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ENGAGING ALL STAKEHOLDERS IN SPACE SUSTAINABILITY GOVERNANCE INITIATIVES

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ABSTRACT

Over the last few years, the goal of space sustainability has become increasingly important within the field of space policy. Many national governments and international bodies are currently pursuing policy initiatives to help achieve the long-term sustainability of the space environment and humanity's activities in space. Nobel Prize Winner Elinor Ostrom developed a set of principles for sustainable governance of commons much like the near-Earth space environment. Ostrom's work can inform the many international norm-building efforts currently ongoing that aim to ensure the sustainable use of space.

According to Ostrom's years of research, one key element of successful governance is that all relevant stakeholders must be involved in the process of designing and implementing rules and norms. This collective-choice arrangement, as she calls it, enhances the legitimacy of the rules. It means the rules are tailored to the environment they govern because they were designed by those most familiar with its characteristics. Additionally, it secures buy-in from the entities expected to comply because their views were represented in the process.

There are currently a wide variety of actors engaged in and affected by space activities, including nation states, private companies, international organizations, academic institutions, and even private citizens who use space-based services every day. This diverse set of stakeholders has an equally diverse set of capabilities and priorities. However, all of them should be represented in some capacity in space governance discussions if their outcomes are to have the best chance of success. This is a dramatically different dynamic than at the dawn of the Space Age, when only a few nation States were engaged in space activities and, consequently, in space governance discussions. This new dynamic in space suggests that the traditional State-centric approach to developing space governance is no longer the most effective way forward, especially considering Ostrom's work.

This paper will identify the variety of actors invested in space and their varying capabilities and priorities as a first step toward promoting their greater involvement in space governance development. The paper will also explore the challenges of involving such a wide range of stakeholders in space governance initiatives while drawing on examples from other domains to suggest possible ways forward for ensuring sustainable use of space.

I. INTRODUCTION

Over the last few years, the goal of space sustainability has become increasingly important within the field of space policy. Many national governments and international bodies are currently pursuing policy initiatives to help achieve the long-term sustainability of the space environment and humanity's activities in space. Nobel Prize Winner Elinor Ostrom developed a set of principles for sustainable governance of common pool resources [1]. Previous work has discussed the applicability of her research to the CPR of the near-Earth space environment, and in particular informing the many international norm-building efforts currently ongoing that aim to ensure the sustainable use of space [2].

According to Ostrom's years of research, one key element of successful governance is that all relevant stakeholders must be involved in the process of designing and implementing rules and norms. This collective-choice arrangement, as she calls it, enhances the legitimacy of the rules [1]. This means the rules are tailored to the environment they govern because they were designed by those most familiar with its characteristics. Additionally, it secures buy-in from the entities expected to comply because their views were represented in the process.

There are currently a wide variety of actors engaged in and affected by space activities, including nation states, private companies, international organizations, academic institutions, and even private citizens who use space-based services every day. This diverse set of stakeholders has an equally diverse set of roles, capabilities and priorities. According to Ostrom's principle, all of them should be represented in some capacity in space governance discussions if the outcomes of those discussions are to have the best chance of success. This is a dramatically different dynamic than at the dawn of the Space Age, when only a few nation States were engaged in space activities and, consequently, in space governance discussions.

This new dynamic in space suggests that the traditional State-centric approach to developing space governance may not be the most effective way for the future. Ostrom found in her research that collective-choice arrangements where all stakeholders were represented in the governance discussions in some way were not only achievable, but necessary for sustainable governance of CPRs. Moreover, her work suggests that collective-choice arrangements can be functional and flexible, where the group finds a way to manage different levels of capabilities, power structures, and varying interests.

This paper attempts to identify the variety of actors invested in space and their varying capabilities and priorities as a first step toward promoting their greater involvement in collective choice arrangements for shaping and modifying rules and norms applicable to space activities. It will put forth a set of dimensions to evaluate how various stakeholders might be involved in collective choice arrangements in space. The paper will then identify the existing fora and mechanisms that comprise the current space governance model and propose a set of dimensions for evaluating them. The paper concludes by proposing areas for additional research.

