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Future Space Tourism: A Review of Emerging Pathways, Challenges, and Prospects for Global Hospitality

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ABSTRACT

Driven by increased private sector investment, reusable launch technology, and growing global interest in commercial space travel, space tourism is developing into a transformative frontier bridging the hospitality and aerospace industries. Despite a significant increase in scholarly output on the topic, research remains fragmented at the technical, economic, policy, and empirical levels, with few attempts at comprehensive overviews. To address this gap, this study conducted a systematic review of publications indexed in the Scopus database between 2019 and 2025. Following the PRISMA screening protocol and VOSviewer for bibliometric visualization, 437 records were initially identified. After removing 172 duplicates and screening 265 abstracts, 135 irrelevant articles and 75 low-quality articles were excluded, leaving 55 studies for in-depth analysis. The bibliometric map reveals five central thematic clusters: (i) spaceport infrastructure and supporting technologies, (ii) market potential and economic feasibility, (iii) governance and regulatory framework, (iv) sustainability challenges and ecological issues, and (v) consumer behaviour and experience design. Co-authorship patterns highlight growing international and interdisciplinary collaboration, while keyword clustering reflects a shift from speculative discussions to practical, market-oriented research. Key challenges include unclear regulations, safety and risk management issues, and the environmental impacts associated with launch activities. However, promising avenues include innovations in the passenger experience, the development of hospitality models appropriate for the orbital environment, and technological strategies for sustainable spacecraft. By integrating these diverse perspectives, this study provides an integrated knowledge map that can guide researchers, industry participants, and policymakers in shaping the sustainable development of the space tourism industry.

1. Introduction

Over the past decade, space tourism has rapidly evolved from science fiction into a commercially expanding sector, integrating the aerospace and hospitality industries. Advances in reusable launch

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systems, billions of dollars in private investment, and growing consumer demand have fueled this growth, with companies such as SpaceX, Blue Origin, and Virgin Galactic pioneering suborbital flights, orbital hotel concepts, and spaceport infrastructure [1,2]. This momentum has attracted scholarly attention from a wide range of fields, including aerospace engineering, life sciences, tourism management, economics, sustainability, and space law [3,4]. However, despite this growth, the research landscape remains fragmented. A review of 265 Scopus-indexed publications (2018-2025) found that most research focuses on narrow areas such as vehicle technology, human factors, or legal frameworks and lacks cross-sectoral perspectives.

Existing reviews typically focus on a single issue, such as environmental risk or market feasibility, and often rely on small or outdated datasets. As a result, the field lacks a comprehensive synthesis of its knowledge structure, key themes, and research frontiers. This fragmentation limits both academic research and practice: policy discourse lacks robust evidence, industry investments progress without integrating knowledge, and sustainability is often viewed as marginal. To address these gaps, this study employed a PRISMA-guided bibliometric analysis of 265 publications, ultimately identifying 55 high-quality studies. This review, combined with co-authorship, keyword, and thematic mapping using VOSviewer, provides the first comprehensive knowledge map of space tourism research, providing insights into future academic research, policymaking, and industry development [5].

2. Methodology

This study adopted a systematic bibliometric approach to map the intellectual structure and thematic evolution of space tourism research. The Scopus database was selected as the data source due to its comprehensive coverage of peer-reviewed literature across multidisciplinary fields such as business, engineering, social sciences, computing, and environmental studies [6-8]. An advanced Boolean search query was executed in June 2025 using title, abstract, and keyword fields. The search string was designed to capture studies focusing on space tourism or commercial spaceflight in connection with future development pathways, technological, policy, economic, environmental, and experiential dimensions. This search Screening followed the PRISMA 2020 protocol [9] as shown in Figure 1 to ensure transparency and reproducibility. This search returned 437 records from the Scopus database. Records were exported in CSV format, and duplicates were removed based on DOI and title matching. Titles and abstracts of the remaining articles were screened manually for relevance to space tourism. Full texts were then assessed for conceptual fitness, methodological quality, and data completeness.

2.1 Inclusion Criteria

- i. Peer-reviewed journal articles, reviews, book chapters, or conference papers
- ii. Published between 2019–2025
- iii. Written in English
- iv. Direct relevance to space tourism or commercial spaceflight and addressing at least one of:
 - a. technological infrastructure and spaceport development
 - b. market readiness or economic feasibility
 - c. legal and policy frameworks
 - d. sustainability and environmental impacts
 - e. participant behavior, motivation, or experience design

2.2 Exclusion Criteria

- i. Editorials, opinion pieces, or grey literature
- ii. Studies unrelated to tourism (e.g., satellite engineering, astrophysics)
- iii. Articles lacking clear methodological content or with incomplete metadata

