

Challenges and Opportunities at the Dawn of the New Space Age

March 21, 2022



ABOUT PERRY WORLD HOUSE

Perry World House is a center for scholarly inquiry, teaching, research, international exchange, policy engagement, and public outreach on pressing global issues.

Perry World House's mission is to bring the academic knowledge of the University of Pennsylvania to bear on the world's most pressing global policy challenges and to foster international policy engagement within and beyond the Penn community.

Located in the heart of campus at 38th Street and Locust Walk, Perry World House draws on the expertise of Penn's 12 schools and numerous globally oriented research centers to educate the Penn community and prepare students to be well-informed, contributing global citizens. At the same time, Perry World House connects Penn with leading policy experts from around the world to develop and advance innovative policy proposals.

Through its rich programming, Perry World House facilitates critical conversations about global policy challenges and fosters interdisciplinary research on these topics. It presents workshops and colloquia, welcomes distinguished visitors, and produces content for global audiences and policy leaders, so that the knowledge developed at Penn can make an immediate impact around the world.

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➤ INTRODUCTION

As space technology evolves due to increased private- and public-sector investments and due to the accelerated pace of innovation, Perry World House hosted a one-day workshop to discuss the novel challenges and opportunities that have emerged at this critical point in the “New Space Age.” This new age is characterized by a diversity of actors beyond the nation-state—actors that have greater accessibility and fewer barriers to acquiring a footprint in space. As participant Xavier Pasco of *Fondation pour la Recherche Stratégique* wrote in his workshop contribution, “Space was born from the Cold War and from the promotion of national interests with the prevalence of foreign policy considerations.”¹ The New Space Age has expanded the map to include private actors and “new technological processes and innovative modes of industrialization and commercial exploitation.”²

Given increased accessibility and lower costs to entry, the space domain is being challenged by a growth in civilian tourism, an increase in space debris caused by collisions and anti-satellite tests, a more robust role from the private sector, and the lack of global space

traffic management, among others. All of these issues need to be tackled. Workshop participants discussed how nations and multilateral institutions, specifically the United Nations, can address these challenges, work to create norms, and enact binding agreements in order to keep the space domain accessible to all, ensure its safety and cleanliness, and maintain it as a commons.

It is imperative that space-faring nations shape their goals through engagement and dialogue with an interdisciplinary group of scientific, business, and policy experts. This ethos guides Perry World House’s mission to “bridge the gap” between the academic and policy communities to foster greater interdisciplinary research, cooperation, and learning in order to ultimately shape better policy. This type of dialogue benefits space programs in at least two important ways: (1) educating stakeholders on key challenges and (2) spurring innovative and collaborative thinking in academia and in the public and private sectors. The results of these types of programs can anchor space-related developments and shape the future of the space domain.

In a pre-workshop survey³ given to participants, over 60 percent of respondents “agreed” or “strongly agreed” that the world has entered a “New Space Age,” which is a principal reason for the workshop: to discuss the opportunities and challenges at this critical moment in time.

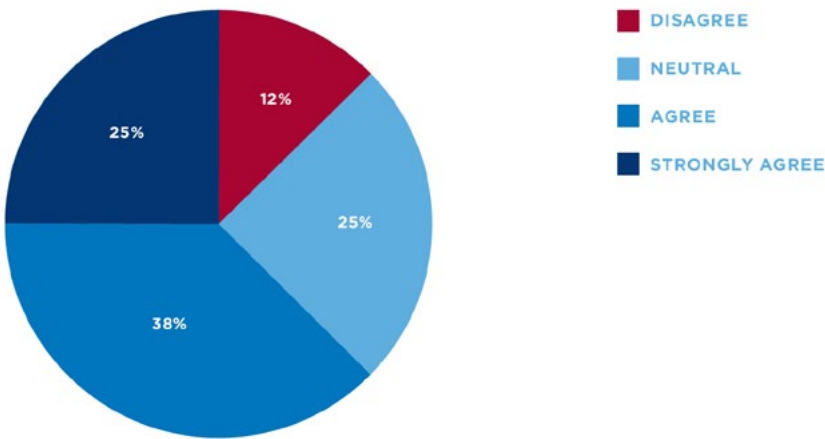
Another reason for convening this workshop was to spotlight an array of space-related needs for policymakers. Participants felt strongly that policymakers do not pay enough attention to space policy, with 70.6 percent of them saying that space policy receives “somewhat too little attention” and 17.6 percent indicating that it received “far too little attention.” Participants offered similar opinions over how much attention think tanks and academics give to space policy, with 47.1 percent saying “somewhat too little attention” and 23.5 percent saying “far too little attention.”

1 As a part of the workshop, participants were asked to write draft thought pieces that addressed the topics to be discussed at the workshop. Xavier Pasco, “Elements on the Cooperation and Competition Dynamics in the New Space Environment,” March 2022.

2 Ibid.

3 A pre-workshop survey was given to all participants to gauge their views, opinions, and priorities on the topics that would be discussed during the workshop.

Figure 1: Do you agree that the world has entered a “New Space Age?”



> BACKGROUND

The Global Order theme examines the implications of changing global power dynamics, the impacts of new technologies, and contributions of governance institutions for the future of international cooperation. The theme addresses the changing international order, and a key part of the theme focuses on how these factors intersect in the space domain. As a result, in recent years, Perry World House’s Global Order theme has focused on critical issues in the space domain. The 2022 workshop follows previous programs that addressed related space-domain topics.

