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Creating a Global Registry of Lunar Activity

White Paper- April 2023

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Bright Moon

Creating a Global Registry of Lunar Activity

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Introduction

Humanity's relationship with the Moon is on the cusp of historic change. Within the next four years, NASA expects to see at least 22 lunar surface missions.[3] An in-space economy is emerging where the coordination of activities between operators will be critical to avoiding threats and challenges,[4] yet there is no trusted information to coordinate and monitor lunar activity.

International policy efforts have recognized the need for coordination and transparency. For example, The Outer Space Treaty Articles XI, IX and XI commit signatories to authorization and continuing supervision, to due regard for corresponding interests, and to inform on the nature, conduct, location and results of activities.[5] The Artemis Accords sections 4, 7, 10 and 11 include provisions on the transparency of activities, registration, safe and sustainable operations, notifications, and safety zones[6]. The Hague International Space Resources Governance Working Group's Building Blocks for the Development of an International Framework on Space Resource Activities 9, 11, and 14 call for due regard for corresponding interests, technical standards for safety zones, and the registration and sharing of information[7].

In 2020, Moon Dialogs, a partnership focused on governance and coordination mechanisms for the lunar surface, hosted a salon of subject-matter experts that explored registration mechanisms for the Moon[8]. The analysis produced policy recommendations, including developing a standard template to streamline the registration and communication processes for lunar activities and objects. The salon report highlights that the current mechanism under the Registration Convention falls short of collecting information on the numerous activities expected to take

[3] Gabriel Swiney and Amanda Hernandez, "Lunar Landing and Operations Policy Analysis," *NASA Office of Technology, Policy, and Strategy Lunar Landing and Operations Policy Analysis*, August 30, 2022, https://www.nasa.gov/sites/default/files/atoms/files/lunar_landing_and_operations_policy_analysis_final_report_24oct2022_tagged_0.pdf.

[4] Carson Ezell, "Space Governance: Risks, Frameworks, and Futures," August 27, 2022, https://spacefuturesinitiative.org/images/Space_Governance_Risks_Frameworks_and_Futures.pdf.

[5] "Outer Space Treaty," United Nations Office for Outer Space Affairs, December 19, 1966, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html.

[6] NASA, "THE ARTEMIS ACCORDS PRINCIPLES for COOPERATION in the CIVIL EXPLORATION and USE of the MOON, MARS, COMETS, and ASTEROIDS for PEACEFUL PURPOSES," October 13, 2020, https://www.nasa.gov/specials/artemis-accords/img/Artemis-Accords-signed-13Oct2020.pdf.

[7] "BUILDING BLOCKS for the DEVELOPMENT of an INTERNATIONAL FRAMEWORK on SPACE RESOURCE ACTIVITIES BUILDING BLOCKS for the DEVELOPMENT of an INTERNATIONAL FRAMEWORK on SPACE RESOURCE ACTIVITIES," 2019, https://www.universiteitleiden.nl/binaries/content/assets/rechtsgeleerdheid/instituut-voor-publiekrecht/lucht--en-ruimterecht/space-resources/bb-thissrwg--cover.pdf.

[8] "Registration Mechanisms for the Moon" (Moon Dialogs, 2020), https://static1.squarespace.com/static/5d36544d1438f10001b32ebd/t/5fd407cdffab5d3c56c1e9ba/1607731150768/MD+Registration+Report.pdf.

place on the lunar surface or in orbit. To address this gap, this white paper explores the creation of a dedicated Lunar Registry to catalogue critical mission details such as the launching state, operating actor, location, time, and more.

A Global Registry of Lunar Objects and Activities will allow governments, private operators, financial institutions and other stakeholders to set a baseline for information sharing, promote a clear understanding of past, current and future activities, and enable appropriate coordination to reduce risk. It will promote transparency around lunar activities as a key component of lunar exploration and empower the public to engage with the development of the lunar economy and environment.

Such a Lunar Registry would not be a competitor to similar efforts from other bodies, but would serve as a complementary effort. In keeping with Open Lunar's values, cooperation, information-sharing, and mutual support would be sought, discouraging any one actor from monopolizing Lunar data sharing, as cooperation is essential in developing a sustainable and cooperative Lunar environment.

This registry would also not seek to replace or make redundant existing registry projects, such as the UN's Space Objects Registry of Objects launched into Outer Space.[9] While the UN registry focuses on objects launched from Earth and their mission, a Lunar Registry would provide comprehensive data on lunar activities and objects. Thus, it would be a supportive effort, enhancing and complementing data that the current system may lack. Concurrently, the Lunar Registry would provide a centralized platform for tracking long-term lunar missions and lunar-based activities, including those which won't require an earth-based launch. This information is essential in mitigating emerging challenges and building a cooperative lunar environment.

It is critical that work on such a registry begins now, prior to the commencement of significant lunar activity. This will ensure a complete historical understanding of Lunar development and normalize the values enshrined in existing agreements. With the complex nature of space actor interactions, leveraging the cooperative design and consensus-building models are central to the registry, by engaging stakeholders in the design process to promote engagement and utilization. As explored further, consensus-building models can greatly increase stakeholder participation and the likelihood of registry utility.

[9] "United Nations Register of Objects Launched into Outer Space," United Nations Office for Outer Space Affairs, https://www.unoosa.org/oosa/en/spaceobjectregister/index.html.

This white paper will establish a clear and detailed understanding of how a non-governmental Lunar Registry can be established. It will examine the need, risks, and opportunities for such a registry as well as the lessons learned from the historical context of analogous registries, outline a policy development process and governance methodology, explore institutional design options, and share an illustrative example of how a registry could function for the benefit of all space stakeholders.

The Evolving Lunar Strategic Landscape

There are three interlinked and changing environments that should be accounted for, which justify the increasing need for an apolitical non-governmental multi-stakeholder Lunar Objects and Activities Registry. These are space, the cislunar environment itself, and the bedrock for both; the geopolitical landscape on Earth2 The latter and its spillover are heavily responsible for how the former develops.

A Developing Space- An Emerging Astro-Economy

Interest in the political, commercial, and security opportunities and potential of the Earth's orbit and increasingly cislunar space has dramatically increased over the last decade.[10] The space-related economy in 30 years is forecasted to be USD3 trillion, which is larger than the oil industry was in 2019 (which contributed a significant 4% to the world's total economy).[11] Already in 2021 the space economy had grown to USD469 billion, a 9% year-over-year increase.[12]

This rapid growth is driven by two mutually supporting prongs:

- On the one hand, the reinvigoration of long-term strategic interest in space as a new frontier of opportunity and competition; be that security (state, human, and climate change-related), scientific exploration, commercial activity, or resource exploitation. This has been primarily driven by state actors of varying

[10] Johnson, Kaitlyn. "Fly Me to the Moon: Worldwide Cislunar and Lunar Missions." *Center for Strategic and International Studies*, February 15, 2022. https://www.google.com/url?q=https://www.csis.org/analysis/fly-me-Moon-worldwide-cislunar-and-lunar-missions&sa=D&source=docs&ust=1675983530997175&usg=AOvVaw0b3Tcj6ZIaeddfwDBIfljh.; Mike Wall, "The Private Spaceflight Decade: How Commercial Space Truly Soared in the 2010s," Space.com, December 20, 2019, https://www.space.com/private-spaceflight-decade-2010s-retrospective.html.; "2010-2019: The Decade in Space," Space News, January 10, 2020, https://spacenews.com/2010-2019-the-decade-in-space/.

[11] "The Space Sector to Be Bigger than the Oil Industry," EVONA, 2021, https://www.evona.com/blog/the-space-sector-to-be-bigger-than-the-oil-industry/#:~:text=In%20less%20than%2030%20years.

[12] Carlie Porterfield, "Space Industry Grew to Record $469 Billion Last Year, Report Finds," Forbes, July 22, 2022, https://www.forbes.com/sites/carlieporterfield/2022/07/27/space-industry-grew-to-record-469-billion-last-year-report-finds/?sh=37d67a7e17f1.

sizes including; China[13], the US[14], Russia[15], India[16], the EU[17], and some private organizations like SpaceX[18].

- On the other hand, this strategic interest has been complemented and is in many ways facilitated, by the "New Space" economy, which is the rapid growth of commercial sector space-related services and industries that have developed in the wake of the private sector breaking the near state monopoly on space activity.[19]

The growth of both these intertwined prongs has also been facilitated by the shrinking cost of payload launches, largely due to efforts by major private sector actors.[20] Costs are only likely to decrease further in the future as the number of space-interested state and commercial actors continue to increase, expanding the market, and new launch-related technologies develop.[21]

[13] Keith Bradsher, "China Maps out Plans to Put Astronauts on the Moon and on Mars," The New York Times, December 12, 2022, https://www.nytimes.com/2022/12/12/science/china-space-moon-mars.html.
[14] Andrew Chatzky, "Space Exploration and U.S. Competitiveness," Council on Foreign Relations, August 23, 2021, https://www.cfr.org/backgrounder/space-exploration-and-us-competitiveness.
[15] Elizabeth Howell, "Russia Has Big Plans for Its Space Program despite International Sanctions," Space.com, April 14, 2022, https://www.space.com/russia-big-plans-space-international-sanctions.
[16] Rajeswari Pillai Rajagopalan, "India's Space Priorities Are Shifting toward National Security," Carnegie Endowment for International Peace, August 1, 2022, https://carnegieendowment.org/2022/09/01/india-s-space-priorities-are-shifting-toward-national-security-pub-87809.
[17] Daniel Clery, "Europe's Space Agency Dreams of Launching Its Own Astronauts amid Ambitious 'Accelerator' Plans," Science, November 19, 2021, https://www.science.org/content/article/europe-s-space-agency-dreams-launching-its-own-astronauts-amid-ambitious-accelerator-plans.
[18] Alexandra Witze, "2022 Was a Record Year for Space Launches," Nature 613, no. 7944 (January 11, 2023): 426–26, https://doi.org/10.1038/d41586-023-00048-7.
[19] Samuel Jardine, "The 'New Space' Economy: A Politically Turbulent Ride towards a Lucrative Horizon," Rosa & Roubini Associates, October 26, 2022, https://content.rosa-roubini-associates.com/space-oct22/.; "National Space Strategy," GOV.UK, February 1, 2022, https://www.gov.uk/government/publications/national-space-strategy/national-space-strategy.
[20] Denise Chow, "To Cheaply Go: How Falling Launch Costs Fueled a Thriving Economy in Orbit," NBC News, April 8, 2022, https://www.nbcnews.com/science/space/space-launch-costs-growing-business-industry-rcna23488.
[21] John McKenna, "How New Technology Is Democratizing Access to Space," Spectra, July 17, 2018, https://spectra.mhi.com/how-new-technology-is-democratizing-access-to-space.

A Developing Moon - The New Frontier

While much of the economic activity and strategic interest is currently concentrated around the earth's orbit,[22] cislunar, and specifically, operating on the lunar surface itself is an increasing consideration for many space-faring actors. Between state and private actors, there are currently over a hundred lunar missions planned by 2030 so far. This includes the US and its Artemis Programme partners, China, Japan, India, the European Space Agency, Russia, Astrobotic, Lonestar, ISpace, and more with direct goals of operating on the lunar surface. It also includes those companies seeking to help support and facilitate this growing "lunar economy".[23]

The reason for this interest in the Moon varies between actors, but overall can be generalised as the Moon being the easiest-to-reach celestial object, giving it significant strategic value from a number of angles;

- Scientific Research - Regarding earth-based matters like climate change and our origins, alongside more outward-facing research like utilising the Moon's dark side for universe observation.[24]
- A laboratory to experience and test off-earth technologies and policy.
- A place to "offshore" infrastructure such as data storage and labs.[25]
- Resource potential.[26]
- A future launchpad, which due to its gravity difference and resources like water, would make it potentially more cost-efficient than earth as a staging post to explore the rest of our solar system.[27]

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[22] "United Nations Register of Objects Launched into Outer Space," United Nations Office for Outer Space Affairs, https://www.unoosa.org/oosa/en/spaceobjectregister/index.html.; Andrew Tarantola, "Earth's Orbital Economy of Tomorrow Could Be Worth Trillions," Engadget, March 23, 2022, https://www.engadget.com/earths-orbital-economy-of-tomorrow-could-be-worth-trillions-192616564.html.

[23] Tim Fernholz, "Private Companies Plan to Launch 70 Missions to the Moon in the next Decade," Quartz, April 21, 2022, https://qz.com/2157513/private-companies-plan-to-launch-70-missions-to-the-Moon.

[24] Isabelle Yan, "10 Things: What We Learn about Earth by Studying the Moon," NASA Solar System Exploration, March 13, 2019, https://solarsystem.nasa.gov/news/812/10-things-what-we-learn-about-earth-by-studying-the-Moon/.

[25] Tom Coughlin, "Storage in Outer Space," Forbes, December 27, 2022, https://www.forbes.com/sites/tomcoughlin/2022/12/27/storage-in-outer-space/?sh=ed2d384585af.

[26] Ian Crawford, "Lunar Exploration," lunarexploration.esa.int, 2023, https://lunarexploration.esa.int/explore/science/224?ia=254.

[27] Jamie Carter, "Can We Really Use the Moon's Billion-Year Old Water to Make Rocket Fuel and Open up the Cosmos?," Forbes, November 1, 2019, https://www.forbes.com/sites/jamiecartereurope/2019/11/01/can-we-really-use-the-Moons-billion-year-old-water-to-make-rocket-fuel-and-open-up-the-cosmos/?sh=7d872d904658.; Jatan Mehta, "Launching Rockets from the Moon Is Our Ticket to a Home on Mars," TeamIndus, June 20, 2018,

As more actors become interested in these facets, and indeed, those yet to be thought of, the Moon and cislunar space will not only become far busier but will also shift away from being the operating domain primarily of a handful of great power states like the US and China; who are often broadly public about their missions.[28] The current state of affairs makes it easier to attribute responsibility for any fallout regarding lunar missions or activities (given the prestige these states attach to their lunar missions, and the rarity of operations). Instead, over time, there will be an increasing number of smaller states and private actors seeking to operate within the lunar environment.

This will potentially make identifying who is doing what, where, and who to contact about a particular operation, and getting an idea specifically of what each operation is up to, increasingly difficult and time-inefficient for earth-based and other lunar-interested stakeholders, as well as exacerbating emerging astropolitical competition between states due to suspicion and mis- or dis-information over intent, and the potential (or perception at least) of dual-use or grey zone activities.[29] This issue will only become more important to address as time goes on.

A Natural Bottleneck: Lunar Landing Sites and Activity Areas

The issue of more actors complicating other stakeholders' ability to get a clear idea of what is happening in the lunar environment becomes more important when the limited number of viable landing sites (due to facts including terrain, solar needs, and communication positioning), alongside concentrated resource areas and regions where the elements necessary for complex or long-term activity can be found, is considered.[30]

https://medium.com/teamindus/why-launching-rockets-from-the-Moon-is-our-ticket-to-a-home-on-mars-30bba878e9d8#:~:text=The%20lunar%20soil%20can%20be.

[28] Elizabeth Howell Howell, "Here's How to Follow NASA's Artemis 1 Moon Mission in Real Time after Launch," Space.com, August 24, 2022, https://www.space.com/artemis-1-Moon-mission-tracking-website.

[29] Malcolm Davis, "The Dragon and Eagle Meet in Space – Astropolitical Competition in the 21st Century, and Where Australia Sits," *East Asia Security Centre* 东亚安全中心 1, no. Middle Power Conference Papers (July 28, 2020): 1–8, https://easc.scholasticahq.com/article/14160-the-dragon-and-eagle-meet-in-space-astropolitical-competition-in-the-21st-century-and-where-australia-sits.

[30] Gabriel Swiney and Amanda Hernandez, "Lunar Landing and Operations Policy Analysis," *NASA Office of Technology, Policy, and Strategy Lunar Landing and Operations Policy Analysis*, August 30, 2022, https://www.nasa.gov/sites/default/files/atoms/files/lunar_landing_and_operations_policy_analysis_final_report_24oct2022_tagged_0.pdf.

While the Outer Space Treaty's (OST) Article II places stringent limitations around the de jure "claiming" of sovereignty on a celestial body, including the Moon.[31] The framework for this was established with state actors staking out sovereign claims in mind. It did not envisage the other ways in which actors can de facto "claim" areas,[32] nor considered commercial operations where "claiming" was not intended, but that could be positioned in an area for an extended period of time and so de facto have authority over that area, or at least be perceived by others to be making such a claim in an increasingly sensitive geopolitical context.[33] In the latter's case, there are then significant political, commercial, security, and safety considerations and disruptions that might befall two actors attempting to operate in the same area. It is, arguably, a difficulty that areas cannot be "claimed" and sharing of it is regulated by an actor or multilateral institution in the context of multiple actors wanting to operate in these limited lunar areas with overlapping time horizons, or wishing to set up longer-term infrastructure.

To try and ease these issues, there have been attempts to circumvent and/or update the OST. Circumventing is expedient, given as legally-binding treaties for space are not on the cards due to increasing geopolitical competition and differing

[31] "Outer Space Treaty," United Nations Office for Outer Space Affairs, December 19, 1966, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/outerspacetreaty.html.

[32] For instance, in the Antarctic where historic sovereign claims are frozen by the 1961 Antarctic Treaty System, and new claims are forbidden (much like the Outer Space Treaty); actors like the UK, US, China, Argentina, Chile, and Australia maintain and lay the groundwork for new claims to be made through physical presence, scientific and commercial activity, environmental stewardship, and the utilization of "protected areas" (such as Marine Protected Areas or Special Managed Areas) to limit or restrict the similar activities of other potential claimants. See; Samuel Jardine, "Climate Change and (In)Security Project Briefing Note," *Climate Change and (In)Security Project* (Oxford University Reuben College and Centre for Historical Analysis and Conflict Research, May 25, 2022), https://static1.squarespace.com/static/60800d20f65a1555173d7f03/t/628e0b321d9b7a3f35a648e3/1653476152084/Jardine.pdf.; Adrian Howkins, *Frozen Empires : An Environmental History of the Antarctic Peninsula* (New York: Oxford University Press, 2017).; Klaus Dodds and Cassandra Brooks, "Antarctic Geopolitics and the Ross Sea Marine Protected Area," E-International Relations, February 20, 2018, https://www.e-ir.info/2018/02/20/antarctic-geopolitics-and-the-ross-sea-marine-protected-area/.; Samuel Jardine and Andrew Young, "The Geopolitics of Britain's Antarctic Empire 1942–1961 and Its Falklands Legacy," rusi.org, March 22, 2022, https://rusi.org/events/open-to-all/geopolitics-britains-antarctic-empire-1942-1961-and-its-falklands-legacy/.; Anne-Marie Brady, "CHINA'S EXPANDING ANTARCTIC PRESENCE," Australian Strategic Policy Institute, 2017, https://www.jstor.org/stable/resrep04257.7.; This doesn't simply apply to the Antarctic context but is universally applicable to how sovereign claims are made, see Andrew F. Burghardt, "The Bases of Territorial Claims," *Geographical Review* 63, no. 2 (April 1973): 225, https://doi.org/10.2307/213412.

[33] Klaus Dodds, *Pink Ice : Britain and the South Atlantic Empire* (London: I.B. Tauris, 2002).; Jeff Foust, "The Space Review: Staking a Claim on the Moon," The Space Review, April 9, 2012, https://www.thespacereview.com/article/2058/1.

perspectives, as will be highlighted.[34] Indeed, there hasn't been an international space treaty signed since the end of the 1970s.[35] It is this context that has necessitated attempts like the US-led Artemis Accords and its "safety zones", which in practice lay out a recognised area for a state to operate in temporarily, and which can be regulated and other actors' access potentially restricted through the aim of preventing "harmful interference".[36]

Another perspective, of course, is that "safety zones" articulated like this directly contravene the OST, rather than circumventing it to fill in its gaps, as the Accords attempt to create a de facto way of claiming and partitioning celestial territory and resources.[37] While for the Artemis Accords, the US has clarified that the safety zones of non-Accord members will also be respected,[38] it is unclear if critics and competitor states will be appeased, or agree to what would in effect be a tacit acceptance of the Artemis Accords' legitimacy.[39] This is a key stumbling block as major space-faring states like China and Russia are opposed, partly due to their perception of the Accords as being an attempt to position the US as the leading arbiter of space governance.[40]

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[34] Juliana Suess, "Episode 21: Space Tech Innovation and Regulations – a Game of Catch-Up?," Royal United Services Institute, October 3, 3AD, https://rusi.org/podcasts/war-in-space/episode-21-space-tech-innovation-and-regulations-game-catch.

[35] Samuel Jardine, "Building Lunar Security and Cooperation through an Astropolitical Lens- the Role of Normative Behaviours in Creating Stability.," Open Lunar Foundation, November 10, 2022, https://www.openlunar.org/library/open-lunar-registry-project-blog-post-series-blog-1.

[36] Alexander Q. Gilbert, "Implementing Safety Zones for Lunar Activities under the Artemis Accords," *Journal of Space Safety Engineering* 10, no. 1 (January 2023), https://doi.org/10.1016/j.jsse.2022.12.007.; "Artemis Accords," NASA, October 13, 2020, https://www.nasa.gov/specials/artemis-accords/index.html.

[37] Alexander Stirn, "Do NASA's Lunar Exploration Rules Violate Space Law?," Scientific American, November 12, 2020, https://www.scientificamerican.com/article/do-nasas-lunar-exploration-rules-violate-space-law/.; Aaron Boley and Michael Byers, "U.S. Policy Puts the Safe Development of Space at Risk," *Science* 370, no. 6513 (October 9, 2020): 174–75, https://doi.org/10.1126/science.abd3402.

[38] Gabriel Swiney and Amanda Hernandez, "Lunar Landing and Operations Policy Analysis," *NASA Office of Technology, Policy, and Strategy Lunar Landing and Operations Policy Analysis*, August 30, 2022, https://www.nasa.gov/sites/default/files/atoms/files/lunar_landing_and_operations_policy_analysis_final_report_24oct2022_tagged_0.pdf.

