

“Principles for Cooperative ADR”: A Viable Path for Remediation of High Mass Derelict Objects in Crowded Low Earth Orbits?

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ABSTRACT

There is no debate today that reducing the collision risk presented by the most concerning large derelict objects in Low Earth Orbits must begin soon. Those objects have been identified and roughly ranked in order of highest priority, and commercial technology subject to still-needed refinements exists to remediate them, but planning among principal stake-holding countries has been stymied by legal, political, national security, economic and funding hurdles. Although the most dangerous objects are Russian rocket bodies left in orbit consistent with then-common international practice (thus arguably without fault) before commercial space emerged, agreement on principles of cooperation among a handful of participating governments will be necessary to accomplish meaningful, efficient risk reduction.

The Artemis Accords reflect one nation’s expression of principles to facilitate cooperative exploration of the Moon and deeper space among countries who share common views about space use, to be implemented through bilateral agreements. Could a similar set of principles and process, lightly referred to as “Debris Accords”, or more seriously, “**Principles for Cooperative Debris Remediation (ADR)**”, frame an alliance among “like-minded” nations for reducing risk and increasing opportunity in space through cooperative removal of many of these dangerous objects, thus contributing to space sustainability for future generations? If so, what would those principles be, how would they be implemented, who should participate, and who should lead their development?

I. Introduction

The world agrees that active debris remediation (ADR)¹ of large derelict objects in high Low Earth Orbits (high-LEO) must begin soon to avoid forecast collisions among those objects or with other space assets. Only one such collision will spawn thousands of deadly fragments, increasing both the cost of using space and the probability of more collisions. Russian rocket bodies top the danger list, but the problem is bigger than any one nation’s debris - cooperation

among the leading governments in space will be necessary to accomplish meaningful risk reduction.

All space-faring nations have left spent rocket bodies and dead satellites in space as a common practice. That habit continues today albeit with some mitigation, but the accumulation of these objects in regions of space rapidly becoming more crowded today with commercial satellites has led to the current predicament. In fact, but for the recent commercial race to space, these objects might have been left to decay naturally over hundreds of years without posing significant risk to anyone. It is therefore historically revisionist today to blame any nation, roughly in

¹ ADR includes “nudging” or other technical alternatives to deorbiting an object to reduce risk.

proportion to the numbers or mass of debris they created before the commercial space revolution began, although it is clear a handful of nations or intergovernmental entities, mainly Russia, the U. S., and China, but also France, Japan, India and the European Space Agency (ESA),² share responsibility for the current situation, and some intentional debris-creating conduct does indeed deserve blame.

It is also important to note that those same seven entities lead the world today in using space to fulfill their own strategic objectives, many of which are commercial in nature. Orbital debris threatens everyone's future opportunity in space, but those few will suffer more than others in the near term from the inevitable consequences of increasing debris.

Given the juxtaposition of these objects' diverse ownership with their technical similarities (e. g., mass, orbital planes, external features, tumbling behavior), single government ADR programs focusing only on their own debris would be inherently inefficient and, except possibly for Russia acting alone, would not appreciably reduce risk. Cooperation will be necessary to achieve meaningful results. However, as has been widely chronicled, cooperation among these stake-holders for ADR has been stymied by legal, political, national security, economic and funding impediments. More broadly, China, Russia and the U. S., in particular, have struggled, today more than ever, to find common ground on anything related to space, in part due to competing views about world order and governance models. Most recently, that divergence has been reflected in their respective views regarding the Artemis Accords.

By way of introduction, the Artemis Accords, prepared by the U. S. and offered individually to selected countries, reflect one nation's view of key legal principles for lunar and deep space exploration, essentially framing a cooperative path for sharing cost and risk.³ Transactionally, potential partners must agree to those principles before signing bilateral

contractual agreements with the U. S. for a share of that work. Russia and China have embarked upon a separate but also cooperative journey to the Moon,⁴ and in doing so they (and others) have criticized the Accords from legal and political perspectives.⁵ This paper will examine the suitability of referencing other unifying characteristics of the Artemis Accords in developing a cooperative model for ADR.