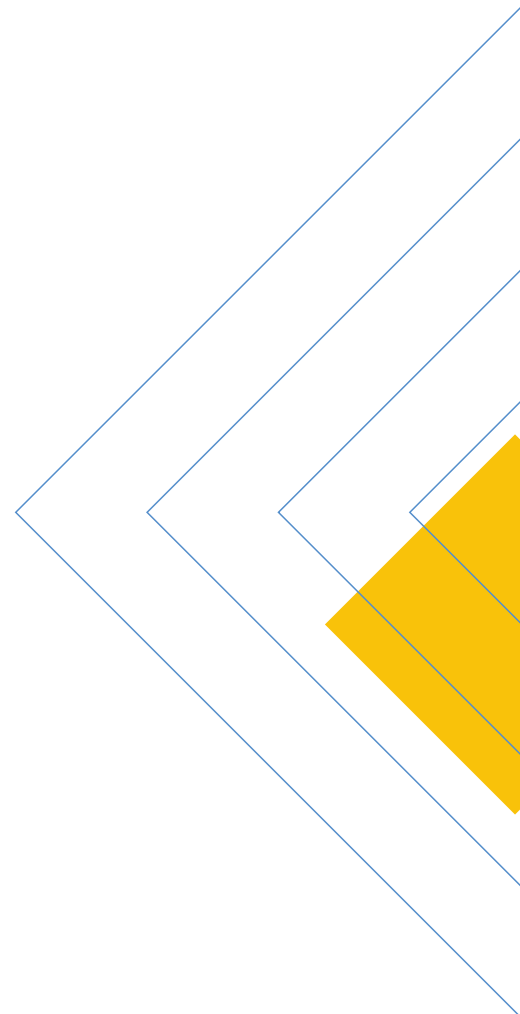
In fall 2021, Perry World House convened a two-day colloquium on *The New Space Age: Beyond Global Order*. That colloquium explored issues such as private-public partnerships, military competition, international space law, and emergent economic opportunities. Over the two days, academics, practitioners, and policymakers explored the new economic paradigms, scientific and engineering breakthroughs, and pitfalls of the New Space Age and set an optimistic tone for the protection of the “commons” of space. The 2021 colloquium made three major policy recommendations: (1) “recognize the danger of space hype: exaggerated claims and mischaracterizations of space are holding back productive discussions on pressing policy issues”; (2) “use space debris as a Trojan horse to strengthen global ‘rules of the orbit’”; and (3) “leverage public-private partnerships to fuel the New Space Age.”⁴ These three recommendations move space policy forward by reducing the haze of exaggeration and by making progress on critical challenges in the space domain, specifically regarding space debris and the role of the private sector. The colloquium demonstrates how Perry World House’s background in both policy and science

⁴ Julia Ciocca, Rachel Hulvey, and Christian Ruhl, “The New Space Age: Beyond Global Order,” Perry World House, Fall 2021, <https://global.upenn.edu/sites/default/files/perry-world-house/The%20New%20Space%20Age%20-%20Beyond%20Global%20Order%20Report.pdf>.

uniquely positioned it to host this interdisciplinary workshop on the challenges and opportunities in the New Space Age. The 2021 colloquium answered many important questions, but in that process, it also raised additional topics and issues for discussion.

Building on the conversations and recommendations from the 2021 colloquium, this workshop addressed space policy gaps across a range of priority issues. The previous workshop specifically identified space debris as an important point for further discussion, so this workshop brought in experts to discuss that critical issue. The space workshops at Perry World House continuously build on previous discussions. *Challenges and Opportunities at the Dawn of the New Space Age* participants provided suggestions on how to better regulate and remove space debris; how innovation will change the future of space technology and economy; and how to prevent competition from undermining stability in the domain. Many challenges in space are global in nature and depend on the activities of all space-faring nations. Issues such as space debris are common to all nations and present the same security threats to all, requiring global coordination to execute techniques such as active debris removal. However, international law and agreements currently in place, like the 1967 Outer Space Treaty (OST), are mostly non-binding and do not contain mechanisms to penalize signatories for violations. To sustain innovation in technology, governments and corporations must first come together to form binding agreements. Moreover, having a better grasp on the existing problems with international coordination and competition will be important for any governments and private-sector enterprises in making efficacious decisions about investing in further space technology programs.

As the New Space Age emerges, Perry World House hosted a hybrid workshop on *Challenges and Opportunities at the Dawn of the New Space Age*, on March 21, 2022. The goal of the workshop was to “bridge the gap” and address critical policy questions by bringing together policymakers, academics, diplomats, and corporate representatives to spark an open discussion focused on the following areas: (1) space technology and economy, (2) challenges of the new space age, (3) space debris, and (4) cooperation and competition. The panels included stakeholders from around the world, reflecting the global nature of these problems and the necessity for international perspectives and solutions.



PANEL

› THE FUTURE OF SPACE TECHNOLOGY AND ECONOMY

MODERATOR

Theo Milonopoulos

Postdoctoral Fellow, Perry World House

Svetla Ben-Itzhak

Assistant Professor, Space and International Relations, Air University with the West Space Seminar, Air War College

Ellen Chang

Vice President, Ventures BMNT, Head of H4XLabs; and Co-Founder and Co-President, Wharton Aerospace

Col. Charles Galbreath

Deputy Chief Technology and Innovation Officer, U.S. Space Force

Naoko Yamazaki

Former JAXA Astronaut; and Director, Spaceport Japan Association

The workshop began with a hybrid panel, comprising four experts, on the future of space technology and the economy. They discussed considerations both for those making large investments in space technology and those receiving investments to develop and use new space innovations. The most important issues addressed by the panelists were the long timelines of developing technologies for space missions and the sheer amount of funding required to complete a project. Workshop participant Svetla Ben-Itzhak of the Air War College at Air University explained the positive and negative ramifications of cheaper and smaller space technology in her written product: “These recent developments in satellite architecture will result in

access to space becoming à la carte where interested parties can enter space at different levels of engagement. One may expect, therefore, that space will become even more congested as the number of new entrants increases. It will, however, also become more diversified in terms of capabilities, interests, and stakes, which will transform the current environment.”⁵

The speakers summarized the most critical near-term space technologies being invested in today and proposed tentative timelines for deployment. Panelists delved into the economic impacts of these technologies and examined the figures on required investments to achieve long-term objectives. The technologies themselves ranged across sectors from near-term applications, like telecommunications, to more ambitious ones, such as space tourism. However, for each of these current and emerging technologies, the discussion was centered on timescales for development, setting priorities for investments, and

5 Initial Workshop Draft, Svetla Ben-Itzhak, “The Future of Space Technology and How It May Benefit Humanity,” March 2022.

public-private partnerships. The space sector is unique because deployment of space technologies requires close coordination with national governments—both to adhere to regulations and to secure the state investment needed to launch multi-billion-dollar initiatives. Large space projects tend to be significantly longer than those of other technologies' typical research and development processes, requiring investors to wait longer for a return on investment.