[39] Beijing's sentiments can be found in its state-affiliated media such as the foreign-facing Global Times. Here the Artemis Accords are framed as a direct competitor to be disdained. See, Deng Xiaoci, "China's Top Space Contractor CASC Reveals New Launch Vehicle Able to Send Chinese to Moon by around 2030," Global Times, August 21, 2022, https://www.globaltimes.cn/page/202208/1273481.shtml.

[40] Elliot Ji, Michael B. Cerny, and Raphael J. Piliero, "What Does China Think about NASA's Artemis Accords?," The Diplomat, September 17, 2020, https://thediplomat.com/2020/09/what-does-china-think-about-nasas-artemis-accords/.

In this context, which is founded in the wider increasing geopolitical and astropolitical competition on Earth and regarding the Moon,[41] the issue of how to regulate, monitor, and share the Moon's limited landing sites and activity points, will remain a problem over the long term as more actors get involved. Indeed, this is already a potential flashpoint as NASA has publicly warned China to be more transparent after the revelations that both states are eyeing overlapping lunar areas of operational interest for their respective lunar programmes;[42]

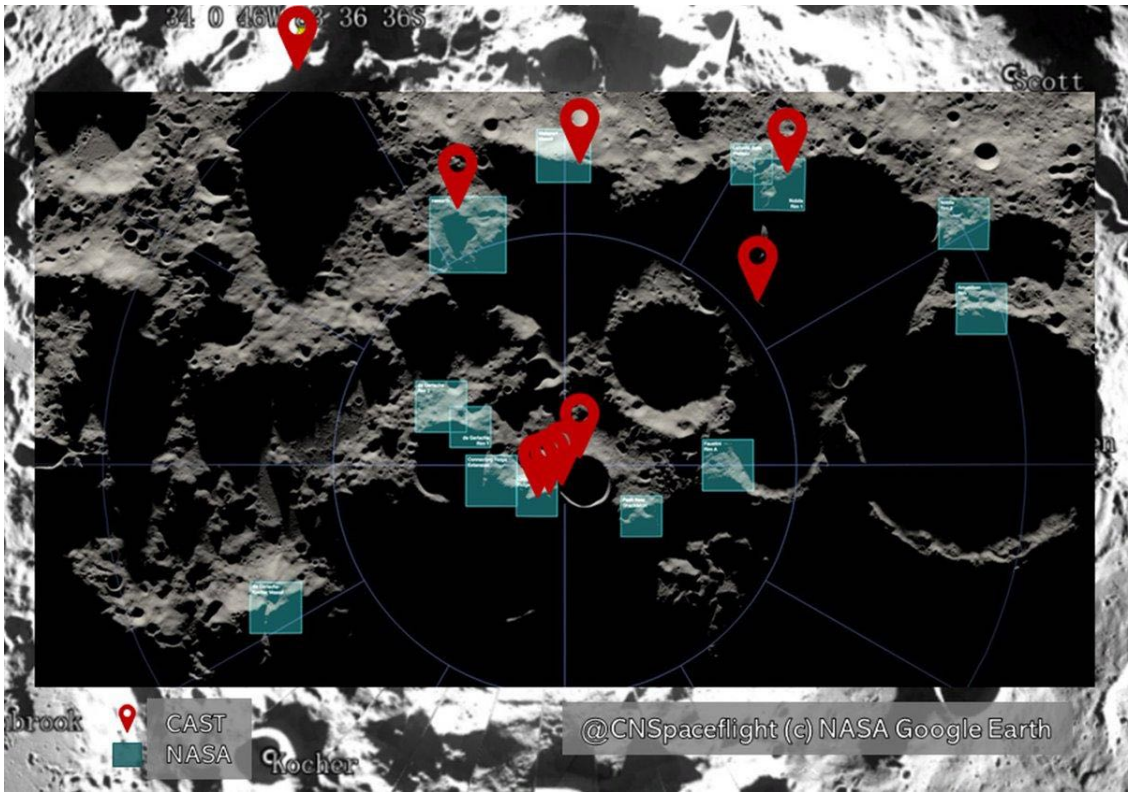

Fig 1: Blue squares are candidate locations for the Artemis Programme's operations. The red points are those proposed by CAST scientists. Data and image courtesy of CNSpaceflight, 22 August 2022.

On this current trajectory, without establishing universally shared norms and regulations for stakeholders and tools to purport and support them,[43] lunar

[41] Bryan Bender, "'We Better Watch Out': NASA Boss Sounds Alarm on Chinese Moon Ambitions," POLITICO, January 1, 2023, https://www.politico.com/news/2023/01/01/we-better-watch-out-nasa-boss-sounds-alarm-on-chinese-Moon-ambitions-00075803#:~:text=So%20says%20NASA%20Administrator%20Bill.

[42] Christopher Carbone, "NASA Calls on China to Be 'Open and Transparent' with Lunar Missions," Mail Online, September 7, 2022, https://www.dailymail.co.uk/sciencetech/article-11189291/NASA-tells-China-open-transparent-OVERLAP-lunar-landing-sites-revealed.html.

[43] Samuel Jardine, "Building Lunar Security and Cooperation through an Astropolitical Lens- Why Normative Behaviours Are Needed for Lunar Activity," Open Lunar Foundation, December 14, 2022, https://www.openlunar.org/library/open-lunar-registry-blog-post-series-blog-3.

competition is set only to intensify and in the longer term may lead to the fragmentation or "bloc-ification" of the lunar political and regulatory environment.

A relevant case study highlighting how quickly states will intensify competition with each other over new frontiers can be found in the geopolitical competition over the Antarctic between 1942-1959. Here, despite the continent having a completely unknown (and often doubted) resource and strategic value, Britain, Argentina, Chile, the United States, and Russia were prepared to invest comparatively significantly in their competing sovereign presences (particularly through the establishment of bases on top of each other),[44] and were willing to escalate, utilising military confrontation,[45] even to the point of open war, over making or maintaining overlapping sovereign claims.[46]

The Antarctic's value over this period remained entirely unknown. However, the fear of losing out on any potential opportunity, and more so that a geopolitical rival could benefit instead drove actors to invest significant political, military, and financial capital and imperil otherwise key bilateral relationships.[47]

While military competition over the Moon is unlikely (though lunar tensions becoming a related factor or spilling over to other earth-based tensions is likely), the point that states are willing to go to such lengths over new frontiers whose potential isn't fully understood yet should highlight why we need to be concerned about developing a universally accepted lunar political framework now before actors start to operate significantly on the Moon.

Geopolitical spillover: The Politicization of "Everything"

The most crucial element informing the shape of space generally, and the lunar landscape specifically in terms of activity and governance, is the current geopolitical context on Earth regarding the increasing competition between states. It is important to highlight just how this environment has developed to understand that;

- Space and, particularly, the lunar environment will inevitably be subject to significant geopolitical spillover that will shape the way actors operate.

[44] Adrian Howkins, *Frozen Empires : An Environmental History of the Antarctic Peninsula* (New York: Oxford University Press, 2017)
[45] Kew National Archives (1952), ADM1/ 23580, Summary of the Incident at Hope Bay, 2 February
[46] Samuel Jardine and Andrew Young, "The Geopolitics of Britain's Antarctic Empire 1942–1961 and Its Falklands Legacy," rusi.org, March 22, 2022, https://rusi.org/events/open-to-all/geopolitics-britains-antarctic-empire-1942-1961-and-its-falklands-legacy/.
[47] Kew National Archives (1957), FO 371/126125, Antarctica, 31 January; Kew National Archives (1957), FCO 7/3248, United Kingdom Policy in the Antarctic Area, 8 November.

Understanding the forms this takes on Earth is fundamental to addressing the concerns of potential lunar stakeholders.

- The need for a Lunar Registry that aids in the creation of transparency as a norm for a new, distant frontier of human operations which can help constrain this competition, and foster the basis for cooperation and trust-building.

- Creating the needed registry will be a very difficult, though necessary, task because of this geopolitical environment. Especially as legally binding international agreements are far harder, if not potentially impossible in certain areas, including space. A voluntary registry with a focus on norm creation is the easiest way forward.

A developing multipolar world,[48] shaped particularly by the US-China rivalry,[49] but joined by a growing array of influential powers including India, Russia, Turkey, Brazil, South Africa, Mexico, Indonesia, and the European Union,[50] competing not over political ideology which drove twentieth-century geopolitical rivalries,[51] but differing interpretations of global governance. Specifically, the ability to shape international frameworks toward best suiting their self-identified interests.[52] This competition is also somewhat internally driven for most actors' courtesy of a global rise in "populism", fuelled by national populaces' increasing socio-economic anxieties which rightly or wrongly are blamed on globalization (or at least hyper globalization).[53]

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[48] "Future of the International Order at a Crossroads," European Commission, November 5, 2022, https://knowledge4policy.ec.europa.eu/foresight/future-international-order-crossroads_en.
[49] "EU Ambassadors Annual Conference 2022: Opening Speech by High Representative Josep Borrell," European Union External Action, October 10, 2022, https://www.eeas.europa.eu/eeas/eu-ambassadors-annual-conference-2022-opening-speech-high-representative-josep-borrell_en.; Jim Garamone, "Dunford Describes U.S. Great Power Competition with Russia, China," Joint Chiefs of Staff, 2020, https://www.jcs.mil/Media/News/News-Display/Article/1792236/dunford-describes-us-great-power-competition-with-russia-china/.; Thomas Wright, "China and Russia vs. America: Great-Power Revisionism Is Back," Brookings, April 27, 2015, https://www.brookings.edu/opinions/china-and-russia-vs-america-great-power-revisionism-is-back/.
[50] "Trend: Future of the International Order at a Crossroads," European Commission, October 5, 2022, https://knowledge4policy.ec.europa.eu/foresight/future-international-order-crossroads_en.
[51] Eric Hobsbawm, *The Age of Extremes : The Short Twentieth Century, 1914-1991* (London Abacus, 1994).
[52] Emel Parlar Dal, "Status Competition and Rising Powers in Global Governance: An Introduction," *Contemporary Politics* 25, no. 5 (June 13, 2019): 1–13, https://doi.org/10.1080/13569775.2019.1627767.; Michael J. Mazarr, *Understanding Competition: Great Power Rivalry in a Changing International Order* (RAND Corporation, 2022), https://doi.org/10.7249/pea1404-1.
[53] Michael Cox, "UNDERSTANDING the GLOBAL RISE of POPULISM," 2018, https://www.lse.ac.uk/ideas/Assets/Documents/updates/LSE-IDEAS-Understanding-Global-Rise-of-Populism.pdf.; Adriana Santamaria Duthon et al., "Overlooked Political Risks for 2023 Pressing or Emerging Political Risks That Have Flown under the Radar" (London Politica, 2023), https://static1.squarespace.com/static/5efb88803e2328745c7b3c39/t/63ce9092c7f2942dbc6c0dc0/1674481812821/London+Politica-+Overlooked+Political+Risks+for+2023.pdf.; Robert Kuttner, "After

This has meant governments are under intense pressure to take a tough line on tangibly inconsequential events that they might personally rather ignore or take a softer line on. An example is the recent Chinese high-altitude surveillance balloon shot down over the US that geopolitically has been blown out of proportion. The balloon posed no threat to the US (including from a surveillance perspective; China has the world's second-largest spy satellite capability).[54] Indeed, such balloon incursions have previously been fairly common and met with almost no comment.[55] The US's political polarization, combined with its bipartisan support for a hawkish approach to China (strategic competition being one of the bipartisan topics) has meant that any US President would have little political choice but to act aggressively,[56] even if this proved escalatory.[57]

The competition between states and its consequences is pervasive and somewhat inescapable given the political environment. Concepts of civil-military fusion,[58] "grey zone" strategies,[59] and politicization are employed by all participants, which means any and all areas of international life are "on the table" and could be subject to politicised competition. Some currently common elements of this are listed below.

Traditional Conflict and Security Operations

Geopolitical competition has seen the return to "near-peer" open warfare in Ukraine,[60] a dramatic shift away from the previous post-1991 low-intensity conflicts

Hyper-Globalization," The American Prospect, May 31, 2022, https://prospect.org/economy/after-hyper-globalization/.

[54] "Senior Defense Official Holds a Background Briefing on High-Altitude Surveillance Balloon," U.S. Department of Defense, February 2, 2023, https://www.defense.gov/News/Transcripts/Transcript/Article/3287204/senior-defense-official-holds-a-background-briefing-on-high-altitude-surveillan/.

[55] Victoria Bisset et al., "What to Know about the Suspected Chinese Spy Balloon," Washington Post, February 3, 2023, https://www.washingtonpost.com/national-security/2023/02/03/what-is-chinese-spy-balloon-montana/.

[56] Kevin McCarthy, Twitter, February 3, 2023, https://twitter.com/SpeakerMcCarthy/status/1621311735914266626.

[57] John Ruwitch, "The Pentagon Says China Declined a Phone Call in Response to the Balloon's Downing," NPR, February 7, 2023, https://www.npr.org/2023/02/07/1155265608/pentagon-says-china-rebuffed-request-for-a-phone-call-after-balloon-shoot-down.

[58] Richard A. Bitzinger, "China's Shift from Civil-Military Integration to Military-Civil Fusion," *Asia Policy* 28, no. 1 (2021): 5–24, https://doi.org/10.1353/asp.2021.0001.

[59] Michael J Mazarr, *Mastering the Gray Zone: : Understanding a Changing Era of Conflict* (Carlisle Barracks: United States Army War College Press, 2015), https://press.armywarcollege.edu/monographs/428/.

[60] Karin von Hippel and Robert Fry, "The Russia–China Alliance versus the West: What about the Rest?," Royal United Services Institute, July 19, 2022, https://rusi.org/explore-our-research/publications/commentary/russia-china-alliance-versus-west-what-about-rest.

and interventions. The Ukraine War is not an isolated incident though but born of a wider tapestry of globally escalating conflict operations related to multipolar competition.[61] These largely have a hybrid or proxy form as showcased in the South China Sea,[62] Syria,[63] and across Mali, the Democratic Republic of Congo, and other areas of Africa.[64] Indeed, Ukraine in 2014 began not as an open conflict, but as a similar (though far more aggressive) hybrid operation.[65] That states are increasingly willing to once more use a wider spectrum of force and violence to achieve their political objectives must be a key consideration for the 21st century's political environment; particularly as factors like climate change add pressure on resources and populations, exacerbating the likelihood of conflict.[66]

Economic Weaponization

The weaponization of key global supply chains and commodities for political purposes, including those like critical minerals and rare earth elements which are fundamental to globally cooperative aims such as climate change mitigation.[67] For instance, China utilised its monopoly on rare earth elements to restrict the access of

[61] "A New Era of Conflict and Violence," United Nations, 2020, https://www.un.org/en/un75/new-era-conflict-and-violence.
[62] "China Accused of Building on Unoccupied Reefs in South China Sea," The Straits Times, December 20, 2022, https://www.straitstimes.com/asia/east-asia/china-accused-of-building-on-unoccupied-reefs-in-south-china-sea.
[63] Andrew S. Weiss and Nicole Ng, "Collision Avoidance: The Lessons of U.S. And Russian Operations in Syria," Carnegie Endowment for International Peace, March 20, 2019, https://carnegieendowment.org/2019/03/20/collision-avoidance-lessons-of-u.s.-and-russian-operations-in-syria-pub-78571.; Thomas Gibbons-Neff, "How a 4-Hour Battle between Russian Mercenaries and U.S. Commandos Unfolded in Syria," *The New York Times*, May 24, 2018, https://www.nytimes.com/2018/05/24/world/middleeast/american-commandos-russian-mercenaries-syria.html.
[64] Samuel Jardine et al., "Exploring Russian Private Military Contractors," London Politica, December 7, 2022, https://londonpolitica.com/conflict-and-security-watch-blog-list/exploring-russian-private-military-contractors.
[65] Kateryna Zarembo and Sergiy Solodkyy, "The Evolution of Russian Hybrid Warfare: Ukraine," CEPA, January 29, 2021, https://cepa.org/comprehensive-reports/the-evolution-of-russian-hybrid-warfare-ukraine/.
[66] Neela Banerjee, "Climate Change Will Increase Risk of Violent Conflict, Researchers Warn," Inside Climate News, June 13, 2019, https://insideclimatenews.org/news/13062019/climate-change-global-security-violent-conflict-risk-study-military-threat-multiplier/.; Climate Change (in)Security Project, "CCIP Annual Conference 2022: Assessing Climate Insecurity within a Defence Context," YouTube, November 27, 2022, https://www.youtube.com/watch?v=kntod1porPQ&t=1631s.
[67] Samuel Jardine et al., "Overlooked Political Risks for 2022: The Politicization of 'Everything,'" London Politica, January 30, 2022, https://londonpolitica.com/conflict-and-security-watch-blog-list/overlooked-political-risks-for-2022-the-politicization-of-everything.

Japan, sparked by a minor event regarding maritime borders,[68] and has threatened to do the same to the US.[69] Likewise, the US semiconductor export restrictions are aimed directly at curtailing China's economic and technological base on grounds of competition and security.[70] Such instances are seeing markets and supply chains potentially fragment along "bloc" lines,[71] contributing to a de-hyper globalization.[72]

This goes hand in hand with the politicization of international investment and development. China's Belt and Road Initiative has competition-based strategic and political aims at its heart, that arguably trump its economic considerations.[73] The US and EU responses to it likewise are both strategically centred.[74] International development, too, has been steadily repurposed as a tool for national interests; the UK, for instance, has been very explicit in tying foreign aid and development assistance to its foreign policy interests and objectives.[75]

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[68] Samuel Jardine, "The Geopolitics of Beijing's Threatened Latest Rare Earth Elements Restrictions: A Rare Opportunity with a Wealth of Risk," London Politica, February 19, 2021, https://londonpolitica.com/apac/the-geopolitics-of-beijings-threatened-latest-rare-earth-elements-restrictions-a-rare-opportunity-with-a-wealth-of-risk.

[69] Sun Yu and Demetri Sevastopulo, "China Targets Rare Earth Export Curbs to Hobble US Defence Industry," Financial Times, February 16, 2021, https://www.ft.com/content/d3ed83f4-19bc-4d16-b510-415749c032c1.

[70] Arjun Kharpal, "China Brings WTO Case against U.S. And Its Sweeping Chip Export Curbs as Tech Tensions Escalate," CNBC, December 13, 2022, https://www.cnbc.com/2022/12/13/china-brings-wto-case-against-us-chip-export-restrictions.html.

[71] "The Destructive New Logic That Threatens Globalisation," *The Economist*, January 12, 2023, https://www.economist.com/leaders/2023/01/12/the-destructive-new-logic-that-threatens-globalisation.

[72] The White House, "Securing a Made in America Supply Chain for Critical Minerals," The White House, February 22, 2022, https://www.whitehouse.gov/briefing-room/statements-releases/2022/02/22/fact-sheet-securing-a-made-in-america-supply-chain-for-critical-minerals/.; Panos Mourdoukoutas, "China Threatens to Cut Rare Earths Supplies to the U.S.," Forbes, May 16, 2019, https://www.forbes.com/sites/panosmourdoukoutas/2019/05/16/china-threatens-to-cut-rare-earths-supplies-to-the-us-bad-idea/?sh=1ef635137486.

[73] Andrew G. Ross, "The Belt and Road Initiative: Economic Development for All or a Geopolitical Power Play?," Royal United Services Institute, May 18, 2020, https://rusi.org/explore-our-research/publications/commentary/belt-and-road-initiative-economic-development-all-or-geopolitical-power-play.; International Institute for Strategic Studies, *China's Belt and Road Initiative* (Taylor & Francis, 2022), https://www.iiss.org/publications/strategic-dossiers/chinas-belt-and-road-initiative.

[74] Chloe Teevan et al., "The Global Gateway: A Recipe for EU Geopolitical Relevance?," ECDPM, June 13, 2022, https://ecdpm.org/work/global-gateway-recipe-eu-geopolitical-relevance.; Raquel Jorge Ricart and Miquel Otero Iglesias, "The Global Gateway: It's Not the Money, It's the Strategy," Real Instituto Elcano, March 9, 2022, https://www.realinstitutoelcano.org/en/commentaries/the-global-gateway-its-not-the-money-its-the-strategy/.

[75] Boris Johnson, "Global Britain - Hansard," hansard.parliament.uk, June 16, 2020, https://hansard.parliament.uk/commons/2020-06-16/debates/20061637000001/GlobalBritain.

Politicization of Global Governance and Cooperation

The international safeguards and institutions that traditionally act as constraining elements for "great power" competition and limit its excesses are also under significant pressure, and indeed, have been wielded by states for their own ends with increasing frequency. For example, the US decision to simply ignore recent World Trade organization (WTO) rulings against it on the basis of its national interests.[76] This is at the same time that the US utilises the WTO to sanction the trade practices of others who break its rules, including China.[77] Indeed, without the WTO ruling against China in 2015, it is unlikely that Beijing would have lifted its rare earth element market restrictions that had heavily impacted Japan and its partners.[78]

It is not merely international institutions that have become subject to politicization. The political environment created by competition has meant that multilateral treaties and legally binding international agreements are becoming more difficult to agree on. This is the case for even "common sense" mutually beneficial issues where cooperation should be low-hanging fruit politically, such as climate change mitigation or anti-satellite weaponry.[79]

In regard to climate change a "bottom-up" approach had to be adopted with the Paris Agreement and subsequent Conference of Parties shying away from making

[76] Bryce Baschuk, "US Snub of WTO Ruling Marks a 'Step Back' in Era of Free Trade," *Bloomberg*, December 12, 2022, https://www.bloomberg.com/news/newsletters/2022-12-12/supply-chain-latest-us-snub-of-wto-called-a-step-back-for-trade.; Keith Rockwell, "Recent WTO Ruling against the United States Highlights Challenges in Dispute Resolution," Wilson Center, December 15, 2022, https://www.wilsoncenter.org/blog-post/recent-wto-ruling-against-united-states-highlights-challenges-dispute-resolution.