II. Artemis Accords

The Artemis Accords began as a unilateral statement by one country, the United States, expressing principles for space exploration. The principles set a baseline for agreements with partners on ten relevant topics: Peaceful Purposes; Transparency; Interoperability; Emergency Assistance; Registration of Space Objects; Release of Scientific Data; Protecting Outer Space Heritage; Space Resources (the right to extract and utilize); Deconfliction of Activities (safety zones); and Orbital Debris (mitigation). Some of these principles simply mirror existing law, but a few go further. Among those forward-looking principles are the right to use space resources for exploration purposes (and perhaps others) without necessarily accounting to others, and the establishment of safety zones which would deny use to others within specified limits to avoid conflicts over particular areas in space. These two principles are grounded in existing international law, but they also arguably express an expansionist view to go beyond the limits of present law based in part on unfolding experience and the pursuit of strategic national objectives. Ten other countries have signed the Artemis Accords as of June 1, 2021, Australia, Canada, Japan, Luxembourg, Italy, the United Kingdom, the United Arab Emirates, Ukraine, the Republic of Korea and New Zealand, and Brazil has expressed its intent to sign. In doing so they have all endorsed a transactional methodology for implementation by agreeing to enter into binding

² Although there are important differences, ESA, an intergovernmental organization, and country governments will be treated alike for the purpose of this paper.

³ *The Artemis Accords, Principles for Cooperation in the Civil Exploration and Use of the Moon, Mars, Comets and Asteroids for Peaceful Purposes*, <https://www.nasa.gov/specials/artemis->

[accords/img/Artemis-Accords-signed-13Oct2020.pdf](#), accessed May 18, 2021.

⁴ See "[China and Russia Enter MOU on International Lunar Research](#)", SpaceNews, March 9, 2021.

⁵ See "[Russia Skeptical about Participating in Lunar Gateway](#)", SpaceNews, October 12, 2020; Wang, "[NASA's Artemis Accords: The Path to a United Space Law or a Divided One?](#)" The Space Review, August 24, 2020.

bilateral contractual agreements with the U. S. to share work on the Artemis Program.⁶

The Artemis Accords rest on four foundational cornerstones which are relevant to determining their fitness as a model for ADR - legal, political, associative and transactional.

A. Legal and Political Contexts

Two competing and potentially contradictory views of the Artemis Accords have emerged since their public promulgation in May, 2020: Are they a new model for developing space law, or do they portend a new race to the Moon?

The first perspective rests on the emerging legal concept of adaptive governance where practice, in the form of growing multilateral and commercial activity in space, has overtaken and partially mooted the existing “Cold War” based space law framework. Norm-creating behavior, like the Accords, is considered necessary by some today to bridge the gap between rapidly unfolding reality and black-letter law, because imposition of laws in advance of actual practice can impede progress, and because new space law in treaty form springing from pure collaborative reasoning is just too hard in today’s multinational, fractured world. The Artemis Accords seek to actualize adaptive governance using unilateral declarations of principles followed by bilateral contractual agreements between the leading country and each partner country to implement the principles in practice, instead of, or in advance of, reaching multilateral agreements in traditional fora.⁷

The second view can be captured in the recently-coined invective “like-mindedness”, an intrinsically vague term that has been used in conjunction with the Accords as well as in other political contexts. “Like-mindedness” has the power to unite or divide,

depending on the user’s intent. Objectively, it could reflect the writer’s view regarding a number of important but controversial space-related principles - for example in an Artemis context, permissible use of space resources for commercial purposes (or not),⁸ or the validity and scope of safety zones in space - or it could even reflect broader political divisions outside of a space framework such as democracy and private rights versus communism. There has been a wide reaction to the Accords among space-faring countries and commentators, largely along political fault lines.

For these reasons, advocating a “Debris Accords” approach to ADR must only be suggested jokingly, to avoid poisoning the concept by name alone. “Principles for Cooperative ADR”, instead, would avoid any negative implications from linking debris remediation principles with the Artemis Accords.