In this panel, a speaker discussed Japan's strategy to gain greater recognition in the space sector and to promote continued investments. The panelist described Japan's plans to install 13 space ports in the next few decades in partnership with companies, including Virgin Orbit, which would make East Asia a key space hub. The panelist also discussed Japan's goal to maintain an independent space transportation system and to leverage public-private partnerships to deploy novel satellite systems based on "small satellites" (also called "smallsats"), which are several factors smaller and cheaper than traditional satellites. Another panelist touched on the overarching technological trends in the New Space Age, drawing comparisons to the dawn of the first Space Age during the 1950s and 1960s. For instance, during this time period, space programs were entirely managed by states. By contrast, a growing number of space actors stem from corporate and academic organizations. Objectives in space have dramatically changed over the past 60 years. For example, state actors were initially focused on achieving a moon landing, while today some companies have ambitions of making space accessible to the public with space tourism. The panelist warned that these signs of a New Space Age will create opportunities as well as risks—risks that governments, multilateral organizations, and military entities must mitigate in order to "reap the benefits of the space domain."



Col. Charles Galbreath, Deputy Chief Technology and Innovation Officer, U.S. Space Force, speaks to workshop participants.

The third participant said that the entire commercial space economy is worth \$371 billion, with \$271 billion of that coming from the communications industry, demonstrating the crucial role that space plays in this arena. The panelist said that over 80 percent of the space travel sector is monopolized by the companies of a handful of billionaires and their private investments. The last panelist focused on an extensive set of emerging space technologies and societal impacts, with an emphasis on smallsats. Smallsats are less costly and take less time to manufacture than traditional satellites. However, this technology could lead to higher orbital congestion due to higher densities and ease of access. Economically, the speaker projected that the global space economy will grow to \$1 trillion by 2040 due to commercial activities, including tourism and mining. The initial discussion concluded with reminders that new challenges will emerge as the space economy grows, requiring novel types of policy and other interventions.

After the initial framing remarks by each panelist, they moved into a moderated discussion and questions from other participants. This discussion focused on the major issues brought up by the panelists in their remarks: time scale, priorities, and security issues.

POLICY DISCUSSION: TIME SCALE OF DEVELOPMENT

Central to executing any engineering endeavor is establishing a timeline of research and implementation to appropriately allocate a budget, delegate tasks, and ensure that the development of the technology stays on course and meets expectations. This is particularly crucial for innovations in space as the budgets are very large, coordination across multiple entities is complex, and small technical roadblocks can often set projects back by years.

The research and development (R&D) stage specific to space for new technologies is a minimum of five years; however, this significantly varies depending on the technology. For instance, more mature technologies, such as communications, will only require five years of R&D, while more ambitious technologies in areas like space tourism and in-space manufacturing would need an additional 15 years. Projecting timelines beyond the R&D phase is challenging, as it is difficult to predict how a specific technology may evolve in a changing climate over the course of five to 15 years.

Panelists drew parallels between the New Space Age and the emergence of the commercial aerospace industry. For instance, although the Wright brothers built the first airplane in 1903, it was only in 1914 that



Svetla Ben-Itzhak, Assistant Professor, Space and International Relations, Air University with the West Space Seminar, Air War College, speaks to participants. Workshop participants listen to the discussion on space technology and economy.

the first commercial flight took place. Although there are some similarities between space and aerospace transportation, the timescale for space transportation is many factors longer than that of aviation. Panelists also emphasized that the financial backing required for the commercial space industry is orders of magnitude larger than its aerospace counterpart.

POLICY DISCUSSION: WHAT WOULD YOU PRIORITIZE?

As humanity enters the New Space Age, it will become critical to prioritize certain aspects of technological development. Panelists were asked, “Space law lags behind innovation, what would you prioritize?” One panelist said that coordination between various actors should come first and “is critical.” For instance, China and Russia have competing interests in lunar positioning, so it is important for the United States and its partners to first establish the rules for cooperation to gain a strategic advantage over Russia or China prior to fully investing in the R&D needed to deploy the technology. The panelist further elaborated that space technology is evolving at such a rapid pace that enabling coordinated efforts first will drive competition and then lead to innovation. All other panelists agreed with this viewpoint highlighting coordination, with some citing the Artemis Accords as a key set of rules to build on. The Artemis Accords establish a shared set of principles for space exploration and moon landings, allowing for the rescue of astronauts by foreign countries. However, establishing trust in the Artemis Accords requires coordination between all space-faring nations.

POLICY DISCUSSION: WHAT ROLE WILL SECURITY SERVICES PLAY IN A DOMAIN WITH MORE ACTORS?

The current environment of outer space activities is rapidly changing as more corporate actors become involved, which has given rise to new security concerns. Confrontation between non-state space assets and commercial satellites now are increasingly becoming a concern, while legal norms to address such events are extremely limited. To elicit the best ideas on this critical topic, participants were asked, “What role will security services play in a domain with more actors?” and “What happens when a private asset is damaged by another asset?” Participants agreed the close proximity of state and non-state objects in outer space will raise significant security concerns because of the unregulated nature of space activities. One panelist highlighted the need for a better understanding of the distinction between civil and military space actors, pointing out that insurers do not comprehend the current risks. Insurers in other sectors have a record of incidents encountered by their consumers, allowing them to quantify the financial risks of certain activities. In contrast, there is a limited record of incidents between civil and government actors in outer space, making risk assessment a challenging task for space insurance companies.