[77] Jeffrey J. Schott and Eujin Jung, "In US-China Trade Disputes, the WTO Usually Sides with the United States," PIIE, March 12, 2019, https://www.piie.com/blogs/trade-and-investment-policy-watch/us-china-trade-disputes-wto-usually-sides-united-states.

[78] "Dispute - DS431- China — Measures Related to the Exportation of Rare Earths, Tungsten and Molybdenum," World Trade Organization, May 20, 2015, https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds431_e.htm.

[79] Laura Quiñones, "COP26 Closes with 'Compromise' Deal on Climate, but It's Not Enough, Says UN Chief," UN News, November 13, 2021, https://news.un.org/en/story/2021/11/1105792.; Justin Catanoso, "COP26: Are Climate Declarations and Emission Reduction Pledges Legally Binding?," Mongabay Environmental News, November 11, 2021, https://news.mongabay.com/2021/11/cop26-are-climate-declarations-and-emission-reduction-pledges-legally-binding/.; Adriana Santamaria Duthon et al., "Overlooked Political Risks for 2023 Pressing or Emerging Political Risks That Have Flown under the Radar" (London Politica, 2023), https://static1.squarespace.com/static/5efb88803e2328745c7b3c39/t/63ce9092c7f2942dbc6c0dc0/1674481812821/London+Politica-+Overlooked+Political+Risks+for+2023.pdf.

legally binding targets,[80] and instead allowing states to set their own national targets and policies for climate goals without external enforcement mechanisms. Countries essentially police their own progress. This is partly because governments are unwilling to relinquish sovereign control, fearing it might hurt their competitive national interests.[81] For instance, Russia sees Arctic hydrocarbon and resource development as vital for its future,[82] and so engages in creative carbon counting practices alongside a generally lax approach to climate mitigation.[83] Also, many states see climate change cooperation as being a tool for geopolitical competition and influence creation. China's Foreign Minister for instance is on record as highlighting to the US Biden Administration that climate change "cannot possibly be divorced" from other geopolitical tensions.[84]

The politicization, courtesy of geopolitical competition of international cooperation, is playing out in space-related areas too with multilateral cooperation, and legally binding treaties on the decline.[85] An example is the attempts to ban anti-satellite (ASAT) weaponry. The US, China, and Russia have all stated their wish to limit ASAT, specifically as the consequences of using particularly kinetic systems could see damage also done to neutral and even allied states' orbital infrastructure as the debris created are uncontrollable.[86] Indeed, the result could be catastrophic as it potentially contributes to a Kessler syndrome event, imperilling humanity's access to

[80] Daniel Bodansky, "Paris Agreement," UN Office of Legal Affairs, December 12, 2015, https://legal.un.org/avl/ha/pa/pa.html.
[81] Nikolas Gvosdev, "The Paris Agreement, World Citizenship and National Sovereignty," Ethics & International Affairs, October 18, 2016, https://www.ethicsandinternationalaffairs.org/2016/paris-agreement-world-citizenship-national-sovereignty/.; Arvind Ashta, "States Will Remain Unable to Solve Global Crises like Climate Change until They Let Go of Their Sovereignty," London School of Economics, February 11, 2022, https://blogs.lse.ac.uk/europpblog/2022/02/11/states-will-remain-unable-to-solve-global-crises-like-climate-change-until-they-let-go-of-their-sovereignty/.
[82] Atle Staalesen, "Putin: Our Future Lies in the Arctic," The Independent Barents Observer, June 16, 2017, https://thebarentsobserver.com/en/arctic/2017/06/putin-our-future-lies-arctic.
[83] https://climateactiontracker.org/countries/russian-federation/
[84] Robert S. Litwak, "Geostrategic Competition and Climate Change: Avoiding the Unmanageable | Wilson Center," Wilson Center, September 15, 2021, https://www.wilsoncenter.org/article/geostrategic-competition-and-climate-change-avoiding-unmanageable.
[85] Juliana Suess, "Episode 21: Space Tech Innovation and Regulations – a Game of Catch-Up?," Royal United Services Institute, October 3, 3AD, https://rusi.org/podcasts/war-in-space/episode-21-space-tech-innovation-and-regulations-game-catch.
[86] Adriana Santamaria Duthon et al., "Overlooked Political Risks for 2023 Pressing or Emerging Political Risks That Have Flown under the Radar" (London Politica, 2023), https://static1.squarespace.com/static/5efb88803e2328745c7b3c39/t/63ce9092c7f2942dbc6c0dc0/1674481812821/London+Politica-+Overlooked+Political+Risks+for+2023.pdf.

key orbits.[87] Despite then a clear universal interest, and the explicitly stated intent of all parties, a legally binding multilateral treaty that restricts or bans ASAT weaponry remains contested with all participants refusing to compromise from their particular UN submissions due to wanting to outmanoeuvre the other side while protecting their own favoured weapon systems and agency of action.[88]

Grey Zone Operations

This covers a myriad of actions that states can take to damage a rival's political, economic, or security position and improve their own while remaining "below the threshold" of war.[89] It utilises and capitalises on the globally increased blurring of military and civilian spheres in the context of competition (famously noted in China's doctrine for geopolitical competition as "Civil-Military Fusion", but also highlighted by the UK's Integrated Review through the marrying of economic and commercial spheres to national security).[90]

The actual methods of competition covered by the grey zone can vary wildly and include political operations,[91] mis- or dis-information campaigns,[92] cyberattacks,[93]

[87] Anders Fogh Rasmussen, "Russia's Anti-Satellite Test Is a Wake-up Call to Mankind," *Financial Times*, December 2, 2021, https://www.ft.com/content/01e1961b-ca40-41b9-b10d-e8107b641550.

[88] Juliana Suess, "Episode 20: Space Dominance Now?," Royal United Services Institute, September 15, 2022, https://www.rusi.org/podcasts/war-in-space/episode-20-space-dominance-now.

[89] Michael Mazarr, "Mastering the Gray Zone: Understanding a Changing Era of Conflict," *United States Army War College Press*, December 1, 2015, https://press.armywarcollege.edu/monographs/428/.

[90] "Why Is MCF so Important to the Chinese Communist Party? Military-Civil Fusion and the People's Republic of China" (US State Department, 2021), https://www.state.gov/wp-content/uploads/2020/05/What-is-MCF-One-Pager.pdf.; Paul O' Neill, "The UK's Integrated Review at One Year – Fit for Purpose?," Royal United Services Institute, March 31, 2022, https://rusi.org/explore-our-research/publications/commentary/uks-integrated-review-one-year-fit-purpose.

[91] Including foreign interference in elections or attempts to influence a nations laws, political process, or policy through underhand means. Martin Russell, "Foreign Interference in EU Democratic Processes" (European Parliament, March 2022), https://www.europarl.europa.eu/RegData/etudes/ATAG/2022/729271/EPRS_ATA(2022)729271_EN.pdf.; Sandra Kalniete, "REPORT on Foreign Interference in All Democratic Processes in the European Union, Including Disinformation | A9-0022/2022 | European Parliament," European Parliament, February 8, 2022, https://www.europarl.europa.eu/doceo/document/A-9-2022-0022_EN.html.

[92] André W.M. Gerrits, "Disinformation in International Relations: How Important Is It?," *Security and Human Rights* 29, no. 1-4 (December 12, 2018): 3–23, https://doi.org/10.1163/18750230-02901007.

[93] Michael McGuire, "Nation States, Cyberconflict and the Web of Profit," HP Development, April 8, 2021, https://threatresearch.ext.hp.com/web-of-profit-nation-state-report/.; Matt Burgess, "Leaked Ransomware Docs Show Conti Helping Putin from the Shadows," Wired, March 18, 2022, https://www.wired.com/story/conti-ransomware-russia/.; Conrad Prince CB, "On the Offensive: The UK's New Cyber Force," Royal United Services Institute, November 23, 2020, https://rusi.org/explore-our-research/publications/commentary/offensive-uks-new-cyber-force.

asymmetrical escalations and threat messaging,[94] and dual-use capability.[95] Its very asymmetricality gives smaller states viable options when it comes to competing with larger ones, and so significantly impacts government considerations when it comes to international relations and cooperation by heightening countries' sensitivity to the actions of others. This increases the risks related to misunderstandings or false perceptions.

An example of grey zone activity Is when “dual use” infrastructure and capability are utilised (or perceived to be). For example, Beijing has expressed interest as part of its green energy agenda in building hydropower plants in key locations across its border with India, with who it has several border disputes. While certainly being part of climate mitigation policy, such plants can, as India fears, also be used to potentially restrict India’s access to key water sources in a region where water scarcity is already an issue.[96] In such instances, due to the heightened sensitivities that the context of competition creates, the perception of potential risk becomes key to escalating tensions rather than intent, exacerbated by a lack of trust between actors.

It is not, of course, just Beijing that engages in (or is at least perceived to) grey zone practices, most states do. The US for instance went out of its way to prevent Greenland’s decision to allow China to build it an airport, due to Washington’s fears of its dual-use potential.[97]

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[94] Mahbi Maulaya, “The Truth behind China’s Fishing Ban in the South China Sea,” Asia and the Pacific Policy Society, June 24, 2022, https://www.policyforum.net/the-truth-behind-chinas-fishing-ban-in-the-south-china-sea/.

[95] A space-related example of this can be found regarding China’s robotic arm-equipped satellite that successfully pulled another satellite away from its orbit in a test. Beijing plausibly highlights this capability will be for space debris removal, a growing global issue. However, the test has also been perceived by the US as China showcasing its capability to target the space-infastructure of competitor states if the need arises. It should also be noted that the US is equally working on such dual-use space-based capabilities that would cause similar alarm to its competitors. See; Brett Tingley, “A Chinese Satellite Just Grappled Another and Pulled It out of Orbit,” The Drive, January 27, 2022, https://www.thedrive.com/the-war-zone/44054/a-chinese-satellite-just-grappled-another-and-pulled-it-out-of-orbit.; Ken Moriya Su, “China Can ‘Grapple’ US Satellites with Robotic Arm, Commander Says,” Nikkei Asia, April 21, 2021, https://www.google.com/url?q=https://asia.nikkei.com/Politics/International-relations/US-China-tensions/China-can-grapple-US-satellites-with-robotic-arm-commander-says&sa=D&source=docs&ust=1676402136434489&usg=AOvVaw0rn2aZ2O38toynQyjiGQSV.

[96] Genevieve Donnellon-May, “China’s Super Hydropower Dam and Fears of Sino-Indian Water Wars,” *The Diplomat*, December 15, 2022, https://thediplomat.com/2022/12/chinas-super-hydropower-dam-and-fears-of-sino-indian-water-wars/.

[97] Drew Hinshaw and Jeremy Page, “How the Pentagon Countered China’s Designs on Greenland,” *Wall Street Journal*, February 10, 2019, sec. World, https://www.wsj.com/articles/how-the-pentagon-countered-chinas-designs-on-greenland-11549812296.

Emerging Risks: Why This Context Matters - The Dawn of Astropolitics

Current geopolitical competition and the way it has been conducted so far has seen the politicization of most areas of international cooperation,[98] growing de-hyper globalization,[99] and the fraying of globalization, with the possibility of de-globalization itself looming.[100]

For our purposes, it has explicitly created a competitive international environment, where trust between competing states is low and has made the creation of legally binding international agreements far harder, if not potentially impossible in certain areas, including space.[101] This includes issues where cooperation is universally in all parties' interest, but where due to competitive considerations, the temptation to politicise, and state actors being highly sensitive to the full spectrum of potential risk ranging from grey zone attacks to economic or treaty weaponization prevents binding cooperation.

It thus forms the key backdrop to the evolving lunar environment. The spill-over of geopolitics to lunar astropolitics is something that cannot be ignored, avoided, or wished away. Evidence that this spill-over is here to stay can be found by looking at contextually similar environments on Earth, and their trajectories and interactions

[98] Samuel Jardine et al., "Overlooked Political Risks for 2022: The Politicization of 'Everything,'" London Politica, January 30, 2022, https://londonpolitica.com/conflict-and-security-watch-blog-list/overlooked-political-risks-for-2022-the-politicization-of-everything.

[99] As in response to political and economic instability created by growing geopolitical competition, states great and small are seeking to increasingly "down-stream" key commodities; dismantling global supply chains in favour of a more national-interest-driven protectionist outlook. Complimenting the examples provided by the US, China, and others, many smaller states like Indonesia or Zimbabwe are seeking to refine their own raw materials into end-goods to both take advantage of the competitive landscape, and secure local economic benefits. This while a potential positive for their own economies will have economic and political consequences for states which previously were part of the up-stream supply chain. Fransiska Nangoy and Bernadette Christina, "Indonesia Confirms Bauxite Export Ban to Proceed as Scheduled," *Reuters*, December 21, 2022, sec. Asian Markets, https://www.reuters.com/markets/asia/indonesia-announce-ban-exports-commodity-without-saying-which-2022-12-21/.; Jevans Nyabiage, "Export Ban Means Chinese Firms Will Have to Build Lithium Plants in Zimbabwe," South China Morning Post, December 31, 2022, https://www.scmp.com/news/china/diplomacy/article/3205135/export-ban-means-chinese-firms-will-have-build-plants-zimbabwe-process-lithium. For a macro overview of this see; Hubert Escaith, "From Hyper-Globalization to Global Value Chains Decoupling: Withering Global Trade Governance?," SSRN (Rochester, NY, October 26, 2022), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4268398.

[100] "Increasing Fragmentation of Globalisation," European Commission, October 5, 2022, https://knowledge4policy.ec.europa.eu/foresight/increasing-fragmentation-globalisation_en.

[101] Juliana Suess, "Episode 21: Space Tech Innovation and Regulations – a Game of Catch-Up?," Royal United Services Institute, October 3, 3AD, https://rusi.org/podcasts/war-in-space/episode-21-space-tech-innovation-and-regulations-game-catch.

with the wider competition. Specifically, the Arctic and Antarctic. These regions not only highlight how spill-over is unavoidable but also showcase how tools like a politically neutral multi-stakeholder Lunar Objects and Activities Registry could be an aid in helping alleviate the excesses of competition and direct energies away from escalation.

Polar Similarities for New Frontiers

Both the Arctic and Antarctic were subject to Cold War and national-interest-based competition prior to 1991 and 1959 respectively.[102] In the Arctic, it pertained specifically to strategic access which was a spill-over courtesy of the wider Cold War's geopolitical competition, alongside, partly, the belief in its potential economic value.[103] The Antarctic was slightly different in that it had a predicted potential strategic and commercial value, though this was not, and still has yet to be definitively proven.[104]

This meant that Antarctic-interested states, including Cold War allies,[105] were prepared to compete with one another regarding overlapping sovereign claims, investing comparatively significant political, economic, and military resources (particularly considering the wider global competitive environment of the Cold War) on a mere possibility.[106] This state of affairs was largely driven by the hope of a future

[102] 1987 -1991 would see Arctic competition diminish as the USSR changed its policy to seeking a "zone of peace" for the region in the Murmansk Inititaive, and then went on to collapse. In the Antarctic 1959 would see the Antarctic Treaty signed, ending the escalatory competition that had been underway among claimant and claim-interested states since 1942. See KRISTIAN ÅTLAND, "Mikhail Gorbachev, the Murmansk Initiative, and the Desecuritization of Interstate: Relations in the Arctic," *Cooperation and Conflict* 43, no. 3 (September 2008): 289–311, https://www.jstor.org/stable/45084526.; Adrian Howkins, *Frozen Empires : An Environmental History of the Antarctic Peninsula* (New York: Oxford University Press, 2017).

[103] Ronald E. Doel et al., "Strategic Arctic Science: National Interests in Building Natural Knowledge – Interwar Era through the Cold War," *Journal of Historical Geography* 44 (April 2014): 60–80, https://doi.org/10.1016/j.jhg.2013.12.004.

[104] Samuel Jardine, "Climate Change and (In)Security Project Briefing Note," *Climate Change and (In)Security Project* (Oxford University Reuben College and Centre for Historical Analysis and Conflict Research, May 25, 2022), https://static1.squarespace.com/static/60800d20f65a1555173d7f03/t/628e0b321d9b7a3f35a648e3/1653476152084/Jardine.pdf.

[105] Despite their Cold War partnership, for instance, both Britain and the US were keen to shore up their Antarctic interests against one another; Kew National Archives (1957), FO 371/126125, Memo by Hankey on possible United States Claims in Antarctica, 11 February.

[106] The UK, Argentina, and Chile engaged in a costly "base race" competition with one another regarding whose physical presence could saturate their overlapping claims and so safeguard sovereignty. Likewise, the US and Russia both invested heavily at various points to expand their presences. Kew National Archives (1955), FO 371/113971, Foreign office Cabinet Paper on Antarctica, 26 January; Kew National Archives (1955), FO 371/113971, Antarctic Position by Brian Roberts, 13 January

economic dividend,[107] or the fear of being left out of one, with a rival taking full advantage.[108] The competition saw shots fired and risked the outbreak of war several times between varying claimants.[109] States like the UK, Chile, and Argentina were even willing to put at risk significant commercial relationships (that in the two decades after World War 2 were fundamental to national reconstruction)[110] in pursuit of what for all intents and purposes was an uninhabitable region, where permanently stationing humans in any significant way was and remains largely impossible. Indeed, the 1982 Falklands Wars were a direct hangover from the previous Antarctic competition, with the Falklands/Islas Malvinas and South Georgia being two regions excluded from the Antarctic Treaty System (ATS).[111]

A clear case study for a similar lunar environment was that states were willing to invest in environmentally hostile and capital-intensive regions that essentially had no currently tangible economic value and varying strategic appeal due to the hope, or fear, that they or a competitor might find a commercial or strategic advantage, and were then willing to significantly escalate the competition. The lunar environment is already subject to, as highlighted, increasing competition regarding regulatory regimes and governance frameworks and overlapping interests in potential operating regions.

In the Arctic and Antarctic, the competition was alleviated through the establishment of multilateral governance mechanisms that grew trust and established norms between actors. The former saw the establishment of the "Arctic Council"; not a legally binding treaty framework, but a forum for discussion for Arctic-related matters excluding security (which was deemed too contentious).[112] The Antarctic had the 1961 legally-binding Antarctic Treaty System (ATS); establishing what has been heralded as one of, if not the most, successful examples of an

[107] Kew National Archives (1957), FO 371/126125, Cabinet Office Report on Antarctica, 31 January
[108] Kew National Archives (1950), FO 371/81131, Admiralty Memo on the Antarctic's Strategic Considerations, 12 May.
[109] Samuel Jardine and Andrew Young, "The Geopolitics of Britain's Antarctic Empire 1942–1961 and Its Falklands Legacy," rusi.org, March 22, 2022, https://rusi.org/events/open-to-all/geopolitics-britains-antarctic-empire-1942-1961-and-its-falklands-legacy/.
[110] British Library (1949), IOR/L/E/8/6783, Argentina-UK Financial and Trade Negotiations.
[111] Klaus Dodds, *Pink Ice : Britain and the South Atlantic Empire* (London: I.B. Tauris, 2002).; Samuel Jardine and Andrew Young, "The Geopolitics of Britain's Antarctic Empire 1942–1961 and Its Falklands Legacy," rusi.org, March 22, 2022, https://rusi.org/events/open-to-all/geopolitics-britains-antarctic-empire-1942-1961-and-its-falklands-legacy/.
[112] Zhao Long, "Arctic Governance: Challenges and Opportunities," Council on Foreign Relations, November 29, 2016, https://www.cfr.org/report/arctic-governance.

international treaty,[113] and an "example of peaceful cooperation" for "the rest of the world".[114]

Both systems aimed to facilitate the development of a consensus-based community adhering to common norms or rulesets, and provide venues for platforming perspectives and discussion, acting as a safety valve to tensions through the transparent airing of issues. Critical to both is that the norms and rules had to be accepted or agreed upon by all participants to be workable, and so a compromise was inbuilt.

However, despite the commonly-held belief that both regions were due to their multilateral governance now somehow "exceptional" and removed from wider geopolitical spill-over[115], they have quickly become (Arctic)[116] or are becoming (Antarctic)[117] arenas of competition again in the current geopolitical environment. This is broadly because of four interlinked factors;

- Both governance systems find it difficult to accommodate a significant number of new stakeholders whose aims and understanding of the region are different from the original participants. In the Arctic, growing global interest has meant even prior to the 2022 Russian invasion of Ukraine, the region was

[113] Gillian Triggs, "The Antarctic Treaty System: A Model of Legal Creativity and Cooperation," *Science Diplomacy : Science, Antarctica, and the Governance of International Spaces*, 2011, 39–49, https://doi.org/10.5479/si.9781935623069.39.

[114] Peter J. Beck, "Fifty Years On: Putting the Antarctic Treaty into the History Books," *Polar Record* 46, no. 1 (October 19, 2009): 4–7, https://doi.org/10.1017/s0032247409990210.

[115] Kristina Spohr, Daniel S Hamilton, and Jason C Moyer, The Arctic and World Order (Washington, Dc: Foreign Policy Institute, Henry A. Kissinger Center For Global Affair, Washington, Dc, 2020), https://transatlanticrelations.org/wp-content/uploads/2020/12/The-Arctic-and-World-Order.pdf.; Gillian Triggs, "The Antarctic Treaty System: A Model of Legal Creativity and Cooperation," Science Diplomacy : Science, Antarctica, and the Governance of International Spaces, 2011, 39–49, https://doi.org/10.5479/si.9781935623069.39.

[116] Abhishek Saxena, "The Return of Great Power Competition to the Arctic," The Arctic Institute - Center for Circumpolar Security Studies, October 22, 2020, https://www.google.com/url?q=https://www.thearcticinstitute.org/return-great-power-competition-arctic/&sa=D&source=docs&ust=1676405161679783&usg=AOvVaw22B1I4RsbiNAl9t8PmhuM5.; Lillian Doc, James Valentine, and Andrew Kliskey, "Asymmetric Competition in the Arctic Implications for North American Defense and Security Great-Power Competition, Gray-Zone Warfare, and Hybrid Threats: Everything Old Is New Again," 2021, https://media.defense.gov/2021/Dec/12/2002907668/-1/-1/1/JIPA%20-%20Alessa%20et%20al.PDF.; "Changes in the Arctic: Background and Issues for Congress" (Congressional Research Service, March 24, 2022), https://sgp.fas.org/crs/misc/R41153.pdf.