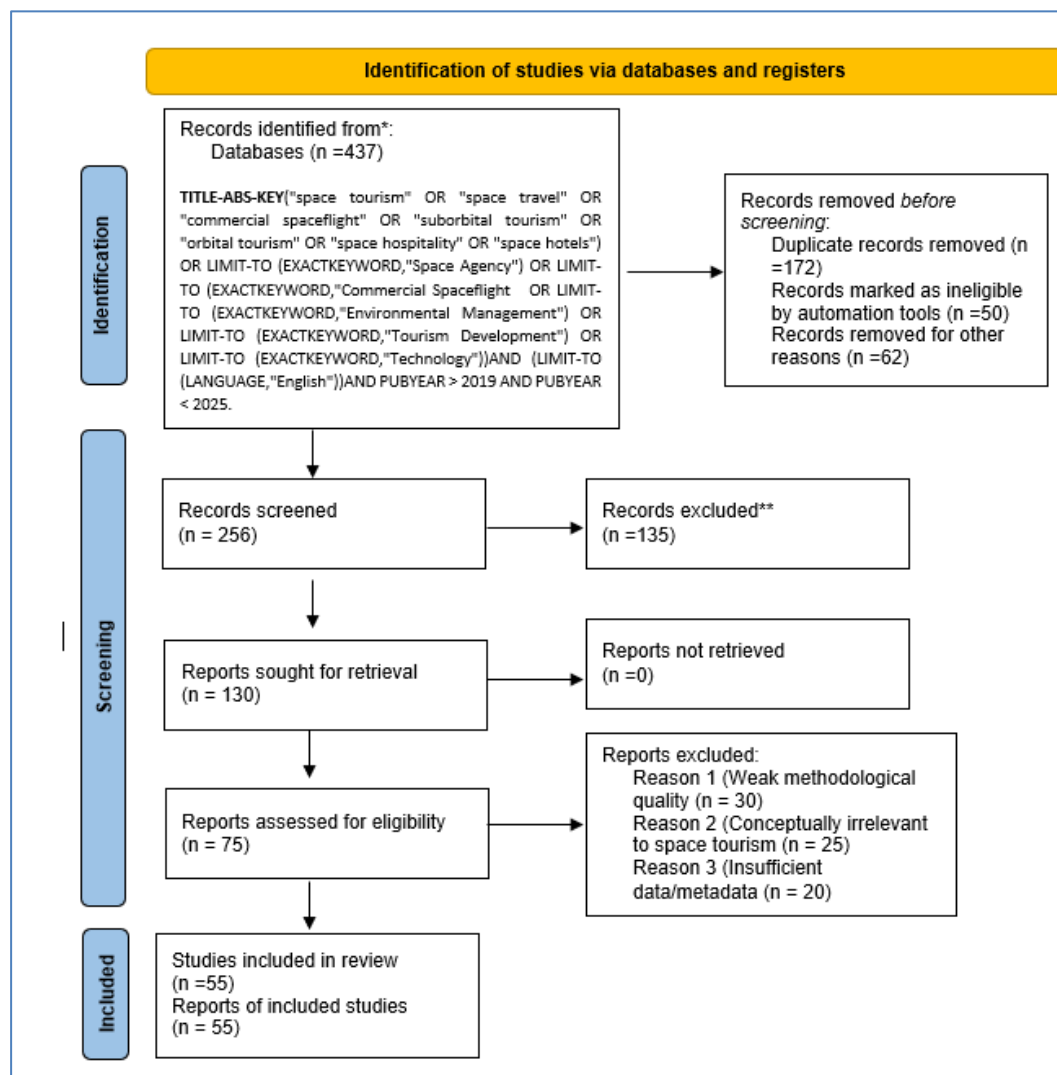


Fig. 1. PRISMA flow diagram

After PRISMA screening, bibliographic metadata for the 55 included studies was exported from the Scopus database and edited in Microsoft Excel for standardization. Data fields including author, affiliation, year of publication, title, abstract, keywords, number of citations, DOI, and source article title were reviewed for accuracy and completeness. Any missing or inconsistent entries were manually corrected to ensure data integrity. This curated dataset formed the basis for the bibliometric analysis [10].

This period primarily reflects formative discussions on the feasibility of commercial spaceflight, regulatory foundations, and initial conceptual frameworks. The second phase (2021-2022), encompassing 27 studies, marks a significant increase in scholarly attention. Publications during this period demonstrate a greater diversity of topics, encompassing legal and ethical governance, sustainability and environmental impacts, actor behaviour, and operational infrastructure [11]. This

phase marks a shift from speculative concepts to applied and multidisciplinary research, encompassing sustainability assessments and cross-sector governance debates [12]. The latest edition (2023-2025) includes 12 studies covering market readiness, experiential design, and user-centric perspectives. These studies reflect the industry's shift toward commercial maturity and human-centred innovation, including research on visitor motivation, service design, and experiential well-being in spatial environments (see Table 1). This temporal stratification demonstrates how the research focus has shifted from policy and infrastructure-based to experiential, market-driven, and sustainability-oriented paradigms, underscoring the field's increasing interdisciplinarity.

Table 1
Thematic distribution of the included studies

Year Range	Focus Area	Paper Count	Authors
2019–2020	Legal / Policy / Ethics, Market / Economic Viability, Participant Experience / Human Factors, Technological / Infrastructure	16	[13][14];[1];[15];[12]; [16]
2021–2022	Legal / Policy / Ethics, Sustainability / Environment, Participant Experience / Human Factors	27	[17];[18]; [19];[20];[21];[22];[23]
2023–2025	Market / Economic Viability, Participant Experience / Human Factors	12	[24];[25];[26];[27];[28];[29]; [30]

This analysis used VOSviewer (version 1.6.20) to generate a visual knowledge graph covering both the structural and thematic dimensions of the field. The analysis included three core components: (i) co-authorship network analysis to examine collaboration patterns among researchers and institutions; (ii) keyword co-occurrence graph analysis to identify topic clusters and research hotspots; and (iii) source analysis to explore the disciplinary distribution and publication trends of space tourism research. We also conducted a manual content review of titles, abstracts, and author keywords, categorizing each publication into one of five thematic areas: technological infrastructure and spaceport development, market and economic feasibility, legal and policy frameworks, sustainability and environmental impacts, and participant behaviour and experiential design [31,32]. This comprehensive approach allowed us to both quantitatively map and qualitatively interpret the field's evolution.

To assess the credibility and disciplinary breadth of the analysed corpus, we analysed the 55 included studies by publication source, year, citation impact, document type, and journal quartile ranking (Q1-Q4) (Table 2). The dataset covers the fields of space science, engineering, tourism, and consumer research, reflecting the interdisciplinary nature of space tourism scholarship. A significant portion of this research is published in Q1 journals and highly cited media, demonstrating the growing academic authority of the field. Furthermore, the inclusion of several conference papers from the International Astronautical Congress (IAC) underscores the field's early stages and rapid development. This diverse source landscape suggests that space tourism research is being influenced by a diverse range of stakeholders, including those driven by science, technology, and the hospitality industry.