Increased space domain awareness is critical in mitigating the security risks of encounters, such as a state-owned satellite crashing into a privately-owned satellite. A layer of transparency is critical because the traditional role of the military in these interventions may not be sufficient. Therefore, a “whole-of-

government approach” should set the path forward. There exists a problem of attribution for specific incidents, with responsibility ultimately falling on states due to the 1967 OST. However, this treaty was established in an era when state actors dominated space activities. Hence, significant modifications should be made to the OST to adapt it to the current corporate climate. The lack of regulation and oversight on the risks of outer space activities, particularly regarding accidental and nefarious confrontations of private and public space assets, is a critical issue for space programs. Leaders from government agencies and space companies must engage in continued dialogue to assess the history of incidents and to quantify the risks involved for insurance companies. Modifications to the OST are necessary to account for the responsibility of civilian activities.



QUESTIONS FOR FUTURE RESEARCH

With the objective of accelerating innovation, what should be prioritized: coordination or expanding R&D budgets?

Do the Artemis Accords sufficiently support the current climate of international coordination in space?

What can governments and the private sector do to improve risk assessment (and coverage) in space?



From top to bottom: Michael C. Horowitz, Director, Perry World House; Ellen Chang, Vice President, Ventures BMNT, Head of H4XLabs and Co-Founder and Co-President, Wharton Aerospace; Theo Milonopoulos, Postdoctoral Fellow, Perry World House; and Naoko Yamazaki, Former JAXA Astronaut and Director, Spaceport Japan Association, speak during the panel.

› THE CHALLENGES OF THE NEW SPACE AGE

MODERATOR

Michael C. Horowitz

*Director and Richard Perry Professor,
Perry World House*

Sean O’Keefe

*University Professor, Howard & Louise Phanstiel
Chair in Leadership, Maxwell School, Syracuse
University, former Secretary of the Navy, and former
Administrator of National Aeronautics and Space
Administration (NASA)*

Izumi Nakamitsu

*High Representative for Disarmament Affairs,
United Nations*

This discussion focused on emerging challenges and opportunities in outer space domestically and internationally. Both speakers agreed that the various challenges in outer space, such as space debris, are global concerns and require international cooperation. The outbreak of war in Ukraine was a point of discussion given the important role that Russia places in international space cooperation efforts, specifically with the International Space Station. Each expert shared their unique insights, with Secretary Nakamitsu focusing on the international challenges given her leadership role at the United Nations and Administrator O’Keefe sharing a more U.S.-based perspective due to his leadership positions at NASA and in the U.S. Navy.

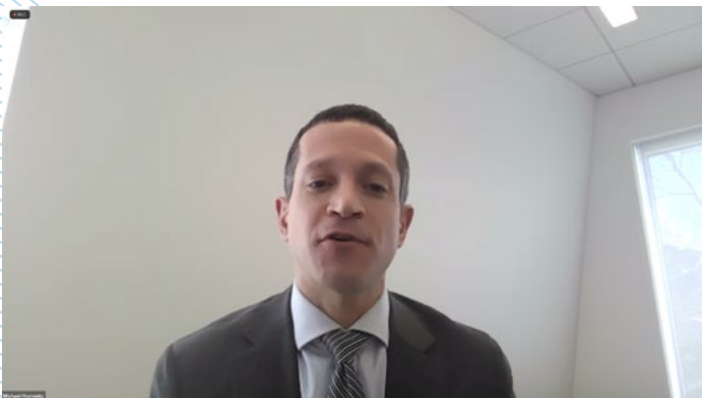
Nakamitsu highlighted the inherent global nature of outer space and how conflict spillovers are to be expected. One area of concern she identified was the jamming of satellites, leading to unintended escalations and the disruption of active space debris removal programs. She reaffirmed the U.N.’s commitment to support its member states in this domain through binding and non-binding norms and treaties. She noted that many international agreements fail due to lack of accountability. Therefore, she stressed the importance of developing binding agreements to ensure that states and companies adhere to their promises.

O’Keefe raised concerns about a crowded low-Earth orbit (LEO), where a majority of satellites operate and are at potential risk of collision. He noted that public-private partnerships at the national level could incentivize companies to adhere to standards that mitigate space traffic. Building from this, he looked at how safety standards will change as commercial space travel becomes ubiquitous. O’Keefe suggested that entities should treat space as a “public good.” He also emphasized that foreign entities who don’t obey safe practices—such as Russia, which recently conducted an anti-satellite test that generated 1,500 pieces of debris in LEO—should be held accountable through binding agreements.

The war in Ukraine and its ramifications in space were addressed by both speakers, who also focused on the dangers of cyberattacks on satellites and the related issue of attribution. Dr. Horowitz asked them, “How might the Russian-Ukraine conflict influence space cooperation with Russia?” O’Keefe suggested that the United States should not tolerate Russia’s invasion of



From top to bottom: Izumi Nakamitsu, High Representative for Disarmament Affairs, United Nations; Sean O'Keefe, University Professor, Howard & Louise Phanstiel Chair in Leadership, Maxwell School, Syracuse University, former Secretary of the Navy, and former Administrator of National Aeronautics and Space Administration (NASA); and Michael C. Horowitz, Director, Perry World House, discuss the challenges of the New Space Age in a virtual keynote conversation.