[117] Elizabeth Buchanan and Ryan Burke, "Strategy and Competition at the Ends of the Earth - Modern War Institute," Modern War Institute at West Point, January 6, 2021, https://mwi.usma.edu/strategy-and-competition-at-the-ends-of-the-earth/.; Yelena Yermakova, "Legitimacy of the Antarctic Treaty System: Is It Time for a Reform?," The Polar Journal, September 10, 2021, 1–18, https://doi.org/10.1080/2154896x.2021.1977048.

becoming contested with a growing number of states pursuing their national interests within the area. For instance, China dubbed itself a "near Arctic" state in 2018 and while stating its support for the Arctic State's governance framework, Beijing has also noted that it has "rights" in the region which need to be respected by other Arctic actors in a way that is at odds with current governance norms.[118] In the Antarctic, the original signatories sought to prevent an escalating conflict between themselves. New signatories, however, many of which joined around the time of the 1980s mineral and exploitation talks,[119] lacked this particular context and interest. Instead, many joined based on reimagining Antarctic governance to be permissive to commercial exploitation.[120] This meant that filling in emerging governance gaps as they occur has become increasingly difficult due to diverging views on how the Antarctic should be managed, and what should be permitted within a system that relies entirely on consensus-based rulemaking.[121]

- Both systems' underlying features were unable to adapt to a waxing competitive environment. With both requiring cooperation and compromise to work, their continued relevancy and the modernization of increasing governance gaps were reliant on all participants continuing to have a shared interest in a particular vision. For the Arctic, that was sustainable development and environmental protection. For the Antarctic, environmental protection again and its utilization reserved as a continent for science.[122] With the expanding number of actors, new considerations came to the fore for both. In

[118] Samuel Jardine, "Brief: Lost in a Whiteout: Why the UK's Defence Arctic Strategy Needs to Be Published Soon," London Politica, March 16, 2022, https://londonpolitica.com/geopolitics-on-the-periphery-1/lost-in-a-whiteout-why-the-uks-defence-arctic-strategy-needs-to-be-published-soon.

[119] Samuel Jardine, "Climate Change and (In)Security Project Briefing Note," *Climate Change and (In)Security Project* (Oxford University Reuben College and Centre for Historical Analysis and Conflict Research, May 25, 2022), https://static1.squarespace.com/static/60800d20f65a1555173d7f03/t/628e0b321d9b7a3f35a648e3/1653476152084/Jardine.pdf.

[120] Anne-Marie Brady, "CHINA'S INTEREST in EXPLOITING ANTARCTIC RESOURCES," Australian Strategic Policy Institute, 2017, https://www.jstor.org/stable/resrep04257.10.; Klaus Dodds, "Ukraine: The Impact on International Collaboration in the Antarctic – Britain's World," Council on Geostrategy, July 6, 2022, https://www.geostrategy.org.uk/britains-world/ukraine-the-impact-on-russias-posture-and-international-collaboration-in-the-antarctic/.

[121] Yelena Yermakova, "Legitimacy of the Antarctic Treaty System: Is It Time for a Reform?," *The Polar Journal*, September 10, 2021, 1–18, https://doi.org/10.1080/2154896x.2021.1977048.

[122] "About the Arctic Council," Arctic Council, 2023, https://www.arctic-council.org/about/.; "The Antarctic Treaty," British Antarctic Survey, 2015, https://www.bas.ac.uk/about/antarctica/the-antarctic-treaty/.; "60 Years of the Antarctic Treaty – an International Success Story," German Federal Foreign Office, November 29, 2019, https://www.auswaertiges-amt.de/en/aussenpolitik/themen/60-years-antarctic-treaty/2283208#:~:text=It%20laid%20the%20foundations%20for.

the Arctic, wider geopolitical competition has meant that Russia even prior to Ukraine was militarizing the region and seeking strategic control.[123] The Arctic Council expressly forbade the discussion of security issues, and so there was no embedded multilateral outlet to voice such concerns. This is particularly problematic when dual-use and the civil-military fusion of current competition meant that a security lens was fundamental for open discussion, and so transparency, and trust building. The inflexibility of the Arctic Council meant that it could/would not offer a pathway for easy dialogue and discussion between members regarding new concerns around the civil-military fusion and grey zone competition, meaning that competition spilt over in the region, despite the Council still functioning as it had since the 1990s. The post-Ukraine invasion then saw the Arctic Council and the concept of a "one Arctic" approach collapse.[124]

In the Antarctic, the unanimous voting system has seen signatories with different interpretations or interests stall or block moves to adapt the ATS' coverage for a modern climate-change-impacted context.[125] This has then given space for such states to then push for a more exploitation-focussed approach and engage in prohibited activity,[126] which gradually diminishes the strength and legitimacy of the ATS, as needed mitigation requires unanimous consensus or compromise; positions that steadily favour

[123] Kaushal, Sidharth, James Byrne, Joe Byrne, Giangiuseppe Pili, and Gary Somerville. "The Balance of Power between Russia and NATO in the Arctic and High North." Royal United Services Institute, April 12, 2022.
https://rusi.org/explore-our-research/publications/whitehall-papers/balance-power-between-russia-and-nato-arctic-and-high-north.
;Eugene Rumer, Richard Sokolsky, and Paul Stronski, "Russia in the Arctic—a Critical Examination," Carnegie Endowment for International Peace, March 29, 2021,
https://carnegieendowment.org/2021/03/29/russia-in-arctic-critical-examination-pub-84181.
[124] Wilfrid Greaves, "The New Arctic Geopolitics," Royal United Services Institute, May 5, 2022,
https://rusi.org/explore-our-research/publications/commentary/new-arctic-geopolitics.
[125] Chelsea Harvey, "China and Russia Continue to Block Protections for Antarctica," Scientific American, November 29, 2022,
https://www.scientificamerican.com/article/china-and-russia-continue-to-block-protections-for-antarctica/.
[126] Anne-Marie Brady, "China Undeclared Foreign Policy at the Poles," Lowy Institute, May 17, 2017,
https://www.lowyinstitute.org/the-interpreter/china-s-undeclared-foreign-policy-poles.; Anne-Marie Brady, "CHINA'S EXPANDING ANTARCTIC INTERESTS: IMPLICATIONS for NEW ZEALAND" (Small States and the New Security Environment, 2017),
https://www.canterbury.ac.nz/media/documents/research/China%27s-expanding-Antarctic-interests.pdf.

exploitation-interested signatories.[127] The ATS, like the Arctic Council, is proving too inflexible to adapt to the changing nature of competition, or able to accommodate differing or changing viewpoints from a wider number of signatories.

- A lack of transparency. The inability of both systems to avoid being politicised and to hold actors accountable/facilitate discussions over security concerns has been exacerbated by the "grey zone" nature of modern geopolitical competition, where civil-military fusion and dual-use concerns make it difficult for actors to discern if an action is benign or has a competitive intent. This is then compounded by the lack of viable trust-building initiatives in either region.

  As such, in the Arctic, Chinese actions and particularly investments which could be perceived as attempts to build political influence,[128] have been met with suspicion by other actors. For instance, when the US prevented the Chinese-led construction of a civilian airport in Greenland,[129] escalated tensions between both sides. This was due to the US perceiving a "dual-use" threat from Beijing to its own Greenlandic Thule airbase, a key component of the US' northern defence.[130] Indeed, researchers at the Arctic Institute have highlighted that given the increasing competition and the number of actors operating in the region, a key escalatory flashpoint in the Arctic stems from "miscalculation and not understanding adversaries' intentions".[131] There is currently very little in terms of pan-Arctic frameworks to alleviate this.

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[127] Jiliang Chen, "Controversy over Russian Vessel in Antarctica Reveals CCAMLR Shortcomings," China Dialogue Ocean, January 11, 2021, https://chinadialogueocean.net/en/fisheries/15935-controversy-over-russian-vessel-in-antarctica-reveals-ccamlr-shortcomings/.; Jeffrey McGee, Bruno Arpi, and Andrew Jackson, "'Logrolling' in Antarctic Governance: Limits and Opportunities," *Polar Record* 56 (2020), https://doi.org/10.1017/s003224742000039x.

[128] Rush Doshi Zhang Alexis Dale-Huang, and Gaoqi, "Northern Expedition: China's Arctic Activities and Ambitions," Brookings, April 12, 2021, https://www.brookings.edu/research/northern-expedition-chinas-arctic-activities-and-ambitions/.

[129] Drew Hinshaw and Jeremy Page, "How the Pentagon Countered China's Designs on Greenland," *Wall Street Journal*, February 10, 2019, sec. World, https://www.wsj.com/articles/how-the-pentagon-countered-chinas-designs-on-greenland-11549812296.

[130] Jason Lemon, "China Wants to Build Greenland Airport," Newsweek, September 10, 2018, https://www.newsweek.com/china-wants-build-greenland-airport-might-threaten-us-military-base-experts-1114836.

[131] Alec Luhn, "Freezing Cold War: Militaries Move in as Arctic Ice Retreats," the Guardian, October 16, 2020, https://www.theguardian.com/environment/2020/oct/16/arctic-ice-retreats-climate-us-russian-canadian-chinese-military.

In the Antarctic, similar concerns over dual use for securitization/exploitation or for preparing potential sovereign claims at a later date present a difficult environment for trust to flourish between stakeholders.[132] Here again, the ATS is too slow and easily politicised to provide the needed transparency. Indeed, its mechanisms can be part of the problem with their utilization by signatories creating the perception among competitors of acting to undermine the system or support a particular interest as highlighted by Beijing justifying its fifth Antarctic base publicly solely on climate research grounds, while internally stating its "resource exploration" aims.[133]

- Growing commercial interest linked to strategic competition. Much of the increasing competition in both regions is linked to, once again, their potential future value rather than gaining tangible returns in the near future.

  In the Arctic, there are hopes, or fears, of significant seabed wealth,[134] alongside estimates of hydrocarbon and mineral resources that states like Russia explicitly see as a "strategic reserve". This means they will not be utilised yet, but instead, the Russian government particularly perceives them as key to Russia's future.[135] This is complemented by an interest in the Arctic potentially providing future cost-efficient shipping routes courtesy of climate change.[136]

  Both Arctic resources and shipping are tied up in strategic competition. The former are sought-after in the context of the strategic deglobalization of supply chains.[137] Likewise, new shipping routes are commercial but also

[132] Klaus Dodds, "Ukraine: The Impact on International Collaboration in the Antarctic – Britain's World," Council on Geostrategy, July 6, 2022, https://www.geostrategy.org.uk/britains-world/ukraine-the-impact-on-russias-posture-and-international-collaboration-in-the-antarctic/.
[133] Anne-Marie Brady, "CHINA'S EXPANDING ANTARCTIC INTERESTS: IMPLICATIONS for NEW ZEALAND" (Small States and the New Security Environment, 2017), https://www.canterbury.ac.nz/media/documents/research/China%27s-expanding-Antarctic-interests.pdf.
[134] Jon Copley, "Deep-Sea Mining Is Making the Seabed the Hottest Real Estate on Earth," New Scientist, November 4, 2020, https://www.newscientist.com/article/mg24833070-700-deep-sea-mining-is-making-the-seabed-the-hottest-real-estate-on-earth/.
[135] "Russian Gas Resources on Arctic Shelf Reach 85 Trillion Cubic Meters, Oil — 17 Bln Tons," TASS, November 28, 2022, https://tass.com/economy/1542911.; Atle Staalesen, "Putin: Our Future Lies in the Arctic," The Independent Barents Observer, June 16, 2017, https://thebarentsobserver.com/en/arctic/2017/06/putin-our-future-lies-arctic.
[136] Samuel Jardine, "Brief: Suez or the Arctic? The First Shot in the Future Battle over Global Shipping Routes Was Fired by Moscow," London Politica, April 1, 2021, https://londonpolitica.com/geopolitics-on-the-periphery-1/suez-or-the-arctic-the-first-shot-in-the-future-battle-over-global-shipping-routes-was-fired-by-moscow.
[137] Samuel Jardine, "Brief: The 2021 Greenlandic Election," London Politica, April 12, 2021, https://londonpolitica.com/geopolitics-on-the-periphery-1/2021s-greenlandic-election.

present new avenues for security competition, as highlighted by the UK's concern regarding China in the near future being able to send warships to the North Sea.[138]

In the Antarctic, all participants still hope for, or fear competitors, encountering a "resource bonanza".[139] Subsequently, all states are, within the framework of the ATS, positioning themselves to make sovereign claims over key areas.[140] Indeed, it is important to note that ATS signatories who are also claimants, or claims-interested, predominantly operate in their claimed areas as a means of maintaining the legitimacy of their potential claim.[141]

Key Point 1: Competition is currently favoured over concentrating on tackling universal existential challenges like climate change mitigation

Again then, while the Arctic and Antarctic are at the forefront of shared global security issues such as climate change which endangers both their environments and through ice melt could contribute to significant sea-rises threatening human life

[138] Dan Sabbagh, "China May Pose Threat to UK as Northern Sea Route Clears, Says Navy Chief," *The Guardian*, October 8, 2020, sec. UK news, https://www.theguardian.com/uk-news/2020/oct/08/china-strategic-threat-to-uk-as-northern-sea-route-clears-says-royal-navy-chief.; Another example are concerns that Russia will attempt to restrict non-partner shipping, bourne out by Russia militarizing and legislating to prevent foreign shipping operating in its claimed Arctic waters. See, Heather A. Conley, Matthew Melino, and Jon B. Alterman, "THE ICE CURTAIN: RUSSIA'S ARCTIC MILITARY PRESENCE," *Www.csis.org*, March 26, 2020, https://www.csis.org/analysis/ice-curtain-russias-arctic-military-presence.; Arild Moe, "A New Russian Policy for the Northern Sea Route? State Interests, Key Stakeholders and Economic Opportunities in Changing Times," *The Polar Journal* 10, no. 2 (July 2, 2020): 209–27, https://doi.org/10.1080/2154896x.2020.1799611.

[139] Samuel Jardine, "Climate Change and (In)Security Project Briefing Note," *Climate Change and (In)Security Project* (Oxford University Reuben College and Centre for Historical Analysis and Conflict Research, May 25, 2022), https://static1.squarespace.com/static/60800d20f65a1555173d7f03/t/628e0b321d9b7a3f35a648e3/1653476152084/Jardine.pdf.

[140] Shirley V. Scott, "Ingenious and Innocuous? Article IV of the Antarctic Treaty as Imperialism," *The Polar Journal* 1, no. 1 (June 2011): 51–62, https://doi.org/10.1080/2154896x.2011.568787.; Anne-Marie Brady, "SPECIAL REPORT China's Expanding Antarctic Interests Implications for Australia" (Australian Strategic Policy Institute, 2017), https://ad-aspi.s3.ap-southeast-2.amazonaws.com/2017-08/SR109%20Chinas%20expanding%20interests%20in%20Antarctica.pdf?VersionId=L_qDGafveA4ogNHB6K08cq86VoEzKQc.

[141] Out of the 110 main scientific facilities on the continent, only 2 are joint stations. This is due to their continuing dual use as sovereign presences to maintain, or if needed, make sovereign claims. Alan D. Hemmings, "Why Did We Get an International Space Station before an International Antarctic Station?," *The Polar Journal* 1, no. 1 (June 2011): 5–16, https://doi.org/10.1080/2154896x.2011.569377.; This is a link that most Antarctic-interested states are very open about, even regarding their own activities; Jane Francis, Henry Burgess, and Linda Capper, "Written Evidence Submitted by the British Antarctic Survey and NERC Arctic Office (CLI0009)," Houses of Parliament, May 2020, https://committees.parliament.uk/writtenevidence/3904/pdf/.

and infrastructure at a global level.[142] Cooperative approaches despite this, take second fiddle or are actively hampered in favour of the competitive politicization of these regions. For the lunar environment, this highlights explicitly that it cannot be taken for granted (especially when the stalling over ASAT weapons is considered) that actors will naturally cooperate due to the Moon's hostile environment, or it being in their best interests to do so. A framework needs to be established to promote this goal; one that is resilient to competition, is not invasive regarding sovereign action and interests, and that can promote trust-building between actors.

A Lunar Objects and Activities Registry, as will be highlighted, would be a key step in facilitating this process.

Key Point 2: Preparing for geopolitical competition as a baseline

National governments, as in each region's historical context, are again willing to significantly invest political and financial capital for potential future gains (of which there is currently scant hard evidence) in the hope to secure an advantage, or, out of fear that a rival will. They, moreover, have no issues in dismantling or undermining cooperative legal and other governance frameworks if they are not resilient to the current nature of competition.

Indeed, a key issue for both regions in their shift to being competitive environments is that the multilateral structures put in place were outdated and unable to adapt to a changing competitive environment, be it the legally binding ATS whose unanimous approach meant a larger pool of participants with differing viewpoints would see it unable to fill governance gaps effectively. Similarly, the Arctic Council refusing to allow security-based discussions meant there was no pressure valve for states to publicly utilise, particularly in the grey-zone context of modern geopolitical competition.

Why this matters for the lunar environment

The Arctic and Antarctic present historic and current lessons for what can be expected of the lunar environment, given the increasing geopolitical competition between states. It highlights that no environment, no matter how hostile or expensive, is off-limits to geopolitical competition and its spillover. Also, governments are willing to invest significant political, financial, and security capital and imperil international relationships, risk escalation and cooperation surrounding universal harms like climate change, and undermine consensus-based multilateral structures

[142] Eric Post et al., "The Polar Regions in a 2°c Warmer World," *Science Advances* 5, no. 12 (December 2019): eaaw9883, https://doi.org/10.1126/sciadv.aaw9883.

in pursuit of their national interests; even if these interests are currently intangible and merely a hoped-for, or feared, economic or strategic advantage in the future.

Geopolitical spill-over is already happening in space, NATO in 2019 labelled space an "operational domain",[143] which in reality is a recognition of how most state actors have perceived space since humans began operating infrastructure in orbit.[144] China and the US have gone further, with the former referring to space as the "new commanding heights" of international strategic competition, and the latter defining space as a "war-fighting domain" whose Space Force is building the capacity for cislunar-related capability.[145] The lunar environment itself then should expect to be subjected to these same issues and concerns, especially given its contextual similarities to the polar regions:

- **The increasing democratization through falling costs and technological development of access to the lunar surface and orbit**

  This will see an increasingly wide array of actors, just like the Antarctic and Arctic, with each new participant having different interests that may not be compatible with others.

- **A potential lack of transparency regarding lunar operations from all actors, exacerbated by the for-now limited areas of interest on the lunar surface**

  This in the context of geopolitical competition will mean, like the Arctic and Antarctic, concerns surrounding civil-military fusion and dual-use will be an ever-present consideration, with the perception of a state's activity to others mattering more than its stated intent. The Arctic and Antarctic's

[143] "NATO's Overarching Space Policy," NATO, January 17, 2022, https://www.nato.int/cps/en/natohq/official_texts_190862.htm.
[144] Bleddyn E Bowen, *Original Sin: Power, Technology and War in Outer Space* (Oxford University Press, 2023).
[145] Theresa Hitchens, "To Infinity and Beyond: New Space Force Unit to Monitor 'XGEO' beyond Earth's Orbit," Breaking Defense, April 21, 2022, https://breakingdefense.com/2022/04/to-infinity-and-beyond-new-space-force-unit-to-monitor-xgeo-beyond-earths-orbit/.; "Chapter 4 Section 3 - China's Ambitions in Space - Contesting the Final Frontier," U.S. - China Economic and Security Review Commission, 2019, https://www.uscc.gov/sites/default/files/2019-11/Chapter%204%20Section%203%20-%20China%E2%80%99s%20Ambitions%20in%20Space%20-%20Contesting%20the%20Final%20Frontier.pdf.; Bruce W. MacDonald, Carla Freeman, and Alison McFarland, "China and Strategic Instability in Space: Pathways to Peace in an Era of US-China Strategic Competition," United States Institute of Peace, February 9, 2023, https://www.usip.org/publications/2023/02/china-and-strategic-instability-space-pathways-peace-era-us-china-strategic.

consensus-based multilateral systems have so far been unable to provide new trust-building initiatives between states to constrain this issue in their regions. In the lunar environment, this will likely be compounded by the two major competitors having additional legislative barriers; mainly the US' 2011 "Wolf Amendment" which hinders NASA's ability to pursue cooperative and collaborative projects with their Chinese counterparts.[146] This limits a traditional tool for building trust and transparency- mainly operating alongside one another or directly observing the activity.