Table 2

Publication Sources, Impact Metrics, and Journal Rankings of Analysed Space Tourism Research (2019–2024)

Year	Source title	Cited by	Document Type	QUA
2020	Acta Astronautica	326	Article	Q1
2020	Journal of Travel Research	92	Article	Q2
2022	Earth's Future	81	Article	Q1
2022	Sustainability (Switzerland)	118	Article	Q1
2021	Frontiers in Bioengineering and Biotechnology	71	Review	Q1
2019	Additive Manufacturing	56	Article	Q3
2021	Life Sciences in Space Research	55	Review	Q2
2022	Journal of Sustainable Tourism	134	Article	Q1
2021	Frontiers in Bioengineering and Biotechnology	51	Review	Q1
2021	International Journal of Molecular Sciences	50	Review	Q1
2020	Aerospace Science and Technology	43	Article	Q1
2024	Journal of Retailing and Consumer Services	40	Article	Q1
2020	Proceedings of the International Astronautical Congress, IAC	37	Conference paper	NIL
2019	Annals of Tourism Research	36	Article	Q1
2020	Proceedings of the International Astronautical Congress, IAC	32	Conference paper	NIL
2023	Psychology and Marketing	26	Review	Q1
2020	Tourism Recreation Research	26	Article	Q2
2019	Advances in Space Research	25	Article	Q1
2024	Tourism Review	42	Article	Q1
2021	Energies	23	Review	Q2
2020	Current Issues in Tourism	38	Letter	Q3
2021	Proceedings of the International Astronautical Congress, IAC	21	Conference paper	NIL
2022	Proceedings of the International Astronautical Congress, IAC	20	Conference paper	NIL
2024	Journal of Travel Research	19	Article	Q3
2020	New Space	19	Article	Q2
2019	Geojournal of Tourism and Geosites	18	Article	Q1
2023	Proceedings of the International Astronautical Congress, IAC	16	Conference paper	NIL
2021	International Journal of Molecular Sciences	45	Article	Q1
2023	Life Sciences in Space Research	16	Review	Q2
2021	International Journal of Molecular Sciences	16	Article	Q1
2023	Journal of Hospitality and Tourism Management	16	Article	Q1
2020	Science and Engineering Ethics	15	Article	Q1
2020	IET Radar, Sonar and Navigation	15	Article	Q2
2023	International Journal of Tourism Research	15	Note	Q1
2023	Futures	14	Article	Q1
2021	Journal of Resources and Ecology	13	Article	Q3

Apparently, based on the initial analysis, paper output rises from about 50 papers (in 2019) to a clear peak in 2022 (about 92), falls in 2023 (about 71), rebounds in 2024 (about 82), and then falls in 2025 (about 39) almost certainly an exponential effect in some years rather than a true contraction.

The 2022 peak coincides with the field's "transformation phase": early feasibility and policy-oriented research give way to more applied research tracking the industry's maturity. This shift is reflected in the dominance of 27 studies from 2021-2022 among the 55 included papers, as well as a shift toward people-centered and sustainability topics (Figure 2). Year-over-year fluctuations are susceptible to conference indexing cycles and partial-year coverage; future updates should resample at year-end to avoid artifacts.

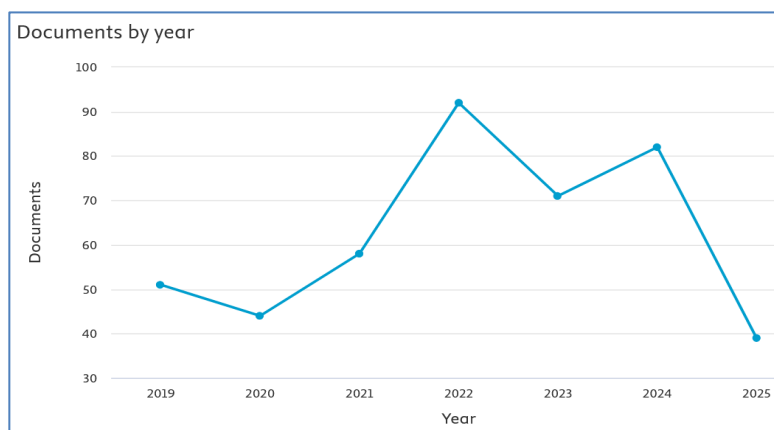


Fig. 2. Document produced by year

Besides that, documents produced by country too showed variation. The United States is undoubtedly the world's largest research centre (about 125 papers), followed by Japan and the United Kingdom (about 48 papers each), and then India and Italy (about 40 papers each) (Figure 3). This geographical location coincides with the most active regions for launch capabilities, spaceport planning, and regulatory experiments, as well as a concentration of English-language journals. Among the 55 included papers, articles authored in the United States, the United Kingdom, and Japan also predominate, but despite some emerging national projects, participants from the Global South remain underrepresented. Gaps: The map suffers from several issues: (i) its English-only nature; (ii) funding/reporting practices (industry reports and government white papers are excluded); and (iii) biases in Scopus' coverage. Comparative policy research and market/empirical studies are needed in under researched regions (e.g., the Middle East, Southeast Asia, Africa, and Latin America).