Ukraine and that breaking off space collaboration with Russia is appropriate given the circumstances. Nakamitsu said that cooperation in outer space should be preserved, that hostilities in outer space pose major threats, and that the idea of outer space as a commons should be preserved. She specifically warned, “It is

unclear how a nuclear-armed state might react if it loses control of a space asset that it regards as critical national security infrastructure or that it uses for early warning.” Hence, a major cyberattack or collision has the potential to disrupt and to be considered an act of war.

› HOW TO SOLVE THE PROBLEM OF SPACE DEBRIS

MODERATOR

Fiona Cunningham

Assistant Professor of Political Science, University of Pennsylvania; and Faculty Fellow, Perry World House

Christophe Bonnal

Senior Expert, Strategy Directorate, Centre National d'Études Spatiales (CNES)

Robin Dickey

Space Policy and Strategy Analyst, Center for Space Policy and Strategy, Aerospace Corporation

Jill Stuart

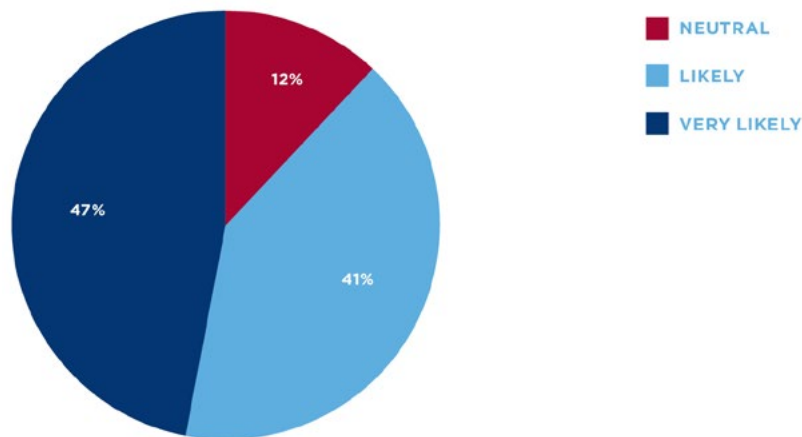
London School of Economics; and former editor, Space Policy

As more states develop space programs and as private space industries proliferate, LEO and geostationary orbit (GEO) will become increasingly cluttered with space debris. This will make the deployment of new missions an increasingly difficult task and compromise the security of space assets and astronauts. Solving this problem will require a broad set of legal, engineering, and policy interventions, all of which demand collaboration and learning among experts across disciplines. Robin Dickey of the Aerospace Corporation explained the complicated nature of the space debris issue in her article: “Because this problem is so multi-faceted and involves such a diverse group of stakeholders, the future of space debris governance may need to go beyond the notion of a single

organizing international body or a single set of rules. An alternate approach, or approaches, to space debris governance is the development of international space norms: generally agreed-upon acceptable or unacceptable behaviors.”⁶ This panel served as a platform for such conversations. There was consensus among panelists for stronger agreements on preventing the creation of additional space debris and removing it. Moving coordination from the national level to the multilateral level for traffic management would also reduce the risk of collisions.

Workshop participants answered a series of questions regarding the importance of this issue. Over 47 percent of participants said that space debris was “very likely” to be a problem for human activity in space over the next five to ten years. Another 41 percent said that it was “likely” to be a problem, with under 12 percent expressing a “neutral” response.

6 Initial Workshop Draft, Robin Dickey, “Solving the Problem of Space Debris: A Normative Approach to Space Debris Governance,” March 2022.

Figure 2: Over the next 5–10 years, how likely is space debris to be a problem for human activity in space?

In a separate question, only 11.8 percent of participants believed that space debris will be the greatest challenge to maintaining space as a sustainable commons over the next five to ten years. The number jumped to 29.4 percent when the timeframe increased to 50 to 100 years. Participants connected the issue of space debris to the militarization of space and the continued testing of anti-satellite weaponry.

Currently, the Earth’s orbit has 100 to 1,000 times more debris than active satellites, separated by 700 to 1,110 kilometers—making it challenging to distinguish debris from active satellites and drastically increasing the probability of collisions due to the high volumetric density of debris. Over 97 percent of space debris comes from the three largest space-faring nations: Russia, China, and the United States. Current debris-mitigation techniques are centered on standard principles, national legislation, and norms, rather than legally binding agreements that hold states accountable for their debris. Active debris removal techniques have already been developed, but government and industry funding to scale them up is extremely limited. This is attributed to the fact that there is no return on investment and that these techniques are very costly with an upfront expense of \$30 to \$40 million.

Additional key problems are the lack of common language and terminology for space debris, entanglement between safety and security issues, and shorter-term rather than longer-term incentives to fix the space debris issue that create the biggest bottlenecks in mitigation. A speaker provided four decisions that policymakers must consider to make progress in this area: (1) develop a mechanism in which a government agency can take the lead on this issue; (2) work with allies and form a broader international effort for mitigation; (3) establish

international commitments and norms for good and bad behavior; and (4) determine how many countries need to agree on a set of behavioral norms that would essentially force an actor to follow them.

After the initial framing remarks by each panelist, they moved into a moderated discussion and questions from other participants. This discussion focused on the major issues brought up by the panelists in their remarks: reducing the amount of space debris and the role of the private sector in mitigating this issue.

POLICY DISCUSSION: EXISTING EFFORTS IN PLACE FOR THE PREVENTION OF SPACE DEBRIS

Some efforts have been made to reduce the amount of space debris, but the efficacy and scalability of these techniques has remained inadequate for decades. While the technology for space debris removal is mature, investment to fully scale these techniques is insufficient. Obstacles to progress in this area are legal, financial, and political in nature.

Focusing on reassessing the current norms of debris removal, the panelists were asked, “What existing kinds of rules do we have in place for prevention of space debris that we should preserve from competition?” One panelist urged the preservation of the OST, as it is state-centric. While keeping the OST will help maintain oversight, the responsibilities of different organizations under the treaty must be more clearly delineated. Civilian space operations are more and more prevalent, which requires an update to the OST to accommodate non-state actors. Another participant agreed, saying that cooperation at different levels of government on this issue is key and should be maintained.