II. NEAR-EARTH ORBIT CPR STAKEHOLDERS

This discussion begins with an exploration of the variety of stakeholders in space activities and the multiple ways of categorizing them. First, the authors will give a brief and general overview of the types of stakeholders in the space domain and examples of each. Second, we will propose a set of dimensions that can be used to characterize and evaluate the many possible stakeholders as a step towards determining who should be included in governance discussions and via which mechanism.

This framework for organizing space stakeholders is meant to be an intellectual tool. Thus, while some real-life examples are given, this paper does not attempt to categorize every State, company, or organization currently active in space, but rather provide representative samples of the diversity of actors to help characterize the set of all actors and develop a characterization schema.

Potential Stakeholders in Space Activities
At the dawn of the Space Age, there were only two actors involved in space activities – the United States and the Soviet Union. In the over fifty years since, the number of actors present in space has increased dramatically, as has the diversity of actors. Currently, around 60 countries own or operate the over 1000 active satellites on orbit [3]. Besides these States, there are a plethora of fully or partially private sector entities active in space, as well as a range of academic institutions, international organizations, and even civil society.

In addition to thinking about space stakeholders as public, private, and non-governmental, there are several further categories within each of these. Often

times, a spacefaring or space-capable country will have many agencies or departments engaged in space activities. For example, in the United States, at least eight entirely separate departments or agencies play some role in space, from the Departments of Defense and State to the more obvious space agencies, the National Aeronautics and Space Administration (NASA) and the National Oceanic and Atmospheric Administration (NOAA).

Within these many different agencies, the types of activities pursued, the motivations for pursuing them, and their capabilities to do so can also differ dramatically. On one hand, for example, a nation's military or defense agency will be interested in flying satellites for intelligence, surveillance, and reconnaissance whereas its civil space agency will be interested in space systems that support scientific research and exploration.

Within the private sector, similar diversity exists. At one end of the spectrum are the large defense contractors, such as Lockheed Martin and EADS Astrium, who work closely with governments and militaries around the world, yet remain commercial entities. At the other end of the spectrum are the more entrepreneurial companies and start-up commercial ventures in the world of space industry. There is also diversity in the definition of commercial industry among various countries, based largely on the role of government and whether the companies are truly independent entities from the State or not. Even when they are fiscally independent, commercial companies will often form public-private partnerships with governments. The way that these various private industries conduct their business is understandably very dissimilar.

Furthermore, diversity in the private space sector exists not just in terms of size and type of customer, but also in services offered. The space private sector includes not just the more traditional space business like satellite owner-operators, but also all those who work in the space field – from those who process space-derived data and offer products or services related to global navigation satellite systems (GNSS) to those who sell high-resolution satellite imagery.

Private companies who are not engaged in space activities themselves may still be considered stakeholders in space governance. These include companies and sectors that are critically reliant on space-based services or space-derived data for their bottom line. The global transportation industry is one example of this. Global shipping relies on space-based positioning, navigation and timing (PNT) as well as satellite communications for safe and efficient operations. Likewise, the entire air travel industry is increasingly reliant on space for inflight navigation, communications, and weather predictions.

The traditional public-private sector divide also neglects a large group of important actors in academia who can also have complicated relationships with companies and governments. Given the open access nature of and the potential for science in the space environment, there is a large group of purely academic and research institutions that operate outside national or governmental structures that are increasingly active in space. Universities are a good example of this group. Especially with the advent of cubesats, many more academic institutions are playing a direct role in the space environment by launching their own spacecraft and conducting experiments. Some universities spin off these activities into private commercial entities that are still partly owned by the university and serve as a source of revenue.

In addition to research groups, international organizations are engaged in space activities and represent another group of space stakeholders outside of the traditional public and private sectors. The United Nations (UN) has several offices actively involved in space activities such as the UN Institute for Training and Research (UNITAR) Operational Satellite Applications Programme (UNOSAT) and the UN Platform for Space-based Information for Disaster Management and Emergency Response (UNSPIDER). Outside of the UN, a number of other international organizations such as European Space Agency (ESA) and World Bank are also engaged in space activities or are significant end users of space capabilities.

In recent years civil society has been an increasingly active player in space activities. Think tanks explore space issues; non-governmental organizations (NGOs) promote a range of objectives in national governments and at international institutions like the UN; and advocacy groups use space-based applications to apply pressure on governments to respond to humanitarian and environmental wrongdoing [4].