- **The OST, like the ATS, makes sovereign claims over the lunar surface legally unrecognised. However, in practice states in the Antarctic manoeuvre to de-facto control areas and restrict the access of competitors regardless**

  This can be seen in Beijing's attempt to create a "Specially Managed Area" around its Kunlun station. This gives special dispenzation to control access to an area and is conventionally reserved for when states are geographically operating close together to protect the environment. At Kunlun, China is the only presence.[147] Likewise, though, other Antarctic claimant states often propose Marine Protected Areas that coincide with their currently unrecognised claimed areas. This both restricts access and protects the area from activity by other states, preserving resources.[148] These actions are often part of a claimant's, and those actors like the US, China, and Russia who reserve the right to make Antarctic claims',[149] process of preparing the ground for a potential sovereign claim if required at a future date given the emphasis

[146] "Bad Idea: The Wolf Amendment (Limiting Collaboration with China in Space)," *The Center for Strategic and International Studies*, December 4, 2019, https://www.csis.org/analysis/bad-idea-wolf-amendment-limiting-collaboration-china-space.
[147]Nengye Liu, "The Heights of China's Ambition in Antarctica | Lowy Institute," Lowy Institute, July 11, 2019, https://www.google.com/url?q=https://www.lowyinstitute.org/the-interpreter/heights-china-s-ambition-antarctica&sa=D&source=docs&ust=1676416946547508&usg=AOvVaw0dpe3glc5Od9npjo_3BFZN.; Anne-Marie Brady, "SPECIAL REPORT China's Expanding Antarctic Interests Implications for Australia" (Australian Strategic Policy Institute, 2017), https://ad-aspi.s3.ap-southeast-2.amazonaws.com/2017-08/SR109%20Chinas%20expanding%20interests%20in%20Antarctica.pdf?VersionId=L_qDGafveA4ogNHB6K08cq86VoEzKQc.
[148] Klaus Dodds and Cassandra Brooks, "Antarctic Geopolitics and the Ross Sea Marine Protected Area," E-International Relations, February 20, 2018, https://www.e-ir.info/2018/02/20/antarctic-geopolitics-and-the-ross-sea-marine-protected-area/.
[149] Anne-Marie Brady, "CHINA'S EXPANDING ANTARCTIC PRESENCE," Australian Strategic Policy Institute, 2017, https://www.jstor.org/stable/resrep04257.7.; "Antarctic Region," United States Department of State, 2019, https://www.state.gov/key-topics-office-of-ocean-and-polar-affairs/antarctic/.; Mathieu Boulegue, "The Militarization of Russian Polar Politics," Chatham House, June 6, 2022, https://www.chathamhouse.org/2022/06/militarization-russian-polar-politics/01-introduction-drivers-russian-polar-interests.

physical presence and activity has in legitimising such potential claims.[150] With this in mind, activity, physical presence and the way regulatory tools like the Artemis Accord's safety zones might be utilised will have a dual-use implication, or perception of that, which state actors will be wary of. This will hinder cooperation and bring politicization directly to the lunar environment.

- **Multilateral consent-based mechanisms that sought to restrain competition, like the ATS, need to be flexible**

  The ATS was highly successful in curtailing what was until 1959 escalating into a military-driven competition and instead shifting the method of competing towards more productive and safer concurrent avenues like scientific research and physical presence. However, its legally-binding consent-based nature has left it unable to adapt in a new context of multipolar competition where competing states are willing to use treaty systems for their own gain and prevent needed modernization for the ATS to incorporate climate change mitigation.[151] This is exacerbated by ATS consent-based governance having to incorporate an increasingly diverse range of views and interests from newer signatories not sharing the same founding interests as the original signatories; meaning that any discussion on the treaty's future is contested and so stalls, or indeed could become a potential political flashpoint in future; warping the ATS from competition restrainer to issue itself. This lesson should be carefully considered regarding attempts to construct lunar governance frameworks. Resilience is provided through slow gradual steps towards promoting a coherent set of values and vision between all current and potential stakeholders which allows flexibility to be retained to better adapt to changing political environments.

Related Emerging Issues for the Lunar Environment:

Coinciding with the lessons which the Polar regions and current geopolitical competition on earth and in space can provide us for challenges in the lunar environment are several other lunar-specific issues rooted in this context.

Lawfare and Politicised Treaties

Multilateral legal treaties like the ATS are increasingly under pressure from competition and being wielded as a tool to further national interests. This is exacerbated by states being increasingly prepared to ignore multilateral agreements

[150] Shirley V. Scott, "Ingenious and Innocuous? Article IV of the Antarctic Treaty as Imperialism," *The Polar Journal* 1, no. 1 (June 2011): 51–62, https://doi.org/10.1080/2154896x.2011.568787.
[151] "Reform the Antarctic Treaty," *Nature* 558, no. 161 (June 13, 2018): 161–61, https://doi.org/10.1038/d41586-018-05368-7.

to which they are signatories when it suits their interests.[152] This is complemented by the ready-politicization of what should be universally cooperative areas of space policy, such as ASAT weapons. This has created a political environment where it is unlikely that the lunar landscape will be conducive to legally binding treaties and frameworks. Specifically, due to the lack of trust and transparency between competing states, both generally, and regarding the lunar environment.[153]

Emergence of a "Bloc" Approach to Regulatory Frameworks

Currently, the OST is incredibly broad, with its articles open to different interpretations.[154] For instance, while it forbids claims of sovereignty "by use or occupation, or by any other means" it leaves a "gap" regarding commercial exploitation. The later 1979 Moon Agreement which styled itself as expanding the OST, attempted to fill this gap unsuccessfully by barring all exploitation of resources on celestial bodies.[155] Subsequently, and in opposition to this,[156] while also claiming to be in keeping with the OST the Artemis Accords' Sections 10 and 11 on resource exploitation and safety zones sought to implement a way to conduct commercial exploitation of celestial objects. This however created legal and political controversy regarding the Artemis-OST relationship.[157] With this criticism, often stemming from geopolitical competitors to the US,[158] other major states are now seeking to create

[152] Bryce Baschuk, "US Snub of WTO Ruling Marks a 'Step Back' in Era of Free Trade," *Bloomberg*, December 12, 2022, https://www.bloomberg.com/news/newsletters/2022-12-12/supply-chain-latest-us-snub-of-wto-called-a-step-back-for-trade.; Tom Phillips, Oliver Holmes, and Owen Bowcott, "Beijing Rejects Tribunal's Ruling in South China Sea Case," the Guardian, November 28, 2017, https://www.theguardian.com/world/2016/jul/12/philippines-wins-south-china-sea-case-against-china.

[153] "NASA Chief Rues Chinese Lack of Transparency in Space Operations," *The Times of India*, April 27, 2022, https://timesofindia.indiatimes.com/world/us/nasa-chief-rues-chinese-lack-of-transparency-in-space-operations/articleshow/91114941.cms.

[154] Sophie Goguichvili et al., "The Global Legal Landscape of Space: Who Writes the Rules on the Final Frontier? | Wilson Center," Wilson Center, October 1, 2021, https://www.wilsoncenter.org/article/global-legal-landscape-space-who-writes-rules-final-frontier.

[155] "Moon Agreement," United Nations Office for Outer Space Affairs, 1979, https://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introMoon-agreement.html.

[156] Scott Atkins et al., "Governance in Outer Space: The Case for a New Global Order," Norton Rose Fulbright, November 2022, https://www.nortonrosefulbright.com/en/knowledge/publications/e8862684/governance-in-outer-space-the-case-for-a-new-global-order.

[157]Alexander Stirn, "Do NASA's Lunar Exploration Rules Violate Space Law?," Scientific American, November 12, 2020, https://www.scientificamerican.com/article/do-nasas-lunar-exploration-rules-violate-space-law/.

[158] Elliot Ji, Michael B. Cerny, and Raphael J. Piliero, "What Does China Think about NASA's Artemis Accords?," The Diplomat, September 17, 2020, https://thediplomat.com/2020/09/what-does-china-think-about-nasas-artemis-accords/.

their own potentially competing regulatory regimes-[159] again drawing on the OST, but which like the Moon Agreement and Artemis Accords runs the risk of not being compatible with the expanded regulations used by other blocs.

The emergence of such potentially competing regulatory blocs from a universal multilateral agreement has precedent. This is the same situation that has evolved in the Arctic and increasingly the Antarctic. In the former, the Arctic Council's "One Arctic" has fragmented into "West" and "East"-facing Arctic based around NATO and an increasing China-Russia partnership whose development and regulation are heading in different directions,[160] and has seen controversies emerge regarding access, and resource management.[161] In the latter, a growing dispute between ATS signatories which seek to maintain the ATS and traditional vision of the Antarctic as a continent for science and environmental conservation for as long as possible is arrayed against those who want to shift the ATS and Antarctic towards a commercially active region.[162]

A Delicate Balance

Any of the mentioned risks and case studies in this section if applied to a lunar context could spark a political crisis on Earth with potentially escalatory consequences between participants. Particularly as competitors states are already planning to securitize the lunar environment or fear others doing so.[163] The perception that activities might have a dual-use political-security angle to them alongside any stated economic or scientific aims will be difficult to shake, particularly due to the lack of any serious "neutral" monitoring frameworks. This means that lunar activity which might be key to a state or private sector actor's interests or aims

[159] "International Lunar Research Station (ILRS) Guide for Partnership," China National Space Administration, June 16, 2021, http://www.cnsa.gov.cn/english/n6465652/n6465653/c6812150/content.html.; Rajeswari Pillai Rajagopalan, "The Artemis Accords and Global Lunar Governance," The Diplomat, June 7, 2021, https://thediplomat.com/2021/06/the-artemis-accords-and-global-lunar-governance/.
[160] Wilfrid Greaves, "The New Arctic Geopolitics," Royal United Services Institute, May 5, 2022, https://rusi.org/explore-our-research/publications/commentary/new-arctic-geopolitics.
[161] Samuel Jardine, "Brief: Lost in a Whiteout: Why the UK's Defence Arctic Strategy Needs to Be Published Soon," London Politica, March 16, 2022, https://londonpolitica.com/geopolitics-on-the-periphery-1/lost-in-a-whiteout-why-the-uks-defence-arctic-strategy-needs-to-be-published-soon.
[162] Klaus Dodds, *Border Wars - the Conflicts That Will Define Our Future*. (New York: Penguin, 2022).
[163] Bryan Bender, "Moon Battle: New Space Force Plans Raise Fears over Militarizing the Lunar Surface," POLITICO, December 3, 2022, https://www.politico.com/news/2022/03/12/space-force-Moon-pentagon-00016818.; Laura Duffy and James Lake, "Cislunar Spacepower the New Frontier," Space Force Journal, December 31, 2021, https://www.google.com/url?q=https://spaceforcejournal.org/3859-2/&sa=D&source=docs&ust=1676418107741347&usg=AOvVaw2m8NpXb9s50An_5QlZWQYO.

can also be a channel for intentional, or more likely, unintentional escalation in the current environment.

Emerging Opportunities within this Competitive Lunar-Earth Environment

The increasingly competitive geopolitical environment informing and indeed driving the relationships of state actors on earth and in space is not merely a contextual barrier to be accepted and understood. Indeed, this environment presents several opportunities for the pursuit of cooperative governance frameworks and initiatives that would otherwise be unavailable, specifically regarding the democratization of governance frameworks.

Decentralization Is Not Fragmentation (Yet)

As established, the current geopolitical competition is not largely over ideology, but pertains to differing approaches to global governance that closer-match the national aims and interests of those states purporting them. As such, a fragmentation of global governance frameworks and international multilateralism into bipolar or multipolar systems is not the intention of competitors; though it may become a consequence of such competition.

Currently, geopolitical competition might be best described as having decentralized globalization, and the international community, rather than fragmenting it. This is because there has been a re-focusing on protecting national sovereignty and interests, rather than outsourcing it within the context of multilateral institutions.

For example, while the US and China ignore decisions that went against them from the World Trade Organization or at a UN Tribunal on the grounds that it would restrict their sovereign action and national interests,[164] neither state has left these institutions. Instead, both continue to utilise them in other spheres. The worst that is happening appears to be their attempts to gradually reform such institutions to their advantage.[165] While this may be deemed hypocrisy, it also showcases that competitor states are not willing to simply walk away altogether from the international order,

[164] Bryce Baschuk, "US Snub of WTO Ruling Marks a 'Step Back' in Era of Free Trade," *Bloomberg*, December 12, 2022, https://www.bloomberg.com/news/newsletters/2022-12-12/supply-chain-latest-us-snub-of-wto-called-a-step-back-for-trade.; Pratik Jakhar, "Whatever Happened to the South China Sea Ruling?," Lowy Institute, July 12, 2021, https://www.lowyinstitute.org/the-interpreter/whatever-happened-south-china-sea-ruling.

[165] Stephanie Nebehay, "U.S. Seals Demise of WTO Appeals Bench - Trade Officials," *Reuters*, December 9, 2019, sec. Industry, Materials and Utilities, https://www.reuters.com/article/trade-wto/u-s-seals-demise-of-wto-appeals-bench-trade-officials-idUSL8N28J3L6.

shattering the world into fragmented blocs; even if simply because it means relinquishing their influence in that community.

Similarly, it is why the ATS, despite the current pressure between opposing perspectives has not merely collapsed, but instead, competitor states are willing to largely compete with one another within its restrictions, albeit using the ATS itself in ways not intended to shore up their position. Unlike the Arctic Council indeed, the ATS with Russia as a member has continued despite Russia's invasion of Ukraine.[166] Certainly, there has been no return to the militarized competition of the 1942-1959 era.[167]

Indeed, despite the growing competition and perceptions of a new "Space Race", cooperation in the high frontier has not ceased. While elements are increasing;y politicised, down to rocket launches,[168] cooperation does continue in certain key areas. For example, NASA and China's CNSA discuss the exchange of ephemeris data for key missions, and against the backdrop of the Ukraine war, NASA and Roscosmos agreed to integrate flights to the International Space Station.[169] Cooperation then can still happen even between competing powers. It largely just needs to be regarding issues where perceptions of "dual use" are low, and so it circumvents the lack of trust between competing powers. This alongside the politicization potential of such issues ideally being low; both in itself, and in terms of states making it a tool of competition being undesirable due to the lack of impact it would have on the competitive landscape, or the potential for such a move to backfire in the perceptions of other neutral actors.

The Rise of Norms

Similarly, in such an environment, while legally binding treaties are subject to politicization, making their creation or updating difficult, if not impossible,

[166] Evan T. Bloom, "No. 16 | Antarctic Treaty System Shows Resilience in the Face of Ukraine War Tensions | Wilson Center," Wilson Center, November 10, 2022, https://www.wilsoncenter.org/blog-post/no-16-antarctic-treaty-system-shows-resilience-face-ukraine-war-tensions.

[167] Adrian Howkins, *Frozen Empires : An Environmental History of the Antarctic Peninsula* (New York: Oxford University Press, 2017).

[168] Chelsea Gohd, "Russia Refuses to Launch UK's OneWeb Satellites Unless Demands Are Met," Space.com, March 2, 2022, https://www.space.com/russia-refuses-launch-oneweb-satellites-demands.

[169] "CNSA and NASA Held Discussions on Exchanging the Ephemeris Data of Mars Spacecraft," China National Space Administration, March 31, 2021, http://www.cnsa.gov.cn/english/n6465668/n6465670/c6811473/content.html.; Joey Roulette, "NASA, Russian Space Agency Sign Deal to Share Space Station Flights - Roscosmos," *Reuters*, July 15, 2022, sec. Aerospace & Defense, https://www.reuters.com/business/aerospace-defense/nasa-russian-space-agency-sign-deal-share-space-station-flights-roscosmos-2022-07-15/.

exacerbated by a focus on sovereign interests and concerns surrounding the intentions of other actors, the opportunity presents for "normative behaviours" to take the lead. This is because it is easier in this environment to get actors to buy in than push them to adhere.[170]

Norms are widely shared expectations about what constitutes appropriate behaviour by a community of actors.[171] They seek to attempt to guide "desirable behaviour" through non-binding frameworks. Often these can lay the foundations for more comprehensive measures or even legally binding agreements down the road.[172] They are thus both building blocks, and a replacement for enhancing and expanding cooperation in a decentralised geopolitically competitive global landscape, as we have now.

An example can be found with a non-state intergovernmental actor - the International Atomic Energy Agency's (IAEA), facilitation and normalization of the voluntary reporting by states of new reactors and civilian plutonium stockpiles to be publicly shared on its registry and database.[173] These measures have had a wide uptake and the transparency of these declarations officiated by an independent intergovernmental organization linked to the UN, has helped defuse and establish norms surrounding an expectation that actors would transparently and voluntarily engage as part of the IAEA's wider normative trust-building frameworks surrounding nuclear material, and so provide other actors with a needed baseline of confidence in competitors having access to such capability.

In 2017 China actually ceased to provide the IAEA with this information, and while this highlights the fragility of norms, particularly when geopolitical competition is on the rise; the fact that this raised the alarm among the international community and

[170] Juliana Suess, "Episode 21: Space Tech Innovation and Regulations – a Game of Catch-Up?," Royal United Services Institute, October 3, 3AD, https://rusi.org/podcasts/war-in-space/episode-21-space-tech-innovation-and-regulations-game-catch.
[171] "The Future of International Norms: US-Backed International Norms Increasingly Contested," Office of the Director of National Intelligence, March 2021, https://www.dni.gov/index.php/gt2040-home/gt2040-deeper-looks/future-of-international-norms.
[172] Samuel Jardine, "Building Lunar Security and Cooperation through an Astropolitical Lens- the Role of Normative Behaviours in Creating Stability.," Open Lunar Foundation, November 10, 2022, https://www.openlunar.org/library/open-lunar-registry-project-blog-post-series-blog-1.
[173] "Communication Received from Certain Member States Concerning Their Policies Regarding the Management of Plutonium," International Atomic Energy Agency, March 16, 1998, https://www.iaea.org/publications/documents/infcircs/communication-received-certain-member-states-concerning-their-policies-regarding-management-plutonium.; "Research Reactor Database (RRDB)," International Atomic Energy Authority, February 1, 2019, https://www.iaea.org/resources/databases/research-reactor-database-rrdb#:~:text=The%20IAEA%27s%20Research%20Reactor%20Database.

signposted a potential change in nuclear policy from a major state,[174] has allowed adjustment and pressure to be brought to bear.[175] This highlights the value of having norms in place to act as a red line and their flexibility in shifting to ensure de-escalation remains a priority. Indeed, China has felt the need to engage in dialogue due to reactions to its shift, the outcome of which will likely see a new norm established with a different supporting framework to prevent escalation down the line.[176]

Norms can also be used incrementally in a way that can create a cooperative framework for all concerned actors without the usual "all or nothing" approach represented by legally binding multilateral treaties like the ATS, whose success relied on all participants signing, with the alternative being the continued escalation of Antarctic competition.[177] With norms, cooperative efforts can organically grow at a pace actors need and are comfortable with, without politicization bringing the updating of multilateral treaties to suit changing environments to a stall as has happened with the modern ATS.[178] This is likely to suit an emerging lunar environment far better as norms can be more easily developed and made adaptable.

The Democratization of Governance-making Efforts

A benefit to relying on norms as the basis for creating cooperation between competing actors in a decentralising environment is that it creates a space for non-state or alternative actors like non-governmental or intergovernmental organizations to have a direct hand in shaping governance frameworks through their own norm-creation efforts; which otherwise might have been ignored in favour of state-led solutions. A key example of this can be seen within nuclear energy politics

[174] "Concerns Grow over China Nuclear Reactors Shrouded in Mystery," Al Jazeera, May 19, 2021, https://www.aljazeera.com/economy/2021/5/19/concerns-grow-over-china-nuclear-reactors-shrouded-in-mystery.

[175] Shannon Bugos, "Pentagon Sees Faster Chinese Nuclear Expansion | Arms Control Association," Arms Control Association, December 2021, https://www.armscontrol.org/act/2021-12/news/pentagon-sees-faster-chinese-nuclear-expansion.; "Joint Statement of the Leaders of the Five Nuclear-Weapon States on Preventing Nuclear War and Avoiding Arms Races," The White House, January 3, 2022, https://www.whitehouse.gov/briefing-room/statements-releases/2022/01/03/p5-statement-on-preventing-nuclear-war-and-avoiding-arms-races/.

[176] George Perkovich, "Engaging China on Strategic Stability and Mutual Vulnerability," Carnegie Endowment for International Peace, October 12, 2022, https://www.google.com/url?q=https://carnegieendowment.org/2022/10/12/engaging-china-on-strategic-stability-and-mutual-vulnerability-pub-88142&sa=D&source=docs&ust=1676419024671556&usg=AOvVaw1oYH-kQ8boQ3aLWfsoHkRh.

[177] Kew National Archives (1958), FO 371/131917, Memo On Meeting of the Six, 5 December; Kew National Archives (1957), FO 371/126129, Report on Quadripartite Talks, 8 November.

[178] Daniela Liggett, "An Erosion of Confidence? The Antarctic Treaty System in the Twenty-First Century," *Diplomacy on Ice*, January 13, 2015, 61–71, https://doi.org/10.12987/yale/9780300205169.003.0004.

and the "Additional Protocol" of the independent International Atomic Energy Agency (IAEA).

The protocol is not a norm itself but is the framework for promoting one, specifically of the expectation that actors will utilise it as a transparency (and so trust-building) measure. It is a voluntary safeguard which is different from, though compliments, the other legally binding agreements which the IAEA has centred around the 1970 Nuclear Non-Proliferation Treaty (NPT).[179] In it, the signatory agrees to provide the IAEA with the needed data and samples for them to verify that the signatories' use of nuclear material is "peaceful" in nature.[180] Currently, 139 states adhere to this protocol, with 13 more in the process of signing up, out of the 191 states who joined the NPT.[181]

The Additional Protocol has, through the normalization of this information from major nuclear-capable states, helped realise the widespread development, sharing, usage, and diffusion of civilian nuclear technology without, by and large, the triggering of significant security escalations and arms races between states who may otherwise be alarmed.[182] Its creation of this norm of expected transparency has acted as part of a safeguard and trust-building mechanism and is particularly a triumph considering that nuclear technology is easily blurred between civilian and military applications.[183]

That non-state actors like the IAEA can be given the space to create and then maintain key norms-based governance frameworks successfully regarding one of the most competitive and potentially militarized of spheres, highlights the openings for non-state actors in competitive environments. The lunar environment is no different.

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[179] United Nations, "Treaty on the Non-Proliferation of Nuclear Weapons (NPT)," United Nations, 2022, https://www.un.org/disarmament/wmd/nuclear/npt/.

[180] "Model Protocol Additional to the Agreement(S) between State(S) and the International Atomic Energy Agency for the Application of Safeguards," International Atomic Energy Agency, September 1, 1997, https://www.iaea.org/publications/documents/infcircs/model-protocol-additional-agreements-between-states-and-international-atomic-energy-agency-application-safeguards.

[181] "Additional Protocol," International Atomic Energy Agency, June 8, 2016, https://www.iaea.org/topics/additional-protocol.; United Nations, "Treaty on the Non-Proliferation of Nuclear Weapons (NPT)," United Nations, 2022, https://www.un.org/disarmament/wmd/nuclear/npt/.