B. Associative (Cooperation)

Grounded in reality but looking to shape the future, the Artemis Accords are one step along one cooperative path back to the Moon. While the Accords may mean different things to different people on a legal or political level, those differences are eclipsed by the need to cooperate on that journey, no matter which team one joins. Space exploration today is defined by partnerships, in part reflecting a new post “Cold War” world order (which may yet be reincarnated into another two-headed Hydra), but more importantly because the costs of space exploration are immense but can lead to immeasurable benefits. The two competing views of the Artemis Accords, grounded respectively in law and politics, can be partially reconciled by recognizing that cooperation among nations in space is more fundamental.

C. Transactional (Implementation Methodology)

⁶ The elements of NASA’s “Artemis Program”, including launch vehicles, spacecraft, landers and lunar surface operations, are more fully described in [Wikipedia](#) (accessed May 19, 2021). The Program, including international partners, was already underway before the Artemis Accords were issued. To effectuate cooperation, international partner space agencies enter into binding contracts with NASA, and then engage their own domestic contractors to perform their share of the work, which is then provided through NASA to the U. S. contractors performing the program for integration.

⁷ See Deplano, [The Artemis Accords: Evolution or Revolution in International Space Law?](#), University of Leicester International and Comparative Law Quarterly, posted April 5, 2021 on Figshare.

⁸ Although not dispositive on whether international law would allow such use, the U. S. position endorsing using space resources for national and commercial purposes was first set out in the [U. S. Commercial Space Launch Competitiveness Act of 2015](#) (Public Law 114-90). A few other nations have passed similar legislation, but many, including Russia and China, have not.

Although, as noted above, the Accords contemplate bilateral, contractually binding agreements between nations for work on the Artemis Program in fulfillment of and based on the principles, as a practical matter the Artemis Program, a U. S. led effort to explore the Moon and then Mars, is already well underway with international partners who have not signed the Accords - for example, a German company is building the Orion crew capsule's service module intended to carry humans back to deep space.⁹ By the same token, another presumptive partner who has signed the Accords, Australia, is also a party to the Moon Agreement which would expressly forbid use of space resources for national purposes without accounting to others. These facts, while slightly at odds with the Artemis Accords adaptive governance law-making theme, only underscore the growing primacy of transactional practice in the development of new space law. In this, they also make plain the new multi-actor reality and necessity of cooperation prevailing today among nations in space.

D. Summary

Framed in a space law context, since no one can own space, cooperation among space-faring nations is therefore imperative if we are to fully realize the benefits it promises. The Artemis Accords seek partnerships, albeit only among "like-minded" nations, in recognition of the new space reality. They also reflect a new transactional methodology for conducting cooperative international space relations where building blocks, in the form of unilateral statements of principle followed by bilateral agreements, help lead to the future.

The imperative to cooperate in space applies equally to exploration and remediation. Laying aside the controversial, divisive legal and political elements of the Artemis Accords, could its unifying associative and transactional elements (i. e., engagement with partners using a unilateral statement of principles

⁹ See Note 5, *supra*.

¹⁰ As of 4/15/2020, roughly 6156 rocket bodies have been left in space, of which 2234 remain in orbit - 1048 are Russian, 709 are U. S., 169 are Chinese, and 308 are from other countries. Of those 2234, 1471 pass through LEO - 643 are Russian, 423 are U. S., 141 are Chinese, and 264 are from other countries. Satellite statistics tell a similar story. A general history chronicling the identification and categorization of these dangerous objects by the world's scientific community can be found at Dickey, [A Proposal for](#)

followed by bilateral agreements consistent with the principles) be adopted as a model for ADR of large derelict objects in high-LEO, allying those who now stand on either side of the Artemis Accords' legal and political chasm?

In other words, are "Principles for Cooperative ADR" a viable solution to the impasse we face today in space from mounting debris?

III. High Mass Debris in High-LEO

Debris comes in all shapes and sizes littering space, but as previously noted, the most dangerous objects are high mass, intact, non-maneuverable rocket bodies and dead satellites in high-LEO clustered orbits left in space primarily by Russia, but also by a handful of other governments including the U. S., China, France, Japan, India and ESA. Leaving these objects in space was a customary international practice before commercial space moved in to the neighborhoods, thus arguably without fault. There are thousands of these objects.¹⁰ Many of them share a few valuable, commonly used orbital altitudes and inclinations which makes them more dangerous to themselves and others, but that also makes them more amenable as a class of objects to the same remediation technologies and missions.