For instance, the Artemis Accords, signed in 2020, serve as a platform to enable this type of coordination. However, countries must work to strengthen the principles of the accords by making binding agreements, and organizations like the United Nations must be more active and coordinate discussions with scientists and engineers.

POLICY DISCUSSION: THE ROLE OF PRIVATE INDUSTRY IN MITIGATING SPACE DEBRIS

With the growing number of corporate actors entering LEO, the responsibility of industries to remove the debris that they create will become increasingly crucial. The moderator asked, “What is the role of the private sector in space debris mitigation?” The consensus was that private actors currently show little accountability and distance themselves from the issue since there is a minimal financial incentive to deploy space debris removal technologies. One participant cited space debris removal programs in China, discussing how long-term programs in China backed by the government—such as one funded by the China Aerospace Science and Technology Corporation (CASC)—provide incentives for companies to accelerate debris removal efforts. Western countries should follow this model to improve the rate of debris removal. In the case of China, Beijing is the main shareholder in CASC; therefore, CASC must adhere to the regulations and timelines set by the government. However, in other cases where shareholders do not hold private companies accountable for collisions in space, the likelihood that those companies will adhere to good practice in avoiding collisions and debris removal is diminished.



QUESTIONS FOR FUTURE RESEARCH:

How do the Outer Space Treaty and Artemis Accords need to evolve to respond to and establish a framework for an effective global, collective effort in reducing space debris?

What aspects of other existing international treaties can be leveraged to do this?

Given the fiduciary duty corporations have to shareholders, how can shareholders incentivize their companies to become more active in space debris removal?



From top to bottom: Christophe Bonnal, Senior Expert, Strategy Directorate, Centre National d'Études Spatiales (CNES); Jill Stuart, London School of Economics, and former editor, Space Policy; and Robin Dickey, Space Policy and Strategy Analyst, Center for Space Policy and Strategy, Aerospace Corporation, engage with fellow panelists discussing the space debris issue.

COOPERATION AND COMPETING VISIONS IN SPACE

MODERATOR

Robert M. Scher

Head of International Affairs, bp America; and Visiting Fellow, Perry World House

Paige P. Cone

Assistant Professor of Strategy and Security Studies, Air University, School of Advanced Air and Space Studies

Namrata Goswami

Independent Researcher

Douglas C. Ligor

Senior Behavioral/Social Scientist, RAND Corporation

Peter Martinez

Executive Director, Secure World Foundation; and former Chair, United Nations Committee on the Peaceful Uses of Outer Space (U.N. COPUOS) Working Group on the Long-Term Sustainability of Outer Space Activities

Xavier Pasco

Director, Fondation pour la Recherche Stratégique

Dealing with competition in space is challenging since most treaties and agreements in outer space are non-binding. They take the form of norms to achieve the common good rather than legal agreements. Significant reform to make binding agreements and to extend them beyond national legal boundaries must be pursued to prevent harmful escalation. Despite the increased prevalence of competition in outer space, areas of overlapping interest between states and corporations present opportunities for cooperation. But as strategic competition between great powers intensifies, this may not always be achievable. Moscow and Beijing, for example, have grown closer in space cooperation, but this may drive other parties to foster collaboration

with Washington instead, potentially escalating the sense of competition and instability in space. As Paige Cone of Air University wrote, there is potential for new relational dynamics: “The lower barriers to entry to becoming a space power—a new marker of prestige in the international system—means that there is real potential for new relations among alliances.... This creates new dynamics for American conceptions of its allies: Is it advantageous for the United States to create a ‘space umbrella’ as it has with its nuclear umbrella?”⁷ With geopolitical competition shifting into the space domain, it is crucial to discuss opportunities for cooperation among allies and adversaries alike.

⁷ Initial Workshop Draft, Paige Cone, “Terran Politics by Other Means? How Cooperation and Competition Among Allies and Adversaries Changes in the Space Domain,” March 2022.

Workshop participants were asked a series of questions regarding the effect of great power competition on space. Nearly 60 percent of participants said that great power competition between the United States and China will have a “somewhat negative” effect on human activity in space.

When the question flipped to cooperative efforts between two U.S. competitors, Russia and China, the outlook improved. Nearly 24 percent of participants believed that cooperation between Russia and China would have a “somewhat positive” effect on human activity in space, with the bulk of the participants (35 percent) taking a “neutral” view.

Despite the likely competitive nature of future great power politics on Earth, workshop participants had a positive view of future cooperation in space. Most participants view international cooperation in space over the next five to ten years to be “somewhat likely” and “extremely likely,” with nearly 30 percent taking a “neutral” view. These three questions point to diverging views within the group about the positive and negative effects of great power competition between the United States, Russia, and China.

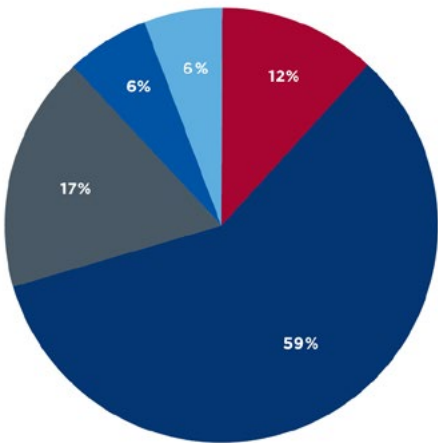


Figure 3: Over the next 5–10 years, “great power competition” between the United States and China will have a _____ effect on human activity in space.