[182] "Nuclear Power Today | Nuclear Energy," World Nuclear Association, 2022, https://world-nuclear.org/information-library/current-and-future-generation/nuclear-power-in-the-world-today.aspx.; Anna Schumann, "Fact Sheet: Nuclear Non-Proliferation Treaty (NPT)," Center for Arms Control and Non-Proliferation, April 14, 2017, https://www.google.com/url?q=https://armscontrolcenter.org/fact-sheet-nuclear-non-proliferation-treaty-npt/&sa=D&source=docs&ust=1676419529684893&usg=AOvVaw0aZSXPrso3YtWE_oExOX9i.

[183] Mark Hibbs, "Congressional Testimony: China's Nuclear Forces," Carnegie Endowment for International Peace, June 10, 2021, https://carnegieendowment.org/files/202106-CHINA_USCC_WRITTEN_TEXT_FINAL_.pdf.

Current geopolitical competition between states as has been highlighted hampers their ability to compromise and agree on even points of clear mutual interest due to politicization, dual-use, and trust concerns. It is here that neutral non-state actors can make their mark, by providing the solutions which competing states would like to agree to, in a way that does not bind states or impinge on their ability to act competitively (i.e. through frameworks that create norms which can be building blocks to trust and a cooperative environment at a later date, such as transparency).[184]

Indeed, the circumstances of geopolitical competition might make states more receptive to non-state-led norm creation as states are keen, from a reputational perspective, to be seen as legitimate and important international actors who are perceived to operate in good faith. It is why a state's governing apparatus is often keen to justify its positions to internal and external audiences,[185] or mitigate reputational damage.[186] In this context, a norm-creating initiative by a politically neutral transnational non-state actor could be well received, courtesy of states not wishing to be left out politically. The NPT provides an easy example of this, with the treaty becoming "near-universal" with its adoption by states who were enticed to join partly on the basis that larger powers were already signatories.[187]

Enter the Registry- Transparency as a Restraint on Excessive Escalation

The pursuit of transparency as a normative behaviour for international relations in nearly all arenas is a key building block to establishing a baseline that aids in restraining the excess of competition and escalation.[188] It does this by helping ease potential security dilemmas and limiting the scope for misunderstandings around intent through sharing specific information regarding a state's activity or intent (and by that, their interests). This helps avoid diplomatic, policy, or political flashpoints that

[184] Samuel Jardine, "Building Lunar Security and Cooperation through an Astropolitcal Lens- How to Construct Normative Behaviours on the Moon- Enter the Registry," Open Lunar Foundation, December 16, 2022, https://www.openlunar.org/library/open-lunar-registry-project-blog-post-series-blog-4.
[185] For instance, Beijing-associated media attempted to downplay revelations about the expansion of China's nuclear arsenal by arguing the US evidence is actually of new Chinese Wind Farms. See, "美智库再次炒作中国新建核弹发射井 总数达250个|核弹|发射井_新浪军事_新浪网," mil.news.sina.com.cn, July 27, 2021, https://mil.news.sina.com.cn/china/2021-07-27/doc-ikqciyzk7932267.shtml.
[186] Kristin Haugevik and Cecilie Basberg Neumann, "Reputation Crisis Management and the State: Theorising Containment as Diplomatic Mode," *European Journal of International Relations* 27, no. 3 (April 21, 2021): 708–29, https://doi.org/10.1177/13540661211008213.
[187] Nobuyasu Abe, "The NPT at Fifty: Successes and Failures," *Journal for Peace and Nuclear Disarmament* 3, no. 2 (September 30, 2020): 224–33, https://doi.org/10.1080/25751654.2020.1824500.
[188] Daniel R. McCarthy and Matthew Fluck, "The Concept of Transparency in International Relations: Towards a Critical Approach," *European Journal of International Relations* 23, no. 2 (June 16, 2016): 416–40, https://doi.org/10.1177/1354066116651688.

stem from knee-jerk reactions or surprises leading to a drop in confidence surrounding a competitor's intent.[189] For this reason, generally, it is something that both democratic and authoritarian-leaning states wish to engage in at the global level in most areas.[190] Indeed, even in the context of competitive activity, a level of transparency regarding competitors is usually desired by the initiating states.

An example of this is NATO's yearly large-scale Cold Response military exercises in the Arctic. They have a deterrence purpose through showcasing NATO capability publicly, but of course, such large manoeuvres near Russia's borders could be deemed highly escalatory. To avoid this, NATO sends yearly invitations for Russian observers to participate and gives advance public warning.[191] Likewise, Russia notifies the US when it undertakes a missile test; while this is a competitive-based display of power and capability there is a wish to ensure, even during a very high-stakes conflict and competition surrounding Ukraine, that intent is clear and knee-jerk responses avoided.[192]

Communication and open sharing of information, however, limited, in pursuit of a degree of transparency between competitors is also a trust-building measure between competitive states. Establishing this link, however limited, provides a baseline to build wider frameworks over time from, if not cooperative in nature, at least can set wider limits on the nature of competition in this area. Such as how the ATS was able to shift the increasingly militarized competition in the pre-1959 Antarctic towards already ongoing scientific competition as the key measure for claims and interest-building.[193] From such a platform, there are further opportunities for establishing down the line larger cooperative frameworks and agreements.

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[189] "Transparency and Confidence Building," United Nations Office for Disarmanent Affairs, 2023, https://www.un.org/disarmament/convarms/transparency-cbm/.

[190] Sean P. Larkin, "The Age of Transparency," Foreign Affairs, November 23, 2021, https://www.foreignaffairs.com/articles/world/2016-04-18/age-transparency.; Tsvetelina Yordanova, "The Transparency - Security Dilemma in National and International Context (a Comparative Analysis of the UN' and NATO's Transparency/Secrecy Policies)," *Fourth Global Conference on Transparency Research, Lugano, Switzerland. United Nation's Sustainable Development Goal* 16 (2015), https://www.ohchr.org/sites/default/files/Documents/Issues/Expression/IntOrganizations/SvetlanaYordonova.pdf.

[191] Trine Jonassen, "Russia Says No to Observing NATO Exercise," High North News, March 4, 2022, https://www.highnorthnews.com/en/russia-says-no-observing-nato-exercise.

[192] Oren Liebermann and Natasha Bertrand, "US Believes Russia Had Failed Intercontinental Ballistic Missile Test around When Biden Was in Ukraine," CNN, February 21, 2023, https://edition.cnn.com/2023/02/21/politics/russia-intercontinental-ballistic-missile-test.

[193] Shirley V. Scott, "Ingenious and Innocuous? Article IV of the Antarctic Treaty as Imperialism," *The Polar Journal* 1, no. 1 (June 2011): 51–62, https://doi.org/10.1080/2154896x.2011.568787.

There are two potential hurdles created by the current context of increasing geopolitical competition that might make some initiatives to build transparency between actors as a norm difficult in certain environments. These are specifically;

1. The lack of trust - China, for instance, has stated its reluctance to be transparent surrounding specific areas of national security and defence with the US- particularly, its nuclear capabilities due to fears that being open would give the US a strategic advantage courtesy of its more powerful capabilities.[194] The overt lack of transparency this entails, however, is perceived by the US as an escalatory risk in itself.[195] This creates a potentially dangerous escalatory cycle of suspicion if dialogue or other trust-building mechanisms are not implemented.

2. Manipulation of transparency mechanisms- Competitive states can be concerned about rivals' attempts to manipulate existing transparency mechanisms to their advantage. An overt example of this was the US' blocking of new judges to the WTO's appeals court, which essentially prevented the body from functioning and was perceived as an attempt to avoid being held accountable for its competition-based trade sanctions.[196] Similarly, Russia abused the ATS consensus-based mechanisms to ensure that Russian fishing vessels engaged in illegal fishing went unpunished.[197]

While these points raise issues to be considered in the pursuit of a transparency-as-a-norm creation initiative, in a lunar context they are more easily tackled;

1. Lunar trust - Firstly, a lack of trust between actors, even in highly sensitive national-security-based contexts, can be circumvented. For instance, fuelled in part by information-sharing dialogue through summits, meetings and

[194] George Perkovich, "Engaging China on Strategic Stability and Mutual Vulnerability," Carnegie Endowment for International Peace, October 12, 2022, https://www.google.com/url?q=https://carnegieendowment.org/2022/10/12/engaging-china-on-strategic-stability-and-mutual-vulnerability-pub-88142&sa=D&source=docs&ust=1676419024671556&usg=AOvVaw1oYH-kQ8boQ3aLWfsoHkRh.
[195] "Press Conference with NATO Secretary General Jens Stoltenberg and the US Secretary of State, Antony J. Blinken," NATO, February 8, 2023, https://www.nato.int/cps/en/natohq/opinions_211482.htm.
[196]"U.S. Shuts down World Trade Organization Appeals Court," CBC, September 28, 2020, https://www.cbc.ca/news/business/u-s-shuts-down-world-trade-organization-appeals-court-1.5390530#:~:text=Global%20commerce%20lost%20its%20ultimate.
[197] Jiliang Chen, "Controversy over Russian Vessel in Antarctica Reveals CCAMLR Shortcomings," China Dialogue Ocean, January 11, 2021, https://chinadialogueocean.net/en/fisheries/15935-controversy-over-russian-vessel-in-antarctica-reveals-ccamlr-shortcomings/.

discussions from the late-1960s (which provided a baseline improvement in confidence and trust),[198] the US and USSR were able to come to a "Détente" opening the way for arms control measures and providing mutually agreed limits to their competition.[199] Despite the 1980s seeing the breakdown of this "Détente", the agreements made, particularly the Strategic Arms Limitation Treaty I (SALT) provided a precedent-setting framework to begin slowly directing and constraining the type of competition away from excessive escalation,[200] and paved the way for future discussions about subsequent measures to further curtail excess escalation between the two superpowers.[201]

The lunar environment is not currently framed as explicitly one of national security. Instead, it is a broad new frontier of emerging human activity where states will be more willing to participate in trust, and norm-building initiatives to ensure that in a highly capital-intensive and hostile environment, their undertakings, and those of related commercial entities can in most circumstances be undertaken as efficiently as possible to ensure maximum benefit. This is true even in a competitive context; the January 1949 Tripartite Naval Declaration between the UK, Argentina, and Chile in the Antarctic stabilised the escalating maritime military build-up and encounters that had been happening in the region since 1942 between the three powers through restricting the number and types of military vessels.[202] In doing so it provided according to the UK Foreign Office a "common sense method of reducing political friction".[203]

While it did not prevent the wider increasing competition elsewhere in the Antarctic, especially between these three states, it ensured that the excessively escalating maritime component had constraints put upon it.[204] Lessening flashpoints, the costs of competition for each state (particularly in an environment where such escalating deployments were highlighted as

[198] Chris Tudda, *Cold War Summits a History, from Potsdam to Malta* (Bloomsbury Publishing, 2015), https://www.bloomsburycollections.com/book/cold-war-summits-a-history-from-potsdam-to-malta/.
[199] Jussi M Hanhimäki, *The Rise and Fall of Détente* (Potomac Books, 2013);
[200] David Tal, *US Strategic Arms Policy in the Cold War Negotiation and Confrontation over Salt, 1969-1979.* (Routledge, 2019), https://www.taylorfrancis.com/books/mono/10.4324/9781315208107/us-strategic-arms-policy-cold-war-david-tal.
[201] Steven Pifer, "The Future of Strategic Arms Control," *Sicherheit Und Frieden (S+F) / Security and Peace* 36, no. 2 (2018): 67–73, https://www.jstor.org/stable/26505491.
[202] Kew National Archives (1955), FO 371/113976, Memo by Speaight on Peron's "forward policy", 1 November
[203] Kew National Archives (1950), FO 371/81131, Memo by Fordham on the Tripartite Naval Declaration, 11 June
[204] Klaus-John Dodds, "Geopolitics in the Foreign Office: British Representations of Argentina 1945-1961," *Transactions of the Institute of British Geographers* 19, no. 3 (1994): 273, https://doi.org/10.2307/622323.

financially and logistically strenuous),[205] and allowing a greater political and capital focus elsewhere within the competitive environment.

There is then precedent for states even engaged in escalating militarised competition over core national interests (as the Antarctic particularly was for Argentina and Chile),[206] to seek at least limited frameworks to start to constrain elements of competition that are excessive in their potential consequences, particularly in hostile and costly regions to operate, such as the Moon will be for the foreseeable future. Thus, there are opportunities here to ease the lack of trust, even if it is through small confidence/trust-building initiatives, such as participation in a Lunar Objects and Activities Registry.

2. A space for apolitical information provision - Concerns surrounding the manipulation of transparency mechanisms are linked to both an aforementioned lack of trust, which small measures mitigate over time, but also the transparency mechanism's capacity to be utilised in such a way. A mechanism that is administered by an apolitical non-state actor, and whose intent is not proactive shaping of the political environment, but potentially just recording voluntary contributions of information and making these publicly accessible would still provide a baseline for transparency and trust-building to scale up from. For instance, this is very similar to the IAEA's voluntary "Additional Protocol" and plutonium and reactor databases. These provide an outlet for neutrally assured transparency through the publication of standardised voluntary information, operating within a very national-interest and competition-sensitive sphere.

In a lunar environment subject to geopolitical competition's spill-over, the same transparency measures regarding such information provision, however, limited, would be key to aiding the provision of constraints on potentially escalatory competition. Being in the form of a registry publicising lunar activities, this initiative would be akin to the Antarctic's 1949 Tripartite Naval Declaration in terms of its targeting of a specific element of competition; that being who is operating where, why, and at which times on the lunar surface, an area that has already shown itself to be potentially a flashpoint and politically escalatory.[207] By publicising this information

[205] Kew National Archives (1950), FO 371/81131, Memo by Fordham on the Admiralty's Consideration of the Tripartite Naval Declaration, 24 July

[206] Shirley V. Scott, "Ingenious and Innocuous? Article IV of the Antarctic Treaty as Imperialism," *The Polar Journal* 1, no. 1 (June 2011): 51–62, https://doi.org/10.1080/2154896x.2011.568787.

[207] Christopher Carbone, "NASA Calls on China to Be 'Open and Transparent' with Lunar Missions," Mail Online, September 7, 2022, https://www.dailymail.co.uk/sciencetech/article-11189291/NASA-tells-China-open-transparent-OVERLAP-lunar-landing-sites-revealed.html.

on an apolitical platform, it would be possible to head off such political accuzations as stakeholders provide information that while not harming their interests or ability to compete with one another, does develop the expectation and so norm for at least a baseline of transparency over time, alongside as mentioned previously, ensuring that surprises are kept to a minimum and so preventing escalation. This would also contribute to at least some development surrounding trust between actors in the lunar environment, paving the way for more extensive efforts down the line.

A direct modern parallel to how this could develop is seen with the International Seabed Authority's activities registry. This publicly showcases which states and companies are operating where, and broadly why regarding seabed exploitation.[208] Such accessibility is important in an environment in which we know more about outer space than it,[209] and in which geopolitical considerations are already coming to the fore regarding the security, dual-use, utilization, and potential transnational impact of deep-sea mining.[210] All things which the lunar surface will also encounter, based on precedent. While there are questions regarding the resilience and effectiveness of the ISA itself,[211] this transparency is a key first step and a needed norm regarding the political and environmental monitoring of such an unknown environment.[212]

A Multi-stakeholder Lunar Objects and Activities Registry to Start the Process of Alleviating Political Risk

With the above analysis concluded there is then a space created, and a potentially receptive state and commercial audience for a non-government voluntary multi-stakeholder Lunar Objects and Activities Registry, proposed by an apolitical actor.

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[208] "ISA DeepData," International Seabed Authority, 2023, https://data.isa.org.jm/isa/map/.
[209] Jennifer Wall, "Oceans: The Great Unknown," NASA, October 8, 2009, https://www.nasa.gov/audience/forstudents/5-8/features/oceans-the-great-unknown-58.html#:~:text=But%20even%20with%20all%20the.
[210] John Childs, "Extraction in Four Dimensions: Time, Space and the Emerging Geo(-)Politics of Deep-Sea Mining," *Geopolitics* 25, no. 1 (June 14, 2018): 189–213, https://doi.org/10.1080/14650045.2018.1465041.; Jocelyn Trainer, "The Geopolitics of Deep-Sea Mining and Green Technologies," United States Institute of Peace, November 3, 2022, https://www.usip.org/publications/2022/11/geopolitics-deep-sea-mining-and-green-technologies.
[211] "The International Seabed Authority and the SDGs: PR vs Reality," Seas at Risk, June 27, 2022, https://seas-at-risk.org/general-news/the-international-seabed-authority-and-the-sdgs-pr-vs-reality/#:~:text=There%20are%20also%20potential%20conflicts.
[212]Douglas McCauley, "Risks of Deep-Sea Mining Are Not Fully Understood: Here's Why That Matters," World Economic Forum, July 21, 2022, https://www.weforum.org/agenda/2022/07/take-a-deep-dive-into-how-deep-sea-mining-could-threaten-our-oceans/.

Such a Lunar Objects and Activities registry would help mitigate already growing concerns over who will be/is operating where on the lunar surface, and volunteer details regarding the nature of such missions. This while not preventing competition would help develop a currently absent expectation of some degree of transparency regarding activity in the lunar environment from state and commercial actors alike, and so provide a building block for trust and further normative behaviour initiatives.

This would benefit actors by starting the process of providing an expected degree of political and commercial stability regarding lunar engagement. States would tangibly see the activities of others, and be able to track the growth of other actors' interests as well as signpost their own. This means that even in a competitive environment, unexpected developments that might elicit a hasty response can be somewhat mitigated, and over time as norms for transparency develop, will be regarded by the international community as aberrations to be avoided, rather than, as currently on track, the "status quo" of lunar politics. This provides clear advantages politically for actors to participate, complimented by the proposer being an apolitical non-state actor, and the registry being multi-stakeholder in utilization, which potentially can cut across geopolitical competition and suspicion compared to if this idea was raised by a competitor (and so get bogged down as ASAT weapon negotiations have).[213]

Furthermore, through a norms-based voluntary approach that begins with the Registry providing a baseline for future growth, we ensure that, unlike the current ATS, there is the opportunity to promote a coherent set of shared values and vision between all current and future lunar stakeholders that is non-contested and can flexibility adapt and shift to changing political environments, and more easily accommodate differing viewpoints under its umbrella. This ensures that future lunar governance frameworks are resilient.

It would be important to establish such a registry before activity expands on the lunar surface, as leaving it too late would potentially mean competing actors have invested politically and economically in their own regimes and so would have more barriers and considerations when gauging if they would be interested in engaging in new multilateral approaches. This could see the continued bloc-ification of space-based governance solidified by lunar activity, and an opportunity to aid in de-bloc-ification missed. While of course agreements down the line are not impossible in a competitive environment, they historically usually are only seriously considered at the last minute, or worse, after an incident has occurred.

[213] Adriana Santamaria Duthon et al., "Overlooked Political Risks for 2023 Pressing or Emerging Political Risks That Have Flown under the Radar" (London Politica, 2023), https://static1.squarespace.com/static/5efb88803e2328745c7b3c39/t/63ce9092c7f2942dbc6c0dc0/1674481812821/London+Politica-+Overlooked+Political+Risks+for+2023.pdf.

For example, the 1959 ATS was only established after concerns surrounding the escalation to open war and nuclear weapon utilization were deemed to be too severe to allow the situation to continue.[214] Even then, some competing actors had invested so much that they were unwilling without significant pressure to agree.[215]

Unlike the pre-1959 Antarctic competition which saw concerted efforts by competitor states to keep events out of the public eye, space and the "race" to operate on the Moon are very much publicly on the radar now. The risk of waiting until being on the precipice to start looking at mitigation steps, especially with arguments being publicly made from some corners against space as a sustainable activity, is a risk to the whole of humanity's space ambitions.[216] Indeed, political spillover resulting from lunar-based tensions, or indeed, the potential for misunderstandings and accidents could see public support for space exploration and exploitation, which has historically been volatile in major space powers like the US, significantly impacted.[217] As such governance measures to build resilience before we reach an escalatory point stemming from geopolitical competition is highly desirable for all actors.

Geopolitical Challenges to a Lunar Objects and Activities Registry

A Lunar Objects and Activities Registry could be a significant benefit to helping build norms surrounding transparency and cooperation in the lunar environment, and begin the process of shaping the norms which will prevent unrestricted lunar astropolitical competition, however, it will also face several political risk-related challenges to its development and success.

[214] Kew National Archives (1957), FO 371/126125, United States attitudes towards the Antarctic, from the Australian Embassy discussion, 8 April; Kew National Archives (1957), FO 371/126129, Report on Quadripartite Talks, 8 November.
[215] Adrian Howkins, *Frozen Empires : An Environmental History of the Antarctic Peninsula* (New York: Oxford University Press, 2017).
[216] Katharine Gammon, "How the Billionaire Space Race Could Be One Giant Leap for Pollution," The Guardian, July 19, 2021, https://www.theguardian.com/science/2021/jul/19/billionaires-space-tourism-environment-emissions.
[217] Steven Dick Editor, "Historical Studies in the Societal Impact of Spaceflight" (NASA, 2015), https://www.nasa.gov/sites/default/files/atoms/files/historical-studies-societal-impact-spaceflight-ebook_tagged.pdf.

Differing conceptions of the role of "civil society" and neutral actors between states

Not all competing states share a liberal "Western" or positive view of civil society efforts to promote governance. The Erdoğan administration in Türkiye for instance has viewed NGO and "civil society" efforts not regulated by the government as seeking to undermine the Turkish government's authority.[218] Similarly, the Chinese Community Party has a complex relationship with civil society, defined by a lack of trust for its actors and NGOs who it feels may undermine its position and authority.[219]

In this context, while it is likely the efforts of a non-state actor regarding the specific lunar context would be welcomed by non-liberal-leaning states, it cannot be taken for granted.

Registry information could be open to politicization

The voluntary provision and public diffusion of information could be utilised by competing states or companies to make controversial or contested claims, either in terms of the potential for "dual use" where activity might be intended to de-facto set up control over an area of interest (particularly if the same conception of safety zones is, as current, not shared by all lunar actors), or that simply they are going to operate in the same areas as a rival.