High mass debris in LEO has been collectively singled out for urgent remediation since before 2006 by virtually all scientists who have studied the problem. The objects have been ranked based on the danger they threaten in terms of mass and collision probability, their relative ease of remediation, and the economic value of the particular orbital environment they inhabit. There is also remarkable unanimity among the world's technical community on which are the most dangerous 50-100 of these objects, most of which are Russian.¹¹ For the purpose of this discussion, and consistent with world-wide scientific consensus, we

[Active Debris Remediation – Selecting Objects](#), June 2020.

¹¹ See e. g., McKnight et al., [Identifying the 50 Statistically-Most-Concerning Derelict Objects in LEO](#), 181 Acta Astronautica 282-291 (<https://doi.org/10.1016/j.actaastro.2021.01.021>), April 2021; Borelli, et al., [A Comprehensive Ranking Framework for Active Debris Removal Mission Candidates](#), 8th European Conference on Space Debris (SDC), April 2021.

will simply assume there are more than one thousand of these objects which are susceptible to ADR in groups of five to twenty objects per mission. Although they are owned by different governments, their similarities are more pertinent for ADR purposes. In other words, they constitute a separate economic “market” for ADR.

Commercial ADR technologies and processes exist today which are capable of remediating these objects, although they stand at various levels of maturity, would be costly to implement, and, because they are derived from military technology, they could be misconstrued if wielded by or on behalf of a government. Although there is a commonly-held perception that ADR technology is “not ready for primetime”, query whether a promise of government funded programs might unleash the commercial sector’s appetite for creativity, risk and profit.

The cost of remediating enough of these objects - likely at least several hundred - to achieve meaningful risk reduction will be great, and more costly than a single nation can bear. Moreover, any single country program, limited to its own objects for legal, political and national security reasons, would be economically inefficient (in light of market considerations) and ineffective in achieving meaningful risk reduction from a statistical perspective, except possibly for Russia. It is further clear that the problem these objects present is owned collectively by the countries in space today who placed them there, not only because they are responsible for their own actions but more importantly because, as sovereign nations, under the Outer Space Treaty, they jointly share the future in space - opportunity - which is jeopardized by the risk these objects present. Collision fragments will be unconstrained by national allegiance in who they impact.

ADR of these objects must start soon to avoid forecast collisions which could begin at any time, although it is less clear when it would be safe to stop, since removing each single object will change the statistical risk presented by each of the large derelicts remaining in orbit, and the overall risk. While other factors will likely influence remediation order besides a strict statistical-based risk calculation, unfortunately, ADR planning for these objects has not even begun yet for a variety of other reasons previously mentioned. Space sustainability hangs in the balance, but no clear path has been chosen for ADR of these objects. Moreover, given the multinational nature of the problem and the

hurdles faced, ADR planning under any proposed scenario, leading up to the first missions, will take several years to accomplish under even the best of circumstances. The next collision may not wait for the world to prepare.

IV. Adopting a Principled Approach to ADR

Facing significant challenges for cooperative ADR in the near term, would any plan work in time to avert the looming catastrophe? In light of the Artemis Accords’ single-country initiative to jumpstart cooperative space exploration through unilateral principles and bilateral partnerships before legal rules governing exploration are fully established, and laying aside its divisive features, suppose one country developed principles for cooperative ADR of high mass debris in high-LEO, and then sought international partners who would agree to cooperate to remove those objects based on the agreed principles? More pointedly, if “Principles for Cooperative ADR” are viable, what would they be, who should participate (i. e. who is “like-minded” for ADR purposes), and who should lead? Assuming such principles could be developed, would international law need to be changed to accommodate them?