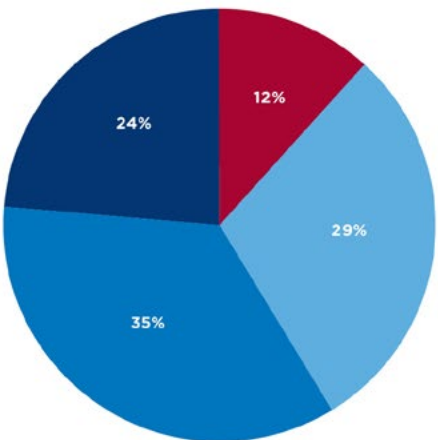


Figure 4: Over the next 5–10 years, cooperation between Russia and China will have a _____ effect on human activity in space.



Middle powers exert a strong influence on competition and cooperation in the space domain. For example, Luxembourg has managed to make itself a significant player in space by using its economic heft to invest in and nurture space companies. Despite Luxembourg’s small size, it has become an enticing location for companies by creating the SpaceResources.lu Initiative, a system of business-friendly regulations and laws. The initiative’s goal is to make Luxembourg a key country for space exploration: “Building on its long history at the forefront of the commercial satellite communications industry, Luxembourg aims to play a leading role in the exploration and utilisation of these resources.”⁸ Luxembourg joined the Artemis Accords and has become a leader in space mining. Participants agreed that while smaller states may not have access to space in the same way that larger states do, they can help to shape the norms of the future.

Another major thrust in space cooperation and competition is space law. One panelist stressed that space itself has no rule of law. Therefore, these non-binding norms need to be revised to hold governments and companies accountable for potentially nefarious actions because governments typically take a “race to the bottom” approach and because the current space climate consists of “laws of rulers” but “no rule of law.” Drawing on Thomas Hobbes, the panelist noted that space law particularly suffers the same issue that international law does: There is no Leviathan to hold states accountable for conducting an anti-satellite test. However, robust international legal regimes, especially

the creation of the United Nations Convention on the Law of the Sea (UNCLOS), could be a model for the space domain. On the economic front, several panelists agreed that cooperation and competition in space will be driven by financial motives. One participant discussed how shifting dynamics in space give rise both to complexities and opportunities for change, with new technologies being deployed within a rapidly evolving space economy.

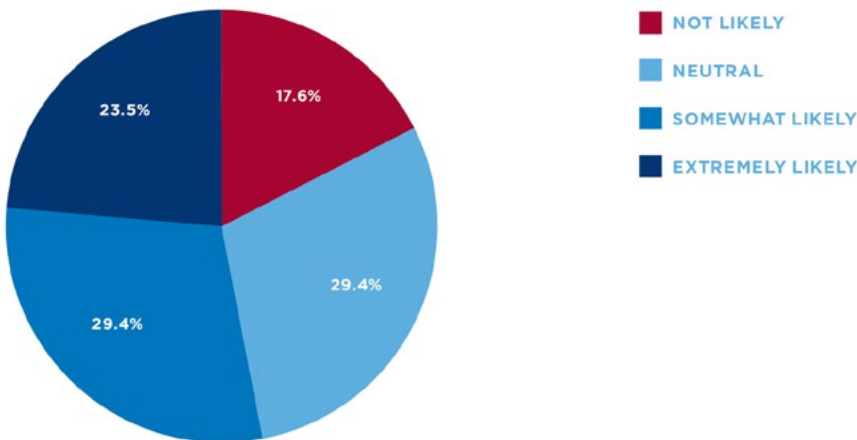
After the initial framing remarks by each panelist, they moved into a moderated discussion and questions from other participants. This discussion focused on the importance of multilateral organizations, particularly the United Nations, in shaping space cooperation.

POLICY DISCUSSION: INTERNATIONAL BODIES AND COOPERATION

International bodies such as the United Nations bring countries with common strategic interests together and establish binding and non-binding norms on major issues. Due to the international nature of outer space, bodies like the U.N. are a natural place to develop norms for cooperation and competition in space.

One panelist emphasized the U.N.’s effectiveness in outer space policy, saying that the body works well in forming a consensus but lacks the heft to implement agreements. In space traffic management, consensus on management strategies would need to first be achieved domestically in each country, working with both public

Figure 5: How likely is international cooperation in space over the next 5-10 years, despite ongoing geopolitical competition on Earth?



⁸ “SpaceResources.lu Initiative,” Luxembourg Space Agency, <https://space-agency.public.lu/en/space-resources/the-initiative.html>.



Douglas C. Ligor, Senior Behavioral/Social Scientist, RAND Corporation, speaks during the panel.



Namrata Goswami, Independent Researcher, engages with panelists on the possibilities for greater cooperation in the space domain.



Paige P. Cone, Assistant Professor of Strategy and Security Studies, Air University, School of Advanced Air and Space Studies, participates in the panel on cooperation and competition in space.



Peter Martinez, Executive Director, Secure World Foundation; and former Chair, United Nations Committee on the Peaceful Uses of Outer Space (U.N. COPUOS) Working Group on the Long-Term Sustainability of Outer Space Activities, talks about cooperation in space.



Robert M. Scher, Head of International Affairs, bp America and Visiting Fellow, Perry World House, engages with panelists.



Xavier Pasco, Director, Fondation pour la Recherche Stratégique, engages with panelists.



Participants during the final panel of the workshop.

and private entities, before seeking cooperation with foreign states. Although a country-specific approach to traffic management might be a better fit for the problem, there is still room for consensus within larger international bodies where disagreement may be more prevalent. As discussed by a speaker earlier in the panel, other U.N. agreements, such as UNCLOS, could be a model to implement norms of operating in a shared domain. Another way for states to increase cooperation and decrease friction is for countries to share their data on projected satellite paths and possible collisions. The space domain is a clean slate to build on common interests with current alliances and set boundaries for competition with others.



QUESTIONS FOR FUTURE RESEARCH:

What will deterrence look like in space and how can current allies on Earth coordinate to prevent escalation of conflicts in space?

