future space exploration activities.	A new legal framework is necessary to address these inadequacies.
14	Ferreira-Snyman (2014)	The OST is outdated and fragmented, failing to adequately address the interests of states, passengers, and private space actors.	A new international legal framework focusing on these stakeholders is needed.
15	Haseena (2014)	The OST does not adequately encompass the expanded scope and prospects of modern space tourism activities.	Amended legislation is necessary to reflect the evolving scope of space tourism.
16	Weeks & Faiyetole (2014)	The OST is inadequate in addressing emerging trends like resource utilization and equal rights in accessing space resources.	Revised space legislation is essential to ensure fair resource sharing and governance.
17	Chang (2015)	Regulatory gaps exist for both orbital and suborbital space tourism, with the U.S. having laws for SST but not for OST.	A comprehensive regulatory framework for all forms of STE is needed.
18	Blount (2016)	Ambiguities in the OST led to the creation of U.S. legislation like the CSLCA, recognizing commercial resource ownership and cooperation.	A new international legal instrument is needed to address conflicts with OST provisions, especially Article II.
19	Bruhns & Haqq-Misra (2016)	Although the OST allows commercial activities, it lacks clarity on how nations and companies can utilize space resources.	A new international legal framework is necessary to coordinate resource usage in outer space.
20	Chang & Chern (2016)	The OST has been inadequate for regulating space tourism since its inception, with inconsistent progress in tourism development.	Revised legislation tailored to space tourism is required.
21	Forganni (2017)	The OST is unsuitable for modern STE as its context does not align with today's realities in space tourism and commercialisation.	A detailed and inclusive legal framework specifically for STE should be created.
22	Su (2017)	The OST's laissez-faire approach to outer space use risks undermining sustainable and safe exploitation of space resources.	An international regulatory system for STE coordination and benefit-sharing is urgently needed.
23	Волынская (2018)	International Space Law has evolved beyond the outdated OST, which is inadequate for regulating private space activities.	A new international legal framework for overseeing private space activities is essential.
24	Martinez et al. (2019)	The OST is insufficient for private sector-driven STE in the modern era.	The combined application of the OST with initiatives like UNISPACE+50 is necessary for comprehensive governance.

Research question 3: How can the provisions of the OST be strengthened as an instrument of international law for space tourism entrepreneurship?

Finding 3: Two important policy implications emerged as results of the third research question, which examines how the provisions of the Outer Space Treaty (OST) can be strengthened as a legal instrument to promote entrepreneurship in space tourism. The first result, derived from the analysis of 32 articles examining the strengthening of the Outer Space Treaty (OST) as a legal framework for space tourism entrepreneurship, suggests that the provisions of the OST are considered inadequate to regulate entrepreneurship in space tourism at the international level. There is a need for improvement and expansion at the international, regional and national levels. This policy recommendation is in line with Proposal 1, which states that if the provisions of the OST are considered to be a relevant and sufficient international legal framework for space tourism entrepreneurship, there may be no immediate need to supplement and expand the existing regulations at the international level, regional and national levels.

5. Implications for Practice

First, the study highlights the consensus among scholars regarding the inadequacy of existing laws, particularly the OST, in addressing the complexities of STE. Practitioners should advocate for the formulation of new legal frameworks or amendments to existing legal frameworks to comprehensively address emerging challenges. Although opinions differ on the relevance of the OST, it serves as a fundamental legal framework. Practitioners should focus on expanding the OST with provisions that address private sector participation, resource utilization, and tourism-specific issues. In addition, there is a clear need for an integrated regulatory system that combines the OST with the specific Space Tourism Law (SST). Practitioners should support efforts to design and implement such a comprehensive framework for effective management of STE. The study highlights the importance of collaboration between nations, private entities and other stakeholders in improving the relevance and effectiveness of legal frameworks such as the OST. Practitioners should actively promote collaborative initiatives to address challenges together. Finally, improvements to existing legal frameworks should address critical issues such as territorial claims, bioethics and the promotion of innovation in the space sector. Practitioners should advocate for changes or new laws to effectively address these issues.

5.1. Implications for Policy

The study also has significant implications for policy development at national, regional and international levels. To address the limitations of OSTs, policymakers must recognize the inadequacies of OSTs in regulating new space activities and prioritize efforts to amend or develop new laws to comprehensively regulate these activities. When formulating new legal instruments, there is a strong consensus on the need for new international laws or amendments to existing laws specifically tailored to space tourism and the extraction of space resources. Policymakers should prioritize legislative initiatives to address these regulatory gaps. When adopting interim soft law

guidelines: While comprehensive legal frameworks are under development, policymakers should consider adopting soft law guidelines as a temporary measure. These guidelines can address immediate needs while allowing time for the creation of binding legal instruments. When resolving legal conflicts, policymakers should address inconsistencies between national laws and international treaties such as the OST by developing coherent legal instruments. The harmonization of national and international legislation will ensure consistent space governance. Regulating private space activities and developing specific policies for private space projects should be a priority to promote responsible and sustainable practices. Regulations should consider issues such as liability, environmental protection and fair sharing of benefits between stakeholders.

5.2. Conclusion, Limitations and Further Research Directions

This systematic review assesses the Outer Space Treaty (OST) as a global legal framework for space tourism and exploration (STE) by critically analysing 46 articles. The results highlight how inadequately the Outline of Space Treaty (OST) addresses the intricacies of commercial space endeavours, even though it offers a fundamental basis for international space law. In particular, the OST is only partially relevant and geared towards national scientific exploration, not towards addressing the burgeoning economic goals of private companies in the space tourism industry. Furthermore, the legal, regulatory, and ecological difficulties that come with conducting business in space make the OST inadequate. To successfully control commercial space enterprises globally, aggressive actions must be taken to develop new legal instruments or improve current OST rules. According to the report, the OST should be improved and expanded to better reflect the changing nature of space mining, economic exploitation, and space tourism in the twenty-first century. In essence, while recognizing the OST's foundational role, this study advocates for innovative international legal frameworks that can robustly address the challenges and opportunities presented by the burgeoning space tourism industry, thereby fostering cooperation and sustainable development in outer space. Apart from employing mainstream doctrinal analysis and comparative legal analysis, this paper introduces an innovative method for Systematic Literature Review (SLR), which integrates historical, conceptual, and empirical evaluations to appraise the relevance and adequacy of the OST. Additionally, it introduces novel metrics, such as the test of relevance (ToR) and test of adequacy (ToA), to evaluate legal complexity in the context of space tourism entrepreneurship. Given the critical importance of comprehensively assessing the relevance and adequacy of the 1967 Outer Space Treaty (OST) as an international legal framework to regulate the rapidly growing space tourism entrepreneurship (STE) sector, below are practical implications for practice and policy. This study is constrained by its dependence on secondary sources and the absence of empirical legal case studies on Space Tourism Entrepreneurship (STE). Further research should explore nation-specific legal adaptations, conduct comparative examinations of space policies, and assess the viability of international legal harmonization for STE regulation.

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