While, if the registry wishes to remain apolitical, there is little that can be done on this account, it in fact might be better for such statements to be made on it. It will highlight publicly that there is a contentious political issue to be addressed among participants, and could indeed kick-start community-based cooperation to resolve these problems. Even failing that, it is simply better, that the registry as a neutral platform displays the actual words and intent of the submitting party for all to see, limiting the scope for disinformation.

Transparency can sometimes escalate competition and remove an "off-ramp" for actors

It has been argued that readily available and publicly accessible information can see political escalation deepen, rather than mitigate it. Particularly as this information

[218] Bilge Yabanci, "Turkey's Tamed Civil Society: Containment and Appropriation under a Competitive Authoritarian Regime," *Journal of Civil Society* 15, no. 4 (September 19, 2019): 285–306, https://doi.org/10.1080/17448689.2019.1668627.

[219] Lawrence Deane, "Will There Be a Civil Society in the Xi Jinping Era? Advocacy and Non-Profit Organising in the New Regime," Made in China Journal, July 15, 2021, https://madeinchinajournal.com/2021/07/15/will-there-be-a-civil-society-in-the-xi-jinping-era-advocacy-and-non-profit-organising-in-the-new-regime/.

can be taken and shaped by actors or disseminated to the public whose opinion can be influenced by various interest groups to pressure policymakers into escalatory action that they may be reluctant to pursue.[220] It is for this reason that highly inflammatory incidents, like the 1952 Hope Bay incident in the Antarctic, were kept out of the public eye by both sides lest public pressure force an escalation.[221] During this crisis, a UK civilian landing party tasked with rebuilding a British Antarctic station were intercepted by a nearby Argentine military detachment tasked with preventing this.[222] Shots from a machine gun were fired over their heads, and they were forced back onto their boat at gunpoint.[223] Officials on the ground called it an act of war.[224]

If this had been transparently reported to their respective public, the UK and Argentina would have had to escalate the situation due to their respective domestic political and public pressure. Indeed, It was highlighted by the UK Foreign Office, that Argentina, Chile, and the UK were constrained from "sitting down" to negotiate in part due to their respective public opinions being so opposed to the idea.[225] Transparency here would have removed a vital off-ramp regarding escalation (the political space to just ignore provocation). Similarly, in our modern context, actors engaged in competition make use of similar political space facilitated by a lack of easily accessible information over activity, particularly as public opinion is still a key pressure on policy even for less democratic states.[226]

However, the loss of such an off-ramp based on a state's ability to hide its activity from public scrutiny in the lunar context might be deemed a fair trade if the registry is able to help have a wider impact in building trust and helping alleviate the excesses and risks of competition.

Lunar actors may not use it

State or commercial actors may simply not wish to participate for a variety of internal reasons. In this case, there might be an issue with the registry's ability to help create

[220] Bernard I. Finel and Kristin M. Lord, "The Surprising Logic of Transparency," *International Studies Quarterly* 43, no. 2 (1999): 315–39, https://www.jstor.org/stable/2600758.
[221] Kew National Archives (1952). ADM1/ 23580, Telegram from Argentine Ambassador to British Foreign Office, 4 February
[222] Adrian Howkins, *Frozen Empires : An Environmental History of the Antarctic Peninsula* (New York: Oxford University Press, 2017). p.2.
[223] Kew National Archives (1952). ADM1/ 23580, Summary of the Incident at Hope Bay, 2 February.
[224] Kew National Archives (1952). ADM1/ 23580, Telegram from Falkland Islands Governor to Secretary of State for the Colonies, 1 February.
[225] Kew National Archives (1955), FO 371/113976, Memo from Sir Evans to Foreign Secretary, 23 September.
[226] Jonathan Sullivan and Weixiang Wang, "China's 'Wolf Warrior Diplomacy': The Interaction of Formal Diplomacy and Cyber-Nationalism," *Journal of Current Chinese Affairs*, March 14, 2022, 186810262210798, https://doi.org/10.1177/18681026221079841.

norms surrounding transparency if it lacks the participation of at least some major actors or if it fails to reach a "critical mass" regarding smaller actors. Our next section, however, delves into the wider specific incentives and of course barriers that exist for participating in a Lunar Objects and Activities Registry and so how to best get stakeholders to buy in.

Incentives and Barriers of Participation

Space Stakeholder's Coordination Efforts

The diversification of emerging and established space actors has led to a multitude of segmented mutually beneficial partnerships. Currently, there are over 100 space information-sharing agreements and temporary exchanges between actors,[227] including the recent NASA - Chinese exchange for conjunction analysis around Mars.[228] These public, private, and scientific stakeholders work collaboratively to collect and share critical information.

Lunar Registry Incentives and Barriers

A global registry is only as effective as the information it acquires. Global registries have revolutionized the way actors access and disseminate information, with such impact easily identifiable by registries such as Internet Corporation for Assigned Names and Numbers.[229] Voluntary international cooperation takes place through independent contributions from actors and requires strong incentives for productive engagement. With the potential of vast political, economic, and social differences amongst stakeholders, it is essential that the Lunar Registry is designed to engage stakeholders through tactical incentives which outweigh the barriers to engagement.[230]

[227]Leishman, A. (2021, July 6). Spacecom Marks 100th Commercial Space Data Sharing Agreement; Gen. James Dickinson Quoted. Executive Gov. https://executivegov.com/2021/07/spacecom-marks-100th-commercial-space-data-sharing-agreement-gen-james-dickinson-quoted/
[228]Foust, Jeff. "NASA Exchanged Data with China on Mars Orbiters." SpaceNews, January 23, 2023. https://spacenews.com/nasa-exchanged-data-with-china-on-mars-orbiters/.
[229]"Cairn.Info," n.d. https://www.cairn.info/revue-francaise-d-etudes-americaines-2012-4-page-29.htm.
[230]De Bossey, Château. "Report of the Working Group on Internet Governance," June 2005. https://www.wgig.org/docs/WGIGREPORT.pdf.

Incentives to Stakeholder Engagement

Mission Safety and Success

To minimize risk with increased activity, space stakeholders will be encouraged to adopt the practice of sharing a wide variety of mission situational information for their systems about both objects and activities. Information sharing can promote mission success and safety by decreasing the risk of collision, and increasing emergency coordination, operational success, and political safety.

For example, if a team on the lunar surface shares information about the location of geological features that could pose a hazard to future landing sites, other organizations can plan their missions accordingly and avoid these areas. Similarly, if a spacecraft operating in lunar orbit shares information about its orbit and telemetry data, other spacecraft can use this information to coordinate their activities and avoid collisions.

One of the most notable information-sharing coordination efforts amongst stakeholders is the multilateral coordination agreement on the International Space Station (ISS) program. Organizations work together to manage the ISS and conduct scientific experiments in low Earth orbit.[231] To ensure the safety of the crew and the station, the different agencies involved in the ISS program share information on a regular basis, along with information on the research and experiments being conducted on the station, allowing for more coordination amongst actors.[232]

Decreased Risk of Collision

Increased activity on and around the Moon invariably brings the risk of collision, especially as more space actors set their lunar sights. The space domain has already seen evidence of accidental collisions, such as the 2009 collision between the U.S. Iridium satellite and a dead Russian Cosmos satellite, creating nearly 2,000 pieces of known orbital debris.[233] Analogously, low-Earth-orbit space debris and growing landscape are increasing the number of conjunction events, or close collision

[231] Reed, Harvey. "Decentralized Space Information Sharing as a Key Enabler of Trust and the Preservation of Space." Advanced Maui Optical and Space Surveillance Technologies Conference (AMOS) –, 2019. https://amostech.com/TechnicalPapers/2021/Poster/Reed.pdf.
[232] NASA. "International Cooperation," n.d. https://www.nasa.gov/mission_pages/station/cooperation/index.html.
[233] Weeden, Brian. "2009 Iridium-Cosmos Collision Fact Sheet." Secure World Foundation, November 2010. https://swfound.org/media/6575/swf_iridium_cosmos_collision_fact_sheet_updated_2012.pdf.

encounters, at a rapid rate. Figure 2 shows the number of times a typical satellite at various altitudes experienced a possible collision alert during 2021.[234]

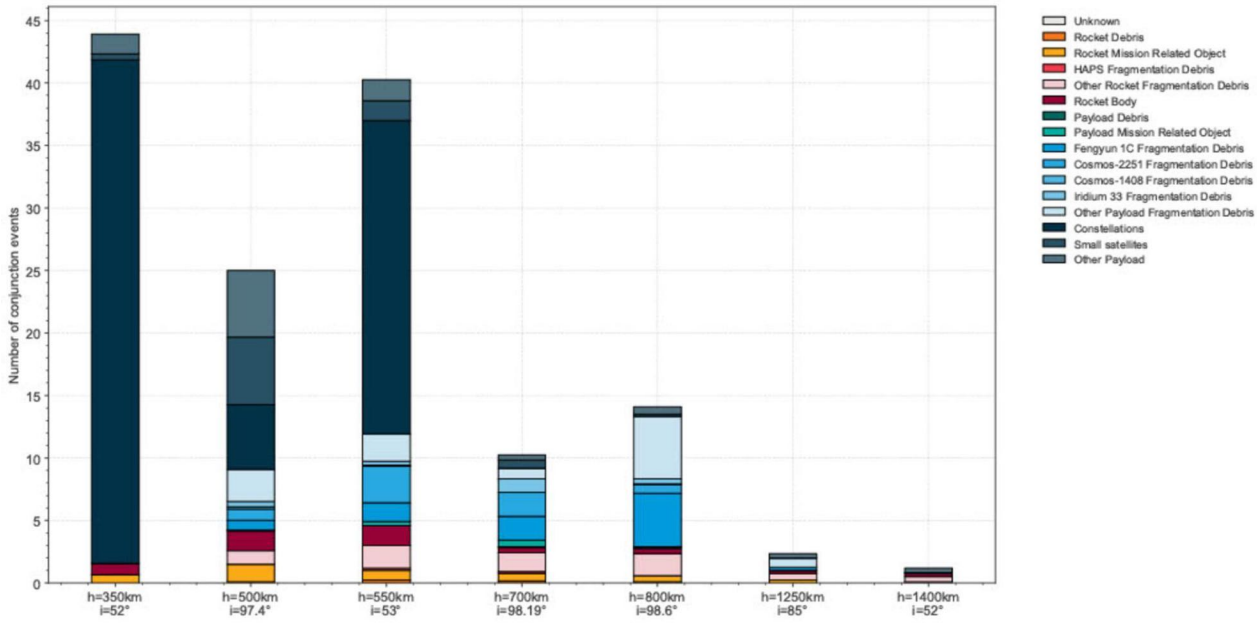

Fig 2: ESA Report: Number of possible conjunction events at various altitudes[235]

In order to prevent collision with the changing and finite lunar landscape, freely accessible information on aspects of activities and objects such as requests, occupancy, planned manoeuvres, and size can prevent unnecessary impact and increase coordination amongst stakeholders.[236]

Increases Operational Success Through Automation

The current lunar operating environment relies on outdated manual activities for space situational awareness, using processes that aren't adequate for the rapid growth planned.

Ensuring that the registry is accessible to both machines and humans will make it useful for both coordination and planning purposes. For example, a rover could query the registry and then notify other objects when it enters or leaves specific areas. By uploading notification requests to the registry, that information is automatically shared with the appropriate parties. This saves them from having to

[234] "Low-Earth Orbits Are Getting Crowded," n.d. https://www.esa.int/ESA_Multimedia/Images/2022/04/Low-Earth_orbits_are_getting_crowded.
[235] "Low-Earth Orbits Are Getting Crowded," n.d. https://www.esa.int/ESA_Multimedia/Images/2022/04/Low-Earth_orbits_are_getting_crowded.
[236] "Critical Infrastructure Resilience | Homeland Security," n.d. https://www.dhs.gov/science-and-technology/critical-infrastructure-resilience.

coordinate sharing that information with individual governments, companies, or other stakeholders, and makes it possible to see intersections and overlapping considerations. Another example is enabling simpler, centralised access to PNT information. A satellite that needs to communicate its exact location can do so by sending that information to the Registry, where it would be logged in an easily accessible single location.

Increased Emergency Coordination

Situational information on objects and activities can increase coordination between actors in critical or emergency events and empower decision-making. Field inclusion, such as contacts, location, and dimensions, amongst others will work to prevent catastrophic impact on existing or planned activities with threats and warnings, such as when a rogue rocket crashed into the Moon in 2021, devastating the area of impact. [237]

Conflict Avoidance and Prevention

The role of openness in reducing conflict through space situational data can be traced back to 1962 with the establishment of the UN Registration Convention, which was created to reduce tensions and by making statements about the purposes of launch.[238] With contentious positions on lunar ownership, concentrated resources, and exploration, political competition and tension have the potential to rise.[239] Transparency can increase international political safety and can aid in decreasing or preventing conflict amongst stakeholders.[240]

Information could help to build trust and reduce the likelihood of misunderstandings or unintentional conflicts. For example, if a country or organization is planning to send a rover to a specific location on the Moon, they could check the registry to see if any other activities are already taking place in that area and adjust their plans accordingly to avoid interfering with existing operations.

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[237]Drake, Nadia. “A Rogue Rocket Part Collided with the Moon.” Science, August 26, 2022. https://www.nationalgeographic.com/science/article/a-rogue-rocket-part-is-about-to-collide-with-the-Moon.

[238] “UN, United Nations, UN Treaties, Treaties.” United Nations. United Nations. Accessed February 16, 2023.https://treaties.un.org/Pages/ViewDetailsIII.aspx?src=TREATY&mtdsg_no=XXIV-1&chapter=24&Temp=mtdsg3&clang=_en.

[239] Elvis, Martin, Alanna Krolikowski, and Tony Milligan. “Concentrated Lunar Resources: Imminent Implications for Governance and Justice.” Philosophical Transactions of the Royal Society A 379, no. 2188 (January 10, 2021): 20190563. https://doi.org/10.1098/rsta.2019.0563.

[240]JERVIS, Robert. From Balance to Concert: A Study of International Security Cooperation. World Politics, Vol.
38, ט1, October 1985.

Additionally, the registry could help to establish a framework for responsible behaviour on the Moon, such as guidelines for avoiding harmful interference with other activities, preserving the Moon's heritage and scientific value, and promoting peaceful exploration and use.

Open and Equal Access

Providing open, transparent, and free data lower the barrier to participation to include all stakeholders. Inclusion challenges are often experienced by actors from low-and middle-income countries (LICs and LMICs), whose financial resources and technical capacity are usually not on par with those of higher-income countries.[241]

Multi-Stakeholder Representation

Key stakeholders include governments, the private sector, civil society organizations, academia, and individual producers and users of data. Multi-Stakeholder governance models require input and design from stakeholders, which incentives participation by allowing a variety of stakeholders to have a say in decision-making.[242]

Lower Cost of Access to the Moon

Access to open information can lead to lower costs of access to the Moon by allowing for more efficient and cost-effective operations. By making information available to all stakeholders, it can reduce the need for costly research and development, as well as reduce the cost of launching and operating spacecraft. Open information can help to reduce the cost of training and certifying personnel, as well as reduce the cost of insurance and other regulatory requirements.

Sharing information can also help improve operational efficiency and reduce the cost of missions. By pooling resources and sharing data, organizations can avoid duplicating efforts, reduce the time required to complete tasks and increase the overall success rate of missions.

Social Responsibility

Stakeholder's desire to achieve good-faith reputational status can be achieved by adhering to international norms and investing in social responsibility demands from

[241] Barzelay, Adele, Malarvizhi Veerappan, and Morgan Lucey. "Promoting Trust in Data through Multi Stakeholder Data Governance." World Bank Blogs, September 2, 2023. https://blogs.worldbank.org/opendata/promoting-trust-data-through-multistakeholder-data-governance.

[242] Vallejo, Nancy, and Pierre Hauselmann. "Governance and Multi Stakeholder Processes." International Institute for Sustainable Development, May 2004. https://www.iisd.org/system/files/publications/sci_governance.pdf.

civil society and corporate social movements.[243] Civil society organizations play an important role in enforcing social responsibility through corporate movements by advocating for responsible and sustainable business practices and have made significant impacts in industries such as energy and natural resources, agriculture, and healthcare. [244]

Barriers to Stakeholder Participation

Political Competition

Since the Cold War, the political and economic competition has created barriers to international collaboration within the space industry.[245] Though successful instances of collaboration exist, scientists report that barriers to international collaboration between competing countries remain present.[246]

Policies exist to stifle collaboration and information sharing, with a notable example being The Wolf Amendment, preventing NASA and relevant agencies from pursuing bilateral projects and information sharing with China without congressional approval.[247] This amendment has resulted in the exclusion of China from the International Space Station and has led to the development of a separate effort.[248]

Economic Competition

Intellectual property protection issues may also act as a barrier to stakeholders sharing activity and object data, especially from corporate entities. Issues concerning patent, copyright, and trade secret protection for the products of human creativity

[243]Carberry, Edward J., Pratyush Bharati, David L. Levy, and Abhijit Chaudhury. “Social Movements as Catalysts for Corporate Social Innovation: Environmental Activism and the Adoption of Green Information Systems.” Business &Amp; Society 58, no. 5 (April 3, 2017): 1083–1127. https://doi.org/10.1177/0007650317701674.

[244]Alam, S. M. Shafiul, and K. M. Zahidul Islam. “Examining the Role of Environmental Corporate Social Responsibility in Building Green Corporate Image and Green Competitive Advantage.” International Journal of Corporate Social Responsibility 6, no. 1 (May 19, 2021). https://doi.org/10.1186/s40991-021-00062-w.

[245]Darrin Ann & O’Leary Beth (Ed.), “History of the Space Age”, Handbook of Space Engineering, Archaeology, and Heritage, 195-207, 2009.

[246]Taylor & Francis. “International Scientific Collaborative Activities and Barriers to Them in Eight Societies,” n.d. https://www.tandfonline.com/doi/full/10.1080/08989621.2020.1774373.

[247]Pentland, William. “Congress Bans Scientific Collaboration with China, Cites High Espionage Risks.” Forbes, May 7, 2011. https://www.forbes.com/sites/williampentland/2011/05/07/congress-bans-scientific-collaboration-with-china-cites-high-espionage-risks/?sh=56569b1c4562.

[248]Jones, Andrew. “China’s Tiangong Space Station.” Space.Com, August 24, 2021. https://www.space.com/tiangong-space-station.

are currently a growing concern in the industry, as intellectual property (IP) is not currently protected in outer space.[249]

The lack of clear and consistent intellectual property rights and regulations in the outer space domain can create uncertainty and confusion for space stakeholders and can work as a major disincentive for space stakeholders from sharing information in a Lunar Registry. In a Lunar Registry, information about lunar resources, technologies, and scientific findings could be considered valuable intellectual property that stakeholders may be reluctant to share for fear of losing control over their assets or having their work used or commercialised by others without proper compensation. In the absence of a unified legal framework for protecting intellectual property in outer space, stakeholders may prefer to keep their information and assets private, which can limit the effectiveness of a Lunar Registry in fostering collaboration and cooperation among space actors.

Liability in Space

The United Nations Liability Convention, which came into force in September 1972, is an important international treaty that governs the legal responsibilities of actors in space.[250] However, despite its significance, the Liability Convention has been criticised for its lack of clarity and precision. In particular, the convention has been criticised for its ambiguous definitions and its lack of clear guidelines for determining responsibility in the event of damage caused by space objects.

This lack of clear definitions and responsibility can be a significant deterrent for actors to publicly declare their activities and objects in a registry. The absence of clear definitions and guidelines for determining responsibility can make it difficult for private entities to assess their potential liability and exposure to risks associated with their space activities.

Similar issues have been faced with the United Nations Office for Outer Space Affairs (UNOOSA) Register of Objects Launched as it was created as a means for states to provide information about the objects they have launched into outer space.[251] However, the Register has faced challenges in securing comprehensive and accurate

[249]Luxenberg, Barbara, "Protecting Intellectual Property in Space" (1985). Documents on Outer Space Law. 6.
https://digitalcommons.unl.edu/spacelawdocs/6
[250] Kehrer, Trevor. “Closing the Liability Loophole: The Liability Convention and the Future of Conflict in Space.” Chicago Journal of International Law. January 1, 2019.
[251] Jakhu, Ram S., Bhupendra Jasani, and Jonathan C. McDowell. “Critical Issues Related to Registration of Space Objects and Transparency of Space Activities.” Acta Astronautica 143 (January 31, 2018): 406–20. https://doi.org/10.1016/j.actaastro.2017.11.042.

information from states, due in part to the lack of incentives for states to publicly declare their objects and activities.

Assertion Opposition

International treaties and agreements not globally accepted yet leveraged heavily in the Registration can be a barrier to participation from opposed actors.[252]

For these actors, the creation of a Lunar Registry which legitimised opposing assertions could be a disincentive to participate. For example, if the Registry were designed to declare safety zones, validating the Artemis Accords, the registry could be perceived as endorsing these principles and recognizing the US-led initiative as the standard for outer space activities. This could be perceived as a threat to the opposed actor's own interests and ambitions in space, who may choose to opt out of the registry as a result.

Poor Registration and Controversial Design

Because of its voluntary nature, poor registration in a registry design can inhibit participation by making it burdensome for stakeholders to participate, find the information they need, or submit relevant information. The inclusion of controversial or intrusive mandatory fields will also disincentivize stakeholders.

Collaboration through Cooperative Design

The development of a Lunar Registry is a complex task that requires careful consideration of the political, economic, and social differences among stakeholders. To create a successful registry, it is important to engage stakeholders in the design process to incentivize support, as stakeholders are more likely to participate in the registry if they see tangible benefits for doing so. Through cooperative design approaches, parties are given an opportunity to collaborate on the development of the registry. Trust can be achieved by involving stakeholders in the decision-making process and by ensuring that the registry is governed by clear and equitable rules and regulations

By incentivizing use, building trust, and ensuring viability, it is possible to create a registry that promotes cooperation and collaboration in the exploration and use of lunar resources among different stakeholders.

[252]Berger, Eric. "China's Official View of NASA's Artemis Program Appears to Be Dismissive." Ars Technica, August 23, 2022. https://arstechnica.com/science/2022/08/chinese-view-of-nasas-Moon-plans-trying-hard-to-relive-apollo-glories/.