How will current conflicts on Earth translate to future rivalries in space?

What is the role of the United Nations in forming these policies?

> POLICY RECOMMENDATIONS

Based on the panel discussions and participant remarks, this report makes the following policy recommendations:

STANDARDIZE SENSORS ON SATELLITES TO INCREASE GEOSPATIAL AWARENESS.

As financial barriers diminish, the number of satellites in space has drastically increased. To address heavier traffic in space, states should normalize implementing technology that can alert space agencies or other responsible parties about potential collisions and the accurate locations of satellites. Doing so will help to manage satellite placement and improve space traffic management. Currently, many satellites have this technology, but usage should be the norm and not viewed as an added cost.

CREATE AN INTERNATIONAL GEOSPACE SITUATIONAL AWARENESS PROGRAM FOR COUNTRIES TO HAVE ACCURATE KNOWLEDGE OF SPACE TRAFFIC.

States need to have a forum where they can reliably alert each other about problems with space traffic. While there are international fora where such communication takes place, there should be a designated body to avoid potential mishaps. A global space traffic management system would ensure the safety of satellites and the future of space travel. This system would also need to address issues related to shared orbit and spectrum resources.

CONVENE A SUMMIT TO BEGIN DRAFTING LEGISLATION CONCERNING MUTUALLY BENEFICIAL ISSUES SUCH AS DEBRIS.

The time has come to codify a set of acceptable space behavior norms into international law. As it stands, nobody disagrees with the current informal regime that all states should seek to avoid creating debris and should work to reduce the amount. While competition can help to develop technology, cooperation will help to manage space-faring activities.

REDUCE BARRIERS AND FOSTER GREATER SPACE COOPERATION.

Laws like the U.S. Wolf Amendment, which prohibits NASA from “develop[ing], design[ing], plan[nin]g, promulgat[ing], implement[ing], or execut[ing] a bilateral policy, program, order, or contract of any kind to participate, collaborate, or coordinate bilaterally in any way with China or any Chinese-owned company,”⁹ create barriers to international cooperation. Since states will not readily share technology with rivals, they should work to cooperate on managing projects and communicate efficiently on specific issues. The United States and the Soviet Union once cooperated over launches; states today can—and should—do the same.

⁹ Department of Defense and Full-Year Continuing Appropriations Act of 2011, Public Law 112–10, Sec. 1340, 112th Congress, <https://www.congress.gov/112/plaws/pub110/PLAW-112publ10.htm>.

> CONCLUSION AND FUTURE RESEARCH

Any hopeful vision for the future of humanity will require a sustainable and secure space domain. The space domain is growing more dangerous—as Douglas Ligor of the RAND Corporation explained in his written contribution to the workshop: “The increase in great power competition between the United States, People’s Republic of China, and Russian Federation is making space more dangerous. The lack of binding international rules, governance regimes, and institutions that would induce or compel coordination and collaboration between allies and adversaries alike and constrain the aberrant behavior of malicious or negligent actors through the imposition of both soft and hard enforcement mechanisms exacerbate the dangers.”¹⁰

The issues of space debris and competition among adversaries will continue to persist in this new era, and both domestic and international policies must be developed to ensure a safe and prosperous future. Workshop participants recommended several key areas

for further study, some of which were discussed during the panels. On the business side, a more complete discussion about the development of space insurance is warranted, given the growing role of the private sector in space—and the inherent dangers of operating in space, given the problem of space debris. Multiple participants supported a more specific focus on space debris and space traffic management in LEO—as well as forging a common vision for humanity’s presence in space. This common vision might conflict with the fact that the development of technology has outpaced laws and norms. In the security sphere, a focused discussion on anti-satellite weaponry and testing is needed, as well as addressing the threat of cyberattacks and threats to space assets. All these issues require a discussion on the future of international and national space governance through the negotiation of new space-related treaties. Perry World House will continue to pursue work in this area to maintain a dialogue with experts from multiple sectors.

> WHAT THE EXPERTS ARE READING

Workshop participants recommended the following materials to learn more about space and space policy issues:

- Doug Brinkley, *American Moonshot: John F. Kennedy and the Great Space Race* (HarperCollins, 2019).
 - Eric Berger, *Liftoff: Elon Musk and the Desperate Early Days That Launched SpaceX* (William Morrow, 2021).
 - Kara Cunzeman, Paul Frakes, Robin Dickey, and Sophia Jones, “Strategic Foresight for the Space Enterprise,” The Aerospace Corporation Center for Space Policy and Strategy (November 2021).
 - Daniel Deudney, *Dark Skies: Space Expansionism, Planetary Geopolitics, and the Ends of Humanity* (Oxford University Press, 2020).
 - Namrata Goswami and Peter Garretson, *Scramble for the Skies: The Great Power Competition to Control the*
- *Resources of Outer Space* (Lexington Books, 2020).
 - Todd Harrison, Kaitlyn Johnson, and Makena Young, “Defense Against the Dark Arts in Space: Protecting Space Systems from Counterspace Weapons,” Center for Strategic and International Studies, February 2021, <https://www.csis.org/analysis/defense-against-dark-arts-space-protecting-space-systems-counterspace-weapons>.
 - Bruce McClintock, Katie Feistel, Douglas C. Ligor, and Kathryn O’Connor, *Responsible Space Behavior for the New Space Era: Preserving the Province of Humanity*, (RAND Corporation, 2021), <https://www.rand.org/pubs/perspectives/PEA887-2.html>.
 - James Clay Moltz, *The Politics of Space Security: Strategic Restraint and the Pursuit of National Interests* (Stanford Security Studies, 2008).
 - Stacey Solomone, *China’s Strategy in Space* (Springer, 2013).

¹⁰ Initial Workshop Draft, Douglas Ligor, “Stabilizing Friction Points in Space by Amending the 1967 Outer Space Treaty,” Perry World House, March 2022.



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