Finally, private citizens are becoming active in space activities. Individuals are already accessing space capabilities such as remote sensing for mapping and cartography and PNT for getting directions. A number of new startups are offering individuals the opportunity to participate in space activities through crowd-funding platforms such as Kickstarter. These

opportunities include the ability to help fund space activities [5] and directly participate by choosing experiments that will fly or in some cases, even giving individuals direct control of satellites or payloads for short periods of time [6].

Stakeholder Dimensions
The previous discussion of all the possible types of stakeholders makes two things clear. One, there is a huge number of potential stakeholders across the various sectors who are impacted by space and, therefore, could be expected to have some say in space governance discussions. Two, it is nearly impossible to involve all these possible stakeholders in space governance discussions if such discussions are to be effective. Thus, it is necessary to not just list all possible stakeholders but to also develop **dimensions** by which the need for their potential involvement in space governance discussions, and the form that involvement might take, might be be evaluated.

Developing these dimensions is a complex process. The goal of this paper is not to formulate the de facto set of dimensions by which stakeholders must be evaluated. Rather, the goal is to propose a set of possible dimensions that can be iterated upon by further analysis and research.

An initial attempt at developing dimensions of stakeholders was previously introduced by Johnson-Freese and Weeden [2] who introduced the concept of three tiers of space actors: spacefaring states, space-capable states, and space users. They defined those tiers the following way:

"When considered from a capabilities perspective, three groups of resource appropriators for the space [common-pool resource (CPR)] emerge. The first tier comprises spacefaring states, defined as those having the full spectrum of space capabilities, including launch and satellite manufacturing and operation. A second tier of space-capable states consists of those which operate one or more satellites. And finally, there are space users, those entities – public, private and individuals – who use space services and data.
In considering space as a CPR, each of these different groups might have both differing rights and roles."

These three tiers are suitable for distinguishing among States that engage in space activities, but are not applicable to the entire spectrum of stakeholders outlined in the previous section. However, it is possible to take the core concepts contained in these original three tiers and expand them into a set of dimensions that can be applied to all possible stakeholders.

The first dimension that is inherent in the original set of tiers is that of **level of engagement in space activities**. This can be generalized to include those who actually participate in space activities directly by building and operating their own satellites or space-based services and those who do not operate their own satellites but do use space data, either through sharing agreements or purchased services.

The second dimension is **spectrum of engagement in space activities**. Some stakeholders limit their engagement in space activities to certain types of capabilities or usage, while others engage in the full spectrum of space activities. The spectrum of engagement plays a role in which governance issues a stakeholder is likely to be involved in and potentially which governance fora they participate in and to what extent.

The third dimension is a stakeholder's **dependence on space activities**. Here we distinguish between stakeholders whose core interests are either unaffected or mostly unaffected by space activities from those whose core interests are dependent on space activities.

The fourth dimension is a stakeholder's **prioritization of space activities** in relation to their peers and their other activities. This dimension distinguishes between those stakeholders who are only minimally engaged in space activities and those for whom space activities are a significant priority.

Evaluating each of these dimensions for a particular stakeholder is necessarily a subjective assessment. Although several different quantitative metrics could be devised for each, it is difficult to design metrics that can apply across the broad range of stakeholders equally. While the size of a budget for space activities may make a suitable metric for the level of engagement of a State, it is unsuitable for direct comparison to other stakeholders such as non-State entities.

Table 1 below lists a number of potential stakeholders in space activities and evaluates them according to the dimensions proposed here. This is not meant to be an exhaustive list, but rather an example of how this process can be used to evaluate the potential stakeholders and what role they may play in space governance decisions.