Current Landscape

Existing Efforts

No current system exists to present a unified and utilised system for tracking lunar objects and activities. Until a unified registry is established, the knowledge surrounding lunar activities and objects will continue to be inadequate and the ability to effectively regulate, coordinate, and monitor exploration and activity. Table 1 below outlines an inventory of related databases.

Table 1: Existing Lunar Databases

Database	Information Reported	Link
Government		
UN Index of Submissions under Article XI OST	Member States' submissions informing of the nature, conduct, location and result of their space activities.	https://www.unoosa.org/oosa/en/treatyimplementation/ost-art-xi/index.html
Online Index of Objects Launched into Outer Space	The Convention on Registration of Objects Launched into Outer Space entered into force in 1976. States and international intergovernmental organizations that agree to abide by the Convention are required to establish their own national registries and provide information on their space objects to the Secretary-General for inclusion in the United Nations Register.	https://www.unoosa.org/oosa/osoindex/search-ng.jspx?lf_id=
Non-Governmental / Commercial		
Lunar Resources Registry	The Lunar Resources Public Registry is a private, paid access registry of human activity on the Moon, and commercial and non-commercial zones for resources exploration and extraction.	https://lunarresourcesregistry.com/
Space Assigned Numbers Authority	The Space Assigned Numbers Authority (SANA) is the registrar function for the protocol registries created under the Consultative Committee for Space Data Systems (CCSDS).	https://sanaregistry.org/
The Lunar Registry	The Lunar Lands Registry falsely advertises selling land on the Earth's Moon, and registering ownership claims to properties on the Moon on behalf of individuals, organizations and business entities around	https://lunarregistry.com/

	the world.	
For All Moonkind Moon Registry	For All Moonkind Registry catalogues historic sites and objects on the lunar surface.	https://Moonregistry.forallMoonkind.org/

Perspectives on a Lunar Registry

To gather insights and perspectives from industry experts on the need, benefits, and challenges of establishing a Lunar Registry, Open Lunar conducted a series of interviews with experts in the field. The insights and ideas gleaned from these interviews explain the potential role a Lunar Registry could play in ensuring the responsible and sustainable use of lunar resources and space activities.

Filling the Regulation Gap

Juliana Suess, Research Analyst and Policy Lead on Space at RUSI, acknowledges that in the build-up of activities in new spaces like lunar exploration, regulation is often met with resistance or delay. “In space, actors operate in an environment that is at times very little regulated, which can lead to gaps in the safety of assets and increases the risk of operating in that sphere. Tools like the Lunar Registry can provide a sort of onboarding regulation in the interim to reduce risk without halting progress, as well as build confidence and trust among actors that future initiatives can build on.” Suess emphasizes that regulation and security do not have to be an all-or-nothing approach.

Verification and Conflict

It is crucial to ensure the trust and usability of the data housed in the Lunar Registry. Jonathan McDowell, Harvard-Smithsonian Center for Astrophysics astronomer, stresses the need for multi-stakeholder reported data verification. To this end, he created and maintains the General Catalog of Artificial Space Objects (GCAT), which is the most complete open-source database of satellites, spacecraft, debris, space organizations and launches ever compiled. The GCAT often corrects previously misreported data by pulling information from a variety of actors, including international registries, space agencies, astronomers, and hobbyist organizations. According to Jonathan, "A Lunar Registry has intrinsic value and could be an extremely valuable asset. With all registries, traceability is trust. The ability for sources to annotate and comment is trust. Retaining original information is crucial in building a registry, but allowing a complementary verifiable mechanism is key."

"A Lunar Registry could work as an essential tool for coveted locations where we will see increased activities, such as the Peak of Eternal Light or the Lunar South Pole," notes McDowell. The tool would not only establish precedent and history but would

also serve as a trusted source of information in case of conflicts among stakeholders. It could also provide an early warning to understand certain trends from countries or governments, such as resource competition, and inform on situational awareness to prevent or avoid conflict.

Lessons from the Internet's Open Registry

Maria Farrell, a writer and speaker on technology policy and the future, emphasizes the importance of diverse cooperative norms on the Moon. According to Farrell, "Norms aren't just semi-formal expectations of how other entities will behave. They're the distilled wisdom of a specific field of human endeavour about what works." Thus, it is critical to involve entities beyond those steeped in national security, military, and humanitarian cultures.

To achieve this, Farrell suggests taking lessons from the internet's open registry. She notes that "humans in every kind of activity have learnt the hard way what works. On the Moon, we need to leave space for different kinds of cooperative norms to flourish, bringing the full diversity of human wisdom to bear." Some of the lessons from the internet's open registries that could be useful on the Moon include being flexible, using simple, low-tech and non-proprietary methods, maintaining a single authoritative source of updated information, and keeping it simple and open.

Specifically, Farrell recommends not setting many top-down rules to begin with and leaving room for players to develop their own practical responses. She suggests using the minimum necessary technology to create and update any registries, and not to over-complicate things. According to Farrell, "authority is for data, not for organizations," and it is essential to maintain a single authoritative source of updated information that is mirrored in multiple sites for resilience. Farrell also warns against politicizing the registry with non-core policy functions. Looking to the future, keep the registry independent and primarily responsible to and managed by the people and organizations that use it, and resist attempts to co-opt it into an existing political institution with different rules, culture, and expectations. She emphasizes that the success of the registry depends on its accessibility to everyone who needs it, regardless of background or culture.

Responsibility and Sustainability

As an astrodynamicist, engineer, and space environmentalist, Moriba Jah is a vocal advocate for responsible and sustainable space exploration. He believes that "a Lunar Registry could aid in the sustainable development and stewardship of the Moon, as transparency and accessibility of data and information are a requirement in achieving peace and conflict resolution in space". Jah also recognizes that "Access to space is not equitable. Those who have assets in space have an upper hand

economically and geopolitically, and the data and information that we get from these space-based assets are unique". In order to create a more equitable space environment, Jah draws inspiration from Traditional Ecological Knowledge (TEK) and suggests that inviting all stakeholders, especially indigenous, to the table is important. By promoting equitable access and transparency, a Lunar Registry could create a more sustainable and just future for space exploration and exploitation.

Cooperative Design Mechanisms

Cooperation from stakeholders is critical for the development of an effective Lunar Registry to ensure the legitimacy and fairness of the registry. The Lunar Registry could be designed with a variety of different consensus-building models, and organizational structures, and facilitated participation from stakeholder groups to promote cooperation and utilization. These models include Multi-Stakeholder Advisory Groups, consensus and trust models, and third-party organizations.

Multi-Stakeholder Advisory Groups

A Multi-stakeholder Advisory Group (MAG) is a forum where different stakeholders come together to engage and collaborate on the development of solutions to complex issues. MAGs bring together representatives from a wide range of stakeholders, including government agencies, private sector companies, and civil society.[253] Multi-stakeholder Advisory Groups (MAGs) could be utilised as a tool in the design and maintenance of the Lunar Registry to build consensus and enhance participation and cooperation.

Studies have shown that MAGs can increase stakeholder engagement compared to traditional approaches due to the inclusiveness and collaborative nature of the process. By providing a platform for stakeholders to work together and build consensus, MAGs have been noted to increase stakeholder cooperation and reduce the time to reach an agreement by as much as 50%.[254]

The diverse range of perspectives and expertise that are brought together in a MAG can lead to improved outcomes for the registry while ensuring that the registry is well-designed, effective, and reflective of the interests of all relevant stakeholders. This can lead to better alignment with the needs of stakeholders and a higher level of stakeholder buy-in, which is central to the success of the registry.

[253] Baumann-Pauly, Dorothée, and Isabelle Glimcher. "Seeking a 'Smart Mix': Multi-Stakeholder Initiatives and Mandatory Human Rights Due Diligence." Geneva Center for Business and Human Rights, n.d. https://gcbhr.org/backoffice/resources/white-paper-msis-24p.pdf.
[254] "Global Technology Governance A Multistakeholder Approach." World Economic Forum, October 2019. https://www3.weforum.org/docs/WEF_Global_Technology_Governance.pdf.

Consensus and Trust Building

Consensus-building is important for the development of a voluntary Lunar Registry to establish a shared understanding and agreement among different stakeholders regarding the objectives, principles, and rules of the registry. This process of reaching a common understanding among stakeholders is crucial in order to ensure the effectiveness, legitimacy, and fairness of the registry.

The use of consensus-building models greatly increases stakeholder participation and the likelihood of success[255]. A recent study found that consensus-building models may lead to a 20% increase in stakeholder engagement and a 25% reduction in conflicts among participants.[256]

A well-designed and widely accepted Lunar Registry can provide a framework for the responsible and sustainable use of lunar resources, support scientific research, and facilitate cooperation among different actors. Conversely, a registry that is not based on a solid consensus may not be trusted or utilised by stakeholders, and may even lead to disputes and tensions.

Third-Party Organizations and Multi-Stakeholder Groups

Multi-stakeholder consensus building is a process where individuals or groups with different interests and perspectives come together to make a collective decision or agreement. This process is used in various industries and organizations, including third-party organizations, to resolve conflicts and find solutions to complex problems.

Examples of successful multi-stakeholder consensus building in third-party organizations include:

- The Internet Corporation for Assigned Names and Numbers (ICANN): ICANN is an international non-profit organization responsible for managing the global domain name system (DNS). The organization has successfully implemented a multi-stakeholder model, where stakeholders from governments, businesses, technical communities, and civil society participate in decision-making processes.[257] This model has helped ICANN make informed and inclusive decisions that benefit the global community.

[255] CT Data Haven. "OVERVIEW OF MULTI-STAKEHOLDER CONSENSUS BUILDING," n.d. https://www.ctdatahaven.org/sites/ctdatahaven/files/HEA%20Consensus%20Building%20Steps%20CBI.pdf.
[256] Blanco, Yankiel. (2020). Consensus building in a group decision-making process. Pesquisa Operacional.
[257] Jongen, Hortense. "Legitimacy in Multistakeholder Global Governance at ICANN." Brill, June 9, 2021. https://brill.com/view/journals/gg/27/2/article-p298_7.xml?language=en.

- The Forest Stewardship Council (FSC): The FSC is an international non-profit organization that promotes responsible forest management. It operates through a multi-stakeholder consensus-building process, where stakeholders from environmental groups, indigenous peoples, and the forest industry come together to set standards for sustainable forestry practices.[258] This process has led to the development of a certification system that helps ensure that forest products are responsibly produced and consumed.

- The Blackfoot Challenge (BFC): BFC is a private non-profit organization which addresses rural values through a community consensus-building approach, they address issues where roughly 80 per cent of stakeholders agree, build trust, and then use that trust to work on the other 20 per cent where disagreement is found.[259] Through this approach, they have facilitated numerous conservation, restoration, and stewardship initiatives between governments, companies, and indigenous communities.

- The Global Compact Network India (GCNI): GCNI is a network of Indian companies committed to promoting sustainable business practices. The organization has successfully brought together stakeholders from business, government, and civil society to find solutions to environmental and social challenges facing the country.[260] Through its multi-stakeholder approach, GCNI has been able to create a platform for collaboration and consensus building, leading to a positive impact on the environment and communities.

Numerous examples of successful multi-stakeholder third parties exist as anecdotes for global collaboration. By bringing together diverse perspectives and interests, this multi-stakeholder approach helps to ensure that decisions are made in an inclusive and informed manner, leading to increased participation and cooperation.

Proposal for a Lunar Registry

This white paper proposes a registry with a specific focus on lunar objects and activity. The mission of the registry will be to foster coordination and transparency with the goal of reducing the risk associated with lunar exploration and development.

[258] Forest Stewardship Council. “Global Strategy,” n.d. https://fsc.org/en/global-strategy.
[259] Blackfoot Challenge. “Blackfoot Challenge - Better Rural Communities Through Collaborative Conservation,” June 14, 2022. https://blackfootchallenge.org/.
[260]“Global Compact Network India,” n.d. https://globalcompact.in/.

Information Characteristics

The registry will recognize that there is a cost to disclosing and maintaining accurate information. It will not collect unnecessary information. It will maintain a high bar for the inclusion of new fields, working to ensure that information deemed necessary to disclose will be simple, static, relevant, comparable and verifiable.

Table 2: Information Characteristics

Characteristic	Explanation	Example
Simple	It is easily produced and understood.	A standardised description of an activity, i.e. soil sampling, or drilling.
Comparable	Where possible, information will be presented in a way that allows comparison.	Common and convertible units of measurement will be preferred over general descriptions of distance.
Static	Does not require frequent updating to minimise issues with reliability.	A final or principal location of an object.
Relevant	Is likely to be of interest and value to others.	Activities that may cause disruption to others nearby are more relevant than those that do not.
Verifiable	Can be verified either by the registry or by a third party.	Where possible, the registry will prefer to collect information that can be verified.
Qualitative	Allows for a free and open explanation of intended activities.	A mission summary.

The registry will not collect information that is confidential or that could cause confusion, conflict or otherwise undermine the registry's purpose. It will display information using a simple, accessible interface that can be easily understood and navigated on most devices and bandwidths, prioritising the speed of the platform and using standardised visual hierarchies.

Guiding Principles

Registry adoption is a fundamental gate to the creation of a registry that achieves its intended purpose. Effective Registry design must adopt a holistic approach to generating confidence in the systems that enable the collection, evaluation and

dissemination of the information so that there are no barriers to adoption. This is much like how the stability of a national currency rests on the market's evaluation of that nation's ability to manage its economic and policy environment to signal trust. Trust signalling should be a baseline consideration in all aspects of the Registry, including technical, institutional, policy and governance. The Lunar Registry could consider adopting principles like the following to ensure that it meets this consideration.

Neutrality: The Registry will function as a neutral platform that does not voice opinions on policy matters. Policies that impact the registry will be addressed by a community-driven policymaking process. The Registry will ensure that the process is followed, and adhere to decisions resulting from that process.

Independence: The Registry will maintain strict financial, operational and political independence. It will not accept financial contributions or political endorsements or support that carry conditions that could compromise this independence.

Voluntary: The Registry will not require specific information or mandate participation from any stakeholders.

Accessibility: Will strive to ensure technical and linguistic accessibility. Information contained in the registry will be freely available to all, including both humans and machines. It will not charge for or require any registration to access information.

Reliability: The registry will ensure a reliable, efficient and consistent level of service.

Accountability: The registry will ensure accountability to information providers, users and the broader lunar community by implementing mechanisms that allow for complaints, dispute resolution processes, and clearly explained governance mechanisms.

By articulating the characteristics of the information that will be included in the Registry, as well as the principles that will guide how information is collected and disseminated, the Registry will achieve the stability and reliability necessary to engender trust. This in turn will foster the adoption and use of the platform.

Governance and Policy Development Process

From time to time, registries will need to make policy decisions about the operation of the registry. This could include decisions about what fields to include, or remove, updates to field characteristics, or technology and accessibility improvements. The Registry must therefore have a way of making these sorts of decisions, ensuring

alignment with its general principles. This section describes how that policy development process could function. The policy process would be defined in the organization's By-laws.

Registry oversight would be maintained by a Board of Directors. Directors would be responsible for ensuring that the policy development process is followed and that activity of the registry, including policy decisions, is aligned with the registry's general principles. Multi-Stakeholder Advisory Groups could be utilised in the development and decision-making process of the registry. An example of how this could function is explored below:

Director Position	Appointment	Role
Executive Director	By the Board of Directors	Represent the secretariat, including operational, financial and staffing concerns.
Chair	By the Board of Directors	Ensures overall oversight of the Board and organization.
Technical	By the technical committee	Uphold the technical principles of the registry, including accessibility, accuracy and reliance principles.
Policy	By the policy committee	Uphold principles for information characteristics.
Independent	By the Board of Directors	Ensure adherence to principles of neutrality and independence.

Legal and Operational Structure

The legal and operational structure of the registry will also impact the reality and perceptions surrounding its neutrality and independence. It is important that these elements of the registry also reflect its guiding principles.

The Registry could be a non-profit organization or a project within an existing non-profit. In either case, it must be independent of private and government sector oversight in governance and operations.

It could accept funding from different sources, but any donor agreement must clearly affirm the independence and neutrality of the registry. Similarly, the Registry should consider the benefits of being based in a jurisdiction that can provide assurances of non-intervention in the governance and operations of the registry.

The registry must enshrine accountability processes in its by-laws or operating policies. This includes term limits for board members and executive directors (if any), independent financial and salary reviews, and dispute resolution procedures allowing for independent arbitration.

The registry does not require significant staff or technical resources. Similar registries, notably the Internet Assigned Numbers Authority, operate at a significant scale without the need for large teams.

Field Inclusion and Design

Activity and Object Definition

A Lunar Registry provides the opportunity to concurrently log information about both lunar objects and activities. The registration of objects relates to articles or items in space, which could include spacecraft, landers, satellites, and technology, amongst others. The registration of activities relates to occurrences, such as manoeuvres, experiments, and collisions, amongst others. By including the opportunity for both activities and objects, stakeholders will have more insight into what occupies the Moon in what regions, along with past, present, and planned activities, increasing coordination and planning.

Update Protocol

As data in the registry changes, an update protocol which prompts, collects and sends updated records will be established. Data like ownership, changes in mass, and object status will be important to update to maintain the integrity of the registry.

Phased Approach for Mass Movement Building

The Lunar Registry will be designed in a phased approach to encourage. “A registry has intrinsic value. The more players participate and do it correctly, the more valuable it is. In order to be successful, the registry needs to build mass, and as such the key significant take up in the beginning”.

Field Design

The fields of information in the Lunar Registry will be designed preferentially to collect standardised answers in order to serve as a useful and automated tool for technology to query and upload instantaneously. However, in order to coordinate and provide optimal information between parties, The Lunar Registry will also

incorporate voluntary free-form fields to allow respondents to include more information, which often results in more useful, contextual feedback.[261]

Prototype Form Fields

Through a consultative process with industry experts and stakeholders, Open Lunar has included a number of fields that are perceived as being important for inclusion in an effective and useful registry. Fields included in the white paper are drafts and, as such, are likely to change and evolve with implementation and additional consultation. For continuity, the fields have been organised into three categories: Entity and Submission Information; Coordination Contacts; and Object and Activity Data Fields.

Entity and Submission Information		
Field	**Collection**	**Question Type**
Contact information for individual/organization submitting	Name Email Title organization Relationship to Registration	Required, Open Line Text Responses
Identify submitting entity type	Individual / Government / Commercial / Other	Selection
Indicate operators, organizations and collaborators involved in Activity / Object	Commercial Government Scientific Partnership Other	Open Text Prompts
Ownership Details	Details about ownership for Object / Activity, including historical data	Open text prompt

[261] Nielsen Norman Group. "Open-Ended vs. Closed-Ended Questions in User Research," n.d. https://www.nngroup.com/articles/open-ended-questions/.

Coordination Fields		
Field	Collection	Field Type
Include Point of Contacts for Collaboration	General, Government, Mission, Operational, Emergency, PR, Other	Open text prompts
Include any assertions for registered Object / Activity	Assertions (Safety zones/notification and coordination zones)	Open text field
General Requests		Open text field

Object and Activity Data Fields		
Field Prompt	Collection	Question Type
Type of entry	Object or Activity	Multiple Choice
Launching State	State of Launch	Select
What is the status of the Activity or Object?	Planned / Active / Out of Service / Inactive / Other	Multi-Select with Open Field Option
What are the primary purposes of the Activity / Object?	Scientific / Commercial / Crewed / Government / Private / Confidential / Other	Multi-Select
Provide a general description of Activity / Object		Open text field
Indicate notable dates (yyyy/dd/mm) related to Activity / Object?	Date of (planned/actual) arrival Date of event Other notable dates	Date field
Identify location of Activity / Object	Surface Orbit Other	Multi Select with Open Data Field for Other
Regional Occupancy	Landing Site Region Drop Down Orbital Regions Drop Down Other	Multi Select with Open Data Field for Other

Identify important operational general location of Activity / Object through coordinates	Operational General Location	Open Field
Information on past, current, or upcoming manoeuvres and activities for Activity / Object.	Location Coordinates Purpose (Planned or Actual) Date	Open Field
Dimensions of Activity / Objects	Mass starting Mass ending Size: Footprint	Open Text Fields
Estimated duration and/or life of Activity / Object	Range	Date range
General Observations of Activity / Objects	General field for relevant operational information	Open text field

Conclusion and Next Steps

As activity increases, the lunar environment presents a complex challenge for global commons management and multi-stakeholder coordination amongst competing values. As we have learned from experiences on Earth, centralised control systems often lead to under-representation and politicization, particularly at times of increasing geopolitical competition. This creates potential risks in governance and management, which can hinder collaboration between state actors and increase the operating risks for non-state actors.

To address these challenges, a Lunar Registry designed to encourage global multi-stakeholder participation and representation, based on consensus-building and inclusion, offers a tool to foster openness, trust, transparency, representation and social responsibility for all. There is, particularly, space for this, courtesy of the current geopolitically competitive environment providing a receptive state-actor audience. States will be more willing to engage with the views of apolitical actors who might offer a bridge forward for lunar governance that they themselves are prevented from taking if offered by a competitor state due to political, prestige, and trust concerns. With this opportunity to design governance and common management cooperatively, we can create a model for a more sustainable and equitable lunar environment.

This Registry White Paper has been developed as an open proposal. The Open Lunar team welcomes relevant opportunities and encourages those interested in these efforts to reach out directly.

The publication of the White Paper and follow-on open consultations with stakeholders at the end of Q1 / Q2, 2023 marks the first important step towards developing a collaborative and multi-stakeholder approach to managing the lunar environment. The feedback received during the consultation phase will be carefully considered and integrated into a revised draft, which will be published in 2023. From there, the development of the registry itself will begin, with the goal of an initial launch in the near future. As the registry is being developed, it will be important to continue engaging with stakeholders and incorporating their feedback to ensure that the registry is designed to be truly collaborative, inclusive, and consensus-built. Ongoing communication and collaboration will be critical in achieving the goal of sustainable and responsible management of the lunar environment.