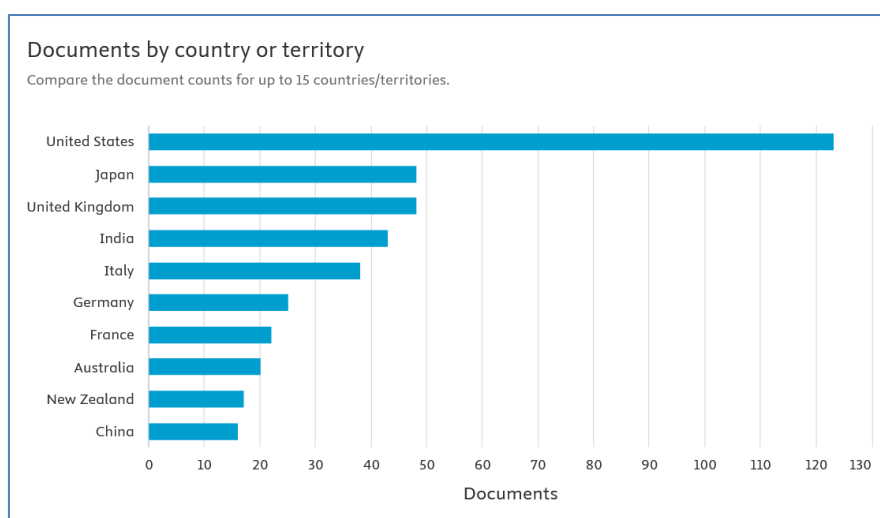


Fig.3. Document produced by country

Next in line, is the articles submitted by subjects within the range year. The results showed differences in terms of fields related to space tourism. The subject area distribution (Figure 4) clearly illustrates the disciplinary concentration of space tourism research. Most publications are found in Engineering (27.8%), Physics and Astronomy (18.7%), and Earth and Planetary Sciences (17.9%). In comparison, fields such as Social Sciences (7.6%), Business and Management (4.6%), Environmental Sciences (4.2%), and Computer Science (3.7%) represent a much smaller share. This disciplinary imbalance highlights the historical focus on technological, operational, and safety aspects of space tourism, with comparatively limited investigation into market readiness, customer experience, service management, or governance issues [33]. However, an emerging shift since 2021 is apparent in the corpus, with hospitality, experience design, and sustainability topics slowly increasing but still underrepresented. This gap points to an urgent need for integrated, interdisciplinary research connecting technology, regulation, environmental impact, and user experience [34]. To further elucidate the field's knowledge structure and collaborative networks, three VOSviewer analyses were conducted on the dataset ($n = 55$): (i) keyword co-occurrence (author keywords with ≥ 2 occurrences), (ii) co-authorship (authors with at least two publications or links), and (iii) source co-citation (journals cited together at least twice). Together, these bibliometric maps reveal the evolving intellectual landscape and collaborative base of space tourism scholarship, underscoring the need for broader engagement across diverse academic disciplines.

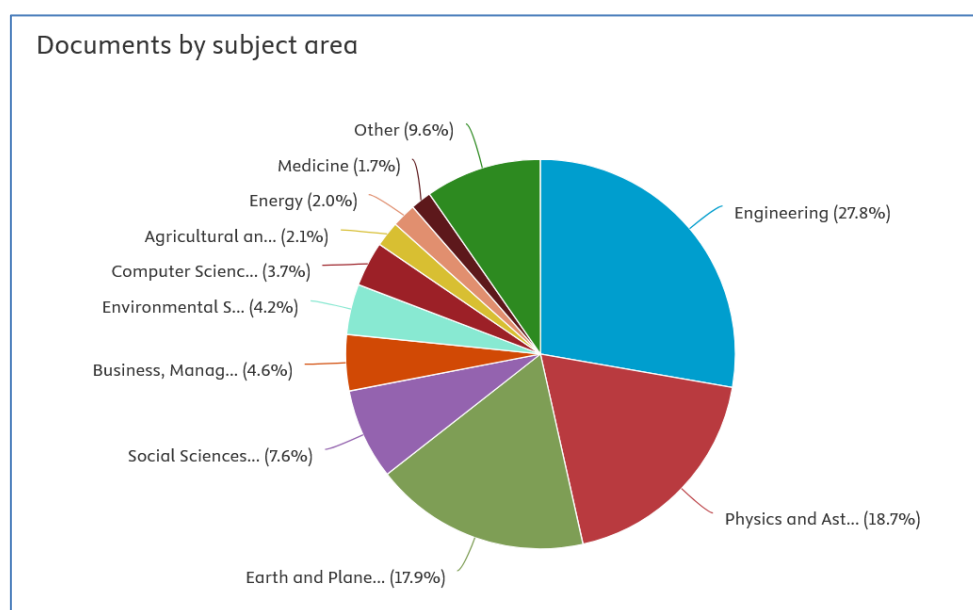


Fig. 4. Document produced by subject area

This document-level analysis shows that recent space tourism scholarship is dominated by engineering and physical science outputs from a limited set of countries with established space capabilities, particularly the United States, Japan, and the United Kingdom. While annual publication counts have grown and shifted in focus after 2021, research remains unevenly distributed by country and field, with clear underrepresentation in social science, business, and emerging regions. These findings highlight a strong need for broader international contributions and greater integration of diverse disciplinary perspectives in future space tourism research.

2021, indicating a shift in focus from feasibility and policy to sustainability and user experience. However, these areas remain marginal, demonstrating that despite continued technological advancement, the sector remains fragmented at the commercial and societal levels.

Impacts and Gaps:

- Cost and Risk Lock-in: Few studies link safety, insurance, and pricing, limiting commercialization.
- Governance Inertia: Regulatory research emphasizes liability issues but lacks a unified international model.
- Environmental Neglect: Sustainability research is poorly integrated into technical or market frameworks, reducing policy impact.

Unless these gaps are bridged by integrating lifecycle, user experience, and legal risks, the industry risks becoming technologically advanced but commercially stagnant. Bridging these gaps is critical to transforming space tourism from a high-profile spectacle into a long-lasting, sustainable industry [35,36].

3.2 Co-Authorship Patterns: Sparse Collaboration and Siloed Communities

Despite this strong publishing momentum, citation and co-authorship analysis reveals a more conservative focus in space tourism research [37]. Of the 55 included studies, the most cited articles are concentrated in the fields of engineering and space science (Q1), while contributions from tourism, hospitality, and sustainable development have only recently begun to gain attention fields that also tend to have lower median citation counts (see Figure 6).