V. “Principles for Cooperative ADR”

Given international consensus on ADR of high mass derelict objects in high-LEO, as opposed to fundamental differences expressed between nations on whether some Artemis Accords principles fit within the framework of existing space law (e. g., permissible uses of space resources, scope of deconfliction zones), “Principles for Cooperative ADR” principles should be relatively easy to determine and agree upon. In political terms, “like-mindedness” for ADR purposes seems beyond dissent – everyone agrees remediation of high mass debris in high-LEO is necessary and urgent for space sustainability, cooperation is imperative for economic reasons, and only a few specific governments are best situated to address and rectify the problem. Finally, as will be demonstrated below, implementation of these principles in support of cooperative ADR will require no changes to existing space law.

To actualize cooperative ADR, principles would need to address Legal Consent for remediation of “owned” objects; Cost Sharing (equal or equitable); Shared Assumption of Risk; country rights to Oversight of Financial Information; Protection of Sensitive Governmental Information or Proprietary Information; Governmental Support (e. g., licensing and other authorizations, provision of information); Dispute Resolution and Conforming Remedies; Preservation of Sovereignty; and agreeable Contractual Mechanisms. Each of these principles will be addressed separately in the remainder of this section.

A. Legal Consent

Consent enables cooperation. Under international space law, for better or worse, ownership of a space object is retained forever by the jurisdiction responsible for placing it in orbit. Therefore, to comply with existing international law, countries participating in ADR would need to first agree in principle to provide authorization or consent sufficient to allow another entity to remediate a selected object over which they have retained jurisdiction. This approval could be provided through a bilateral contractual agreement implementing the “Principles for Cooperative ADR”.¹² However, since more than two countries might participate in the ADR effort, project-wide consent from each participating nation would be necessary to authorize the “hands-on” remediator who might be a foreign public or private party. Therefore, the principle should include the right to include appropriate limits on providing sensitive governmental information about the selected object to other country participants, and limits on further disclosures by the party performing the work. Information disclosure limits will be further addressed as a principle under Section E. below. The principle should also require the owning country to provide information about the target object necessary for remediation purposes. This principle is further addressed in Section F. below.

In addition to providing consent, authorizing countries could also provide rights in the selected object if desired (e. g., granting salvage rights to the “hands-on” remediator could reduce the share of remediation cost assumed by the owning country, as well as possibly reducing the overall cost of remediation).¹³

B. Cost Sharing

A range of cost-sharing formulas among participating governments (up to seven, namely, Russia, China, the U. S., Japan, India, France and ESA) are possible, but in substance all are either “equal” or “equitable”, based on each country or intergovernmental entity’s respective risk and/or opportunity derived from ADR. For example, costs could be shared based on the numbers of operating satellites each participating government presently owns (opportunity-based measure), or could be based on their respective debris contribution by mass (responsibility-based measure), or a blend of both. Although reaching complete agreement across all partners on cost-share has the potential to delay and divide rather than expedite and unite, there is likely very little cost difference among the various alternatives for cooperation. Moreover, any potential differences among cost-sharing methodologies would be further reduced proportionally based on the number of participating parties (i. e., between two and seven). Even if each bilateral cost sharing agreement was based on a different formula, the raw financial differences among all of them might be insignificant. Simple pro rata sharing among all participants is therefore recommended as a starting principle, but regardless of the formula(s) ultimately agreed upon, multi-party participation in the project would spread the burden, make the project affordable, and yield efficiency in execution. Cost sharing, while neither constrained nor encouraged under international law, is the corollary of consent for cooperative ADR.

“In-kind” contributions from government participants (e. g., launch service) should be permissible in principle.

¹² The idea of using a contract to provide legal authorization (consent) for ADR of state-owned space objects was first proposed in Dickey, [*“Three Country-Trusted Broker”: An Effective Public-Private Model for Orbital Debris Remediation*](#), (IAC October 2019), and was recently echoed in Way and Koller, [*Active*](#)

[*Debris Removal: Policy and Legal Feasibility*](#), (Aerospace Corporation, April 2021).

¹³ Repurposing these objects through pure salvage, as an alternative to ADR, is a good idea but lacks paying customers.