Table 1: A Sample List of Stakeholders in Space Activities and their Dimensions

Stakeholder	Type	Level of Engagement	Spectrum of Engagement	Dependence on Space	Prioritization of Space
United States	spacefaring State	Direct	Full	high	high
Canada	space capable State	Direct	limited to science, exploration, some military	medium	medium
Brazil	space capable State	Direct	limited to science, exploration, some military	medium	medium
European Space Agency	international organization	Direct	limited to science and exploration	high	high
International Civil Aviation Organization	international organization	Indirect	limited to use of space-based PNT	high	medium
Satellite Sentinel Project	NGO	Indirect	limited to use of space-derived information	high	medium
FedEx	private company	Indirect	limited to use of space-based PNT and communications	high	low

Table 2: A Sample List of Space Governance Fora and Mechanisms and their Dimensions

Governance Fora or Mechanism	Type	Decision-Making Process	Membership	Scope	Status of Decisions
UNCOPUOS	treaty organization	consensus	limited to States and NGO observers	peaceful uses	binding
UNSC	treaty organization	voting (with veto for some)	limited to States	security	binding
ITU	treaty organization	voting	limited to States and private sector entities	radio frequency allocation	binding, but not enforceable
ISO	international organization	consensus	limited to national standards bodies	standards	non-binding
IADC	international organization	consensus	limited to space agencies	space debris mitigation	non-binding
FCC	national agency	authoritative	Consultative	radio frequency licenses	Binding

III. GOVERNANCE FORA AND MECHANISMS FOR THE NEAR-EARTH ORBIT CPR

In this section, we consider the existing governance fora and mechanisms for the near-Earth orbit CPR in the same fashion as we did the stakeholders. We begin by discussing the various types of fora and mechanisms that currently exist, and then present a set of dimensions by which they can be evaluated.

Our definition of "governance forum" or "governance mechanism" used in this paper is somewhat broader than the traditional definition. Historically, only the formal mechanisms by which States negotiate, sign, and enforce treaties have been considered governance mechanisms. We define them more broadly as any institution, body, organization, agreement, or process by which rules, standards, or norms for space activities are discussed, negotiated, or enforced. The reason for proposing this broader definition is that governance is more than just the formal process of creating binding rules. They are an important foundation for governance, but not the only means by far.

Existing Governance Fora and Mechanisms

At one end of the spectrum, fora and international mechanisms for negotiating formal space governance agreements are mainly housed in the United Nations system, specifically the General Assembly (UNGA). Within the six permanent committees of the UNGA space is considered in two. The First Committee, generally dealing with Disarmament and Security, focuses on space in association with the Conference on Disarmament (CD), which has been tasked by the First Committee to address the prevention of an arms race in outer space (PAROS). The Fourth Committee, which considers political issues, focuses on the civil and commercial uses of space in association with the UN Committee on the Peaceful Uses of Outer space (COPUOS). Many of the foundational legal principles for outer space stem from treaties produced by COPUOS since its formation in 1959. Another UN entity, the International Telecommunication Union (ITU), also plays a significant role in space governance mechanisms through its coordination and regulation of the electromagnetic spectrum.

Although not specific to space activities, the United Nations Security Council (UNSC) also should be considered an important forum for space governance. The UNSC is the primary mechanism by which the UN system enforces international law through sanctions or military force. For example, the UNSC has adopted multiple resolutions prohibiting the Democratic People's Republic of North Korea (DPRK) from testing ballistic missile technology, including the development of space launch capabilities, and has placed sanctions on the DPRK for violating those prohibitions [8].

Outside of the formal UN system, there are other international fora that have a role in space governance. One is the International Organization for Standardization (ISO), which focuses on creating and promoting standards worldwide and is comprised of representatives from national standards organizations. Although the standards it creates are voluntary, they still carry considerable weight in many domains. Another standards body similar in nature to ISO but with a narrower scope is the Consultative Committee on Space Data Systems (CCSDS) [9].

Another set of important international fora for space governance are those where like-minded States come together to discuss or collaborate on specific issues. An example of this is the Inter-Agency Space Debris Coordination Committee (IADC), which currently has membership of twelve space agencies. Formed in the early 1990s, the purpose of the IADC is to "exchange information on space debris research activities between member space agencies, to facilitate opportunities for cooperation in space debris research, to review the progress of ongoing cooperative activities and to identify debris mitigation options" [10]. Although it does not have the power to create binding regulations or law, the IADC has had a significant impact on space governance. In 2008, the IADC Space Debris Mitigation Guidelines were used by the UN as a basis for the UN guidelines and have informed enforceable national law in a growing number of countries.

Other international fora similar to the IADC include the International Space Exploration Coordination Group (ISECG) [11], the International Primitive Body Exploration Working Group (IPEWG), and the Group on Earth Observations (GEO) [12]. While none have the same formal status and power as official UN bodies, they all have active participation from a number of States who find them valuable fora to discuss cooperation and collaboration on specific topics.