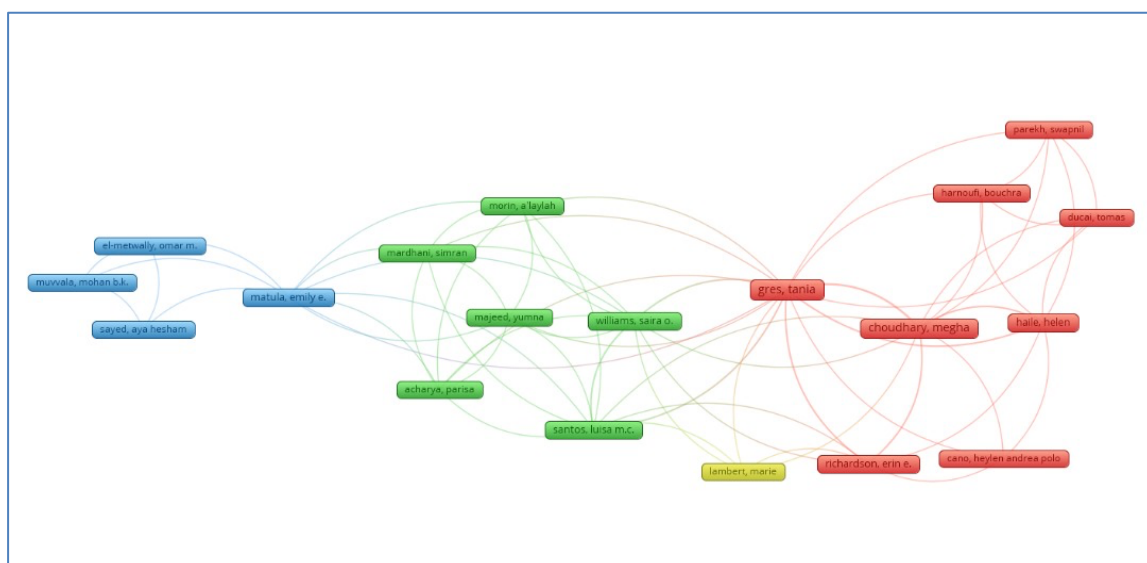


Fig. 6. Co-authorship network in space tourism research

This pattern perpetuates the “Matthew effect”: technology research consistently cites other technology papers, policy research cites policy, while empirical or sustainability-focused research is marginalized [37]. Even though conference papers comprise nearly half of the broader database ($n = 437$), their rapid dissemination comes at the expense of methodological depth and interdisciplinary citations, reinforcing academic silos and limiting broader impact. Funding mechanisms dominated by space agencies like NASA and ESA further direct research toward technical problems safety engineering, launch vehicle design rather than the development of services, markets, or sustainability models [29]. Consequently, citation networks primarily reinforce established technical and legal

fields, with little translation of knowledge into market feasibility, experience design, or environmental impact [12]. Effective integration across fields remains rare, slowing the progress of actionable and deployable scholarships. Deliberate interdisciplinary efforts are needed to bridge these gaps. To address these challenges, Table 4 proposes five integrative research design frameworks that can foster connections between dispersed clusters, encourage wider data sharing and interdisciplinary citations, and reposition sustainability and user-centered research as core rather than peripheral aspects of space tourism scholarship.

While these proposed research frameworks offer clear pathways for bridging disciplinary barriers in space tourism research [15], their implementation faces ongoing challenges. Institutional inertia, siloed funding pipelines, and entrenched disciplinary boundaries hinder the full integration of technical, regulatory, economic, sustainability, and experiential perspectives [25]. Furthermore, data sharing and methodological harmonization remain limited, and market-focused research often prioritizes short-term viability over system sustainability and user safety. Closing these critical gaps will require thoughtful cross-sector collaboration, flexible funding models, and a cultural shift in both academia and business. By adopting the integrative design framework outlined here, researchers and stakeholders can move the field toward holistic, actionable models transforming space tourism from a fragmented area of research into a robust, sustainable enterprise capable of developing informed policies and practices.

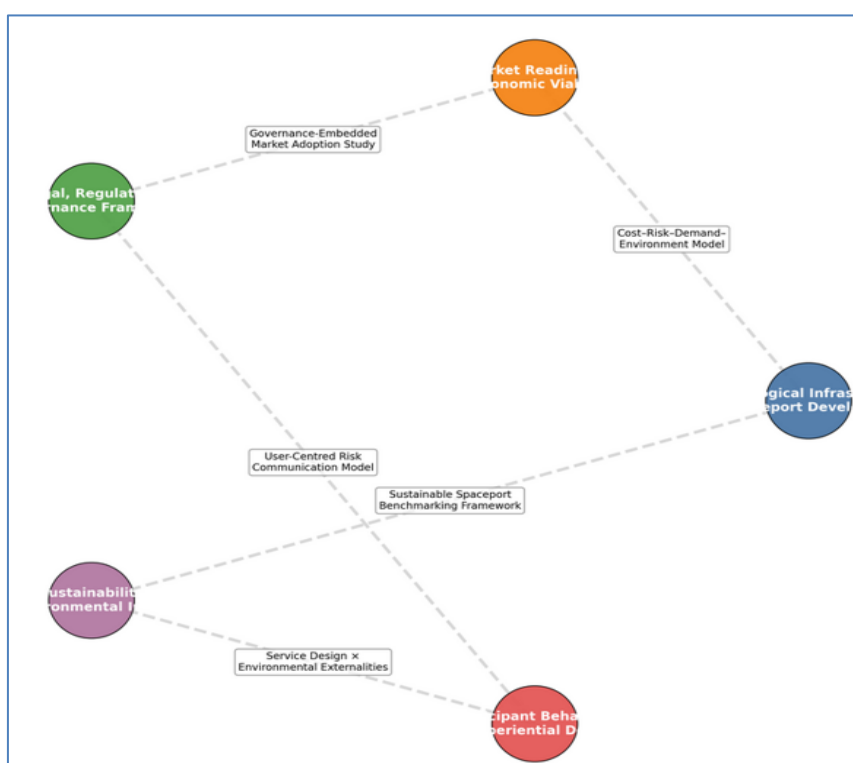


Fig. 7. Integrative research network bridging thematic clusters in space tourism

The network diagram illustrates how the proposed research framework establishes direct connections between technology, market, regulatory, sustainability, and user experience clusters, thus moving the field toward a more integrated and operationally relevant knowledge base [43,44]. The network analysis (see Figure 7) reveals an active but strategically misaligned field, where most intellectual energy is focused on technical systems and regulatory frameworks, while market design, environmental responsibility, and user experience remain secondary [45]. This persistent imbalance stems from funding and editorial ecosystems that prioritize spacecraft-centric research, reinforcing

closed citation loops and limiting the operational and conceptual maturity of space tourism[46]. The integrative research design presented in Table 5 and Figure 7 addresses these gaps by explicitly linking sustainability, behavioral insights, and governance models to economic and technological systems. By fostering collaborative, system-oriented research rather than fragmented specialization, these interdisciplinary connections reposition space tourism from a curiosity to a credible and sustainable component of the global hospitality economy [11,47,48].

3.3 Source Co-Citation: Three Foundational Disciplines

Space tourism research is supported by three disciplinary pillars: (i) space science and engineering journals, such as *Acta Astronautica Sinica*, *Progress in Space Research*, and *Space Research Life Sciences*; (ii) tourism and hospitality media, such as the *Journal of Tourism Research*, *Annals of Tourism Research*, and *Journal of Sustainable Tourism*; and (iii) sustainability and policy journals, such as *Sustainable Development (Switzerland)*, *Earth's Future*, and *Science & Engineering*. These disciplinary clusters reflect the fragmentation of the field's knowledge landscape: technical research is often disseminated through aerospace networks, behavioral and market research is primarily published in hospitality journals, and environmental or governance work is confined to the sustainability and policy arena (see Figure 8).



Fig. 8. Clustered co-citation map of journals related to space and tourism research

Crucially, this co-citation structure replicates and reinforces the thematic segmentation found in the keyword map: Engineering fields have the highest citation density and impact factors, while sustainability and behavior journals have lower co-citation centrality and weaker inbound links. This suggests a persistent structural asymmetry: research on safety systems and vehicle design is frequently cited, while research on lifecycle carbon emissions, waste management, or user experience design is often isolated and under-cited, limiting its dissemination beyond its disciplines [37,49]. Even when sustainability is discussed, it is often treated as an external factor or attached to impact statements, rather than being integrated into design or economic factors [50]. Similarly,

tourism-focused research is often based on concepts or perceptions, lacking a scientific basis in technical or regulatory realities, which limits its applicability to engineering or policy research.

This model means that citation prestige and editorial hierarchy act as gatekeepers, concentrating influence on traditional aerospace and policy publications while pushing market, sustainability, and service design research to the margins [51]. Without steps to incorporate environmental responsibility and user experience into the same evaluation framework as cost, safety, and regulation, the topic risks becoming a collection of parallel literatures rather than an integrated body of knowledge. Strategically publishing integrated research across these three journal areas (e.g., combining life cycle assessment with service blueprints and responsibility models) has the potential to break co-citation locks, establish new interdisciplinary hubs, and accelerate the transition from conceptual novelty to operational maturity.

A comprehensive network analysis reveals that space tourism research is a rapidly developing but highly fragmented field, with strong internal connections and weaker interdisciplinary links. The keyword network reveals five major themes: technology, market, regulation, sustainability, and experience. These themes are largely independent of each other [52]. Co-authorship and co-citation maps reveal a lack of collaborative connections, with citation prestige primarily concentrated in the classic aerospace and policy fields. This tripartite fragmentation explains the paradox noted in this commentary: despite a growing number of publications, space tourism research has yet to develop into a cohesive, practical body of knowledge [53]. Funding and editorial incentives exacerbate this trend, directing scholarly resources toward spacecraft-related and regulatory issues while marginalizing commercial, behavioral, and environmental perspectives. Consequently, the discipline enjoys significant scholarly prominence but little momentum for integration [54].

To advance discipline, we must move from fragmented research to the development of multidisciplinary systems. First, researchers should focus on cross-disciplinary integration, incorporating sustainability measurements, user experience data, and regulatory parameters into technical and economic models, for example by combining life cycle assessment with service design and risk-cost models [55]. Second, upcoming research should emphasize collaborative and multidisciplinary authorship frameworks and draw on expertise from fields such as aerospace, hospitality management, law, and environmental assessment to enhance methodological rigor and interdisciplinary relevance. Third, scholars should strategically publish in hybrid journals, such as submitting technical research to sustainability journals or integrating behavioral data from engineering fields to recalibrate co-citation networks and disseminate knowledge across diverse communities [56].

Furthermore, a common data architecture encompassing an open emissions inventory, a safety incident taxonomy, and standardized user experience measurements could accelerate replication and attract long-tail citations [50]. Ultimately, space tourism research should evolve from purely descriptive analysis to evaluative and operational frameworks that can proactively influence policy instruments, investment strategies, and design standards[24]. Advancing this goal could transform the field's structure from parallel literature to an interconnected, cumulative knowledge ecosystem. This shift would not only accelerate scholarly integration but also provide the necessary evidence to position space tourism as a viable and sustainable industry within the global hospitality economy, thereby facilitating its regulation, financing, and expansion.