In addition to these formal international fora, there are also formal national fora and mechanisms for space governance. These national fora and mechanisms are grounded in the broad principle of how States implement and enforce their responsibilities under international law. They are

important to this discussion because they often serve as a venue where specific polices, laws, and regulations that affect space activities are debated and implemented and may involve a different set of stakeholders than those represented in formal international bodies. In the United States, these include agencies such as the National Oceanographic and Atmospheric Administration (NOAA), which issues remote sensing licenses, and the Federal Communications Commission (FCC), which issues radio frequency spectrum licenses for commercial space activities.

Dimensions of Governance Fora and Mechanisms

As with the discussion of stakeholders, it is important to not only be able to list the various fora and mechanisms, but also categorize them in a meaningful way. Further, as with the stakeholders, the diversity of fora and mechanisms represent a significant categorization challenge that we attempt to meet by proposing a set of dimensions through which the various fora and mechanisms can be evaluated.

The first dimension is the *decision-making process* that is used by the fora to come to agreement. There are several processes in use across the various fora, including consensus, majority voting, and voting with certain entities having veto power over some or all decisions.

The second dimension is *membership*. This refers to which types of entities are allowed to participate in a particular forum. In some cases, membership is restricted to a specific category of member, such as nation state or a national agency, while in other cases it is limited to a particular sector (civil or private). There are some fora where membership is open to anyone who wants to apply and others where membership is limited to those who meet certain qualifications. Finally, there are cases where those impacted by a particular rule are not allowed to directly participate in the decision, but are consulted for their input during the process.

The third proposed dimension for space governance fora is *scope*. This dimension refers to the range of space activities that fall under the purview of the forum or mechanism. In most cases, the scope of a forum is limited to particular types of space activities, such as non-military and non-security activities in UNCOPUOS. In certain cases, the scope of a forum may be extremely limited to just one particular activity, such as space debris mitigation in the IADC.

The fourth proposed dimension is the *status of decisions* made by a particular forum. Decisions can be binding in nature, meaning that members of that forum are required to abide by them, or non-binding, meaning that members are not required to abide by them. Closely related to the status of decisions and included in this dimension is whether or not a fora has *enforcement power* over those members that do not abide by a binding decision.

Table 2 on the previous page lists a number of existing space governance fora and evaluates them according to the dimensions proposed here. This is not meant to be an exhaustive list, but rather an example of how this process can be used to evaluate the existing fora and determine whether they are sufficient for sustainable governance of the near-Earth orbit domain under Ostrom's framework.

III. SUMMARY AND NEXT STEPS

According to Ostrom's research, sustainable governance of CPRs requires collective-choice arrangements whereby the CPR stakeholders have some sort of voice in developing norms, rules, and a regime for the commons. For the near-Earth orbit CPR, there is a multitude of stakeholders with a diverse set of interests and capabilities. In this paper, the authors have explored who those many stakeholders are and have proposed an intellectual approach to organizing both the stakeholders and existing governance mechanisms. This is intended to be a first step toward evaluating whether or not our current space governance landscape meets the requirement of collective-choice arrangements as outlined by Ostrom.

A few major takeaways emerge from this intellectual exercise and may form the basis for further research and analysis. First, it is clear that the community of space stakeholders today is much broader and more diverse than when the original international space law regime was formed, and while the governance fora and mechanisms have changed somewhat over the same time period, they are largely the same as what was in place at the end of the Cold War. This suggests that the fora currently used for negotiating and formulating rules regarding the near-Earth orbit CPR may not suffice for collective-choice arrangements that have buy-in from all the relevant stakeholders.

Second, the diversity of both stakeholders and fora suggests that there may be different lenses for comparing and contrasting them than what was

proposed here. This was meant as an initial analysis and further analysis and insight is still needed to examine alternative frameworks and the advantages and disadvantages compared to what has been proposed here.

Finally, it is important to remember that while space has differences compared to other domains, it is not different. There are other domains facing the same challenge of diversification of stakeholders and collective-choice arrangements. Further comparative analysis between the space domain and these other domains could help identify key areas of similarity and differences that could inform the debate in both.

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