3. Discussion

This assessment reveals that academic research on space tourism is rapidly evolving but remains intellectually immature. While a wealth of new information is emerging, it has yet to be integrated

into a shared conceptual framework. The map shows that the field understands existing components (e.g., vehicles, policies, markets) but has yet to delve into how these components work together to form a complete system. The field's primary challenge is a lack of system-level thinking. This explains the surge in publications while progress in business and policy research on space tourism has been slow. Despite its breadth, space tourism research lacks integration. The most obvious gap is the lack of design principles that integrate risk, regulation, market demand, and environmental externalities into evaluation frameworks. Technology research rarely assesses the financial or social impacts of its design; sustainability research rarely examines its adoption dynamics; and behavioral research rarely measures its impact on safety or insurance models. The result is a fragmented collection of material that fails to address the fundamental question facing industry and regulators: What are the conditions necessary to make space tourism feasible, ethical, and sustainable? This question, rather than incremental research within the existing framework, must form the cornerstone of subsequent research phases.

Future research should prioritize translational architectures over contributions to specific areas. For example, system models that integrate emissions, decentralization probabilities, and carbon pricing with costs and safety margins; service blueprints that integrate user comfort, risk perception, and lifecycle quality; and governance simulations that integrate permitting systems with market entry timelines and willingness-to-pay thresholds [57,58]. These integrators are not endpoints, but platform models that other researchers, governments, and businesses can use, adapt, and build upon. We shouldn't conduct discovery in isolation but rather build reusable platforms that provide the critical knowledge we need to transform citation networks from fragmented nodes to cumulative hubs.

Beyond integrating themes, the field needs to address issues of space, infrastructure, and cognitive concentration. Over 80% of the refined corpus originates from North America, Europe, or Japan. This supports technical and legal assumptions that may not hold true in the emerging space economy [49]. Comparative policy and applied research, as well as sustainability-oriented benchmarking of spaceports across the Global South, will be crucial to strengthening the empirical base and mitigating risks associated with future investments [59]. The prevalence of conference proceedings and the lack of open datasets hinder replicability and cross-research synthesis; establishing a public repository for emissions, safety events, user experience metrics, and licensing agreements would promote reuse and accelerate long-tail citations.

This review demonstrates that the problem isn't a lack of information, but rather a lack of frameworks that connect and reinforce data, models, and insights. Without these frameworks, space tourism will remain methodologically fragmented, conceptually shaky, and unprofitable. The next major research priority should be building these frameworks by integrating models, open datasets, authors from other fields, and data from around the world [60,61]. Such work will transform the field from a disparate body of literature into a single body of knowledge capable of managing, funding, and developing space tourism into a successful and enduring enterprise. This assessment translates the structural deficiencies identified within the network into a set of actionable research priorities, aiming to transform the field from fragmented outputs to cumulative knowledge architecture [62]. Table 5 summarizes these prioritized pathways. Each pathway seeks to connect currently independent clusters (A-E), while also considering real-world industry and governance constraints. These approaches are not intended to expand existing research silos. Rather, they are intended to serve as platform research, enabling other scholars, regulators, and businesses to access integrated models, datasets, and frameworks that others can use, build upon, and adapt. This transformation is crucial for the field to transition from quantitatively driven expansion to systemic coherence and effectiveness.

These designs shift space tourism research from a focus on its individual parts to a focus on how they work together. These approaches can also help rebalance the field's citation structure by introducing market, sustainability, and user-centric logics into technology and policy research. This will lead to cross-disciplinary citations and funding, shifting the current focus on space tourism from traditional engineering and policy research. This will not only lead to greater theoretical maturity in the field but also help to inform people how to operate, fund, and develop space tourism as a successful enterprise.

In summary, the research paths presented in Table 5 integrate the many existing space tourism literatures into a single, cohesive body of knowledge. Rather than expanding existing research silos, these suggested studies aim to create a cross-cluster platform that integrates safety, market dynamics, governance, environmental responsibility, and user experience into evaluation models. This shift is crucial to breaking through the field's current citation and funding lock-in, which prioritizes vehicle-centric and regulatory research while relegating sustainability and human-centric perspectives to the background. These agenda paths can accelerate methodological maturity, encourage cross-sector collaboration, and inform the decisions of regulators, investors, and operators by integrating lifecycle impacts, risk communication, and demand modeling into operational and policy frameworks. They achieve this by moving space tourism research from conceptual novelty to developing the systems infrastructure and empirical credibility necessary to sustainably manage, fund, and expand the industry.

4. Conclusion

This review aims to depict the academic landscape of space tourism research from 2019 to 2025, revealing that the field is rapidly developing but remains structurally fragmented. A comprehensive review of 55 journal articles reveals five thematic clusters: technical infrastructure, market readiness, legal and regulatory governance, sustainability, and participant experience that exhibit internal cohesion but weak interconnectedness. Co-authorship and co-citation analysis show that influence and citation prestige are primarily reflected in traditional engineering and policy fields, while sustainability and human-centered research have been largely marginalized. This fragmentation reveals a paradox: seemingly active academic research on space tourism has not yet led to significant convergence or practical application; while knowledge has expanded, it has not yet coalesced into a coherent or reusable framework.

This study not only maps the field but also provides a core framework for resolving this impasse. It presents the first comprehensive three-level bibliometric map of the space tourism field, illuminating the interconnections among its topics, authors, and sources, and proposes a focused research agenda (see Table 5) to transform structural deficiencies into an actionable research framework. The proposed pathways covering cost-risk-demand-environment modeling, lifecycle-integrated service design, a sustainable spaceport index, and user-centered risk communication aim to establish a cross-cluster platform that prioritizes sustainability and user experience as fundamental, rather than peripheral, dimensions of the field. This framework, combined with the research integration roadmap (see Figure 7), provides a replicable structure for future academic research to generate cumulative, interoperable knowledge, rather than individual contributions.

The future development of space tourism scholarship will rely less on in-depth research in isolated disciplines and more on establishing a cohesive conceptual framework that integrates diverse fields. Integrating environmental responsibility, market feasibility, user-centered design, and regulatory coordination into a cohesive framework can transform the discipline from a collection of fragmented specialized fields into an integrated body of knowledge. This shift will improve academic

collaboration and enhance citation diversity, while also providing the policy insights necessary to manage, fund, and expand space tourism as a responsible, ethical, and sustainable sector of the global hospitality industry. The transition from a "spectacle" to a "sustainable" industry does not rely on further research but rather on a holistic model that integrates risk, regulation, market demand, and environmental responsibility into a cohesive intellectual framework.

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Table 4
Integrated Research Design Frameworks for Advancing Space Tourism

Study Type	Key Variables	Data Requirements	Analytical Methodology	Intended Impact & Citation Reach	Bridges Clusters
Cost–Risk–Demand–Environment Coupled Model	Ticket price, launch cost, insurance premiums, liability risk, safety metrics, carbon emissions, debris probability	Historic suborbital mission data, insurance actuarial tables, LCA emissions inventories, consumer surveys	System dynamics modelling; Monte Carlo risk simulations; conjoint demand analysis[38]	Links economic, technical, policy, and sustainability discourses; creates cross-field citation anchor	A–B–C–D
Service Design Environmental Externalities	Cabin provisioning, training duration, crew ratio, flight profile mass, lifecycle GHG/black carbon emissions	UX studies, human factors data, LCIA (Life Cycle Impact Assessment) of mission components	Service blueprinting; LCA hot-spot mapping; multi-criteria decision analysis (MCDA)[39]	Couples’ user experience with measurable environmental metrics; attracts tourism & sustainability citations	D–E
Governance-Embedded Market Adoption Study	Legal frameworks, licensing timelines, safety standards, market entry costs, willingness-to-pay	Regulatory documents, space law treaties, investor pitchbooks, consumer behavioural surveys	Policy Delphi; scenario planning; choice-based conjoint[40]	Connects market adoption studies to legal and governance regimes; relevant to policy and industry journals	B–C–E
Sustainable Spaceport Benchmarking Framework	Energy use, community impact, biodiversity, noise, STM/SSA compliance	Environmental audits, local socioeconomic data, spaceport operations reports	Weighted index modelling; entropy weighting; stakeholder scoring[41]	Creates replicable sustainability benchmarks for regulators and NGOs; becomes citable reference standard	A–D
User-Centred Risk Communication Model	Risk perception, safety protocols, insurance comprehension, eco-trust, anxiety/discomfort indices	Eye-tracking, surveys, biometric stress data, VR-simulated flight UX	SEM (Structural Equation Modelling); psychometric scale development[42]	Improves public trust; drives human factors, marketing, and law citations	C–E

Table 5
Integrated Research Design Frameworks for Advancing Space Tourism

Gap Identified	Space Tourism Context	Future Study Direction	Data & Methods	Expected Impact	Clusters Bridged
Tech and safety models are isolated from market/economic analysis	Suborbital vehicle design studies rarely include passenger demand, insurance pricing, or cost–risk trade-offs	Integrated cost–risk–demand–environment model for suborbital/orbital tourism	Mission cost data, safety incident logs, liability insurance tables, WTP surveys; system dynamics + Monte Carlo + conjoint modelling	Generates bankable risk–price curves for investors; aligns vehicle engineering with demand realities	A–B–C–D
Regulatory studies are abstract and detached from market feasibility	Licensing papers don’t test real launch timelines or pricing impacts	Governance-embedded adoption model for commercial spaceflights	National licensing frameworks, space law treaties, operator business plans, consumer intent surveys; policy Delphi + scenario + discrete choice	Offers realistic policy-sensitive demand forecasts; informs regulator–investor decisions	B–C–E
Sustainability papers are disconnected from vehicle or service design	LCA or black carbon studies ignore payload design and passenger experience	Service blueprinting with embedded LCA for orbital tourism services	Component LCA (propellant, seats, training), passenger workflow UX data; MCDA + LCA hot-spot analysis	Identifies design levers that reduce lifecycle emissions without degrading UX	D–E
Spaceport siting studies ignore environmental and community impact	No indices exist to measure “sustainable spaceport” performance	Sustainable spaceport benchmarking framework	Energy mix, local biodiversity, jobs, STM/SSA compliance reports; entropy weighting + stakeholder scoring	Provides regulators with a licensing benchmark; aligns spaceport planning with ESG standards	A–D
Risk perception studies don’t connect to safety or insurance	UX work tracks anxiety but not its pricing consequences	User-centered risk communication model for space tourists	VR flight simulations, biometric stress data, insurance comprehension surveys; SEM + psychometric scale development	Improves trust; lowers perceived risk; supports pricing of safety premiums	C–E
Environmental governance studies remain high-level	Debris risk, black carbon, and contraction rarely appear in policy models	Lifecycle environmental liability model for space tourism missions	Debris probability models, BC forcing data, insurance clauses; probabilistic risk assessment + legal-economic analysis	Enables pricing of externalities into tickets and insurance; supports international standards	C–D

Data is scattered; few reusable datasets exist	Safety, emissions, and UX data are locked in private reports	Open space tourism data commons	Curate emissions profiles, safety incidents, UX scales in standardized CSV/DOI formats	Enables replication; boosts cross-study citations and longitudinal analysis	A–D–E
Research is geographically concentrated	Most studies are from NASA/ESA/JAXA contexts, few from emerging space economies	Comparative space tourism policy and adoption studies (Global South)	Policy scans, investor interviews, cultural WTP surveys in SEA, MENA, LatAm, Africa; mixed methods	Diversifies governance models; derisks future market expansion	B–C–E
Ethical debates are not operationalized	Ethics is discussed normatively, not linked to cost or safety design	Ethics-to-premium risk mapping framework	Mission incident typologies, insurance pricing, risk communication experiments; actuarial translation	Make ethics actionable in underwriting and service protocols	C–E
Conference-heavy publishing limits depth and reuse	Many papers are conceptual, few data-rich	Cross-domain consortia producing dataset-based journal articles	Multi-PI projects; publish integrated studies (risk+UX+LCA) in high-impact mixed-domain journals	Shifts field from novelty to reproducible science; rebalances citation network	A–B–C–D–E