C. Shared Assumption of Risk

Although ADR planning among partners would essentially be risk-free, ADR missions will expose party participants to significant performance risks. Each space-faring country has already developed its own risk allocation regimen for space related projects as part of its internal regulatory structure, addressing participating party and third-party risks, consistent with its national obligations to supervise space projects under international law. These domestic rules and practices vary from country to country, but generally include insurance, indemnity and party-participant cross-waivers, covering all phases of a project (e. g., manufacturing, pre-launch, launch, on-orbit and de-orbit). Across all space-faring nations, these processes share more similarities than differences. For this reason, it is recommended that a starting principle should simply offer to share risks, equally or equitably, under the cost-sharing formula identified above, subject to a requirement that the performing project contractors would be required to provide all-risk, all party insurance to the extent reasonably available, before beginning performance. Each participating government could then account for its share of any remaining uncovered risk as it saw fit, consistent with national and international law, without compromising the fundamental principle. As with cost sharing, this principle would facilitate affordability.

D. Oversight of Financial Information

In general, ADR projects undertaken by cooperating governments will involve the possibility for sharing three types of information – financial, technical and classified. Regarding financial information, and related to the cost-sharing principle, oversight of financial information should be provided to each participating government for audit and accounting purposes. Transparency, a common denominator for international law, lies at the heart of this principle.¹⁴ This principle could be implemented through use of a private party hired by governments to manage/perform the work, through independent accountants, or by an intergovernmental organization established for the specific purpose of managing funding for the project.

¹⁴ Bianchi and Peters (eds.), Transparency in International Law, Cambridge University Press (2013). ISBN:978-1-107-02138-9.

Agreeing to use an independent private party for this purpose might enhance transparency and bureaucratic economy by limiting the flow of information directly between governments.

E. Protection of Sensitive Governmental Information or Proprietary Information (Firewalls)

It is possible classified or export-controlled information could be embedded in the debris selected for remediation, or in the technology chosen to remediate. Proprietary information could also be contained within the selected remediation technology. Firewalls within the performing remediator could be established to protect both types of information from disclosure to unauthorized persons or governments, and proprietary information could be further protected through negotiation of limited data rights in non-performing parties to be used solely for project oversight purposes. The initial principle to address both these concerns would be to simply agree to protect sensitive government information and proprietary information through appropriate firewalls established within the performing remediator's organization, and through mutually agreeable data rights provisions. All potentially participating governments have laws which protect sensitive and proprietary information from disclosure to others. This could be accomplished without harming the integrity of the project or prejudicing governmental oversight rights to review financial information. This principle would address and overcome the national security and political hurdles which have been described by numerous authors as impediments to ADR.

F. Governmental Support

To facilitate accomplishment of ADR projects, each government party would need to agree to provide all information within its possession or control regarding selected ADR targets (e. g., tracking data, technical specifications, object characteristics, environmental factors), or necessary for (and including) project licensing or other approvals such as export authorizations. This principle would be further subject

to appropriate firewalls to protect sensitive governmental information, as discussed with regard to the prior principle. This principle could be facilitated by a project requirement that any performing contractor must procure all authorizations and licenses necessary for performance. In general, this principle is based on the fact that all potentially participating governments allow access to sensitive information based on a “need to know” standard, and all incorporate implementation and enforcement mechanisms to insure protection. Finally, using a private party for performance would further mitigate any need to share sensitive information among all participating governments.

G. Dispute Resolution and Conforming Remedies

This principle and the next, addressing disputes and sovereignty, are not necessary for planning phases, but would have to be considered and agreed upon at some point during the project in support of ADR performance activities. Waiving the immutable international legal principle of sovereignty, for the limited purpose of achieving a shared objective, is unavoidable but not without precedent.

The key to resolving disputes among sovereign governments or other project participants which will inevitably arise during performance of cooperative ADR is to first establish a principle based on a statement of shared purpose. That will accomplish three things: It will tie all bilateral “Principles for Cooperative ADR” agreements together without the need for more cumbersome multi-party agreements; it will provide a basis for common interpretations across all bilateral agreements to ensure consistency in remedies; and it will pave the way for a binding dispute resolution mechanism which will be necessary to best effectuate accomplishment of the ADR projects. If premised on a statement of shared purpose, bilateral dispute resolution principles between any two governments would not need to be identical to all the others, since they would be made effectively equivalent through the universal principle of shared purpose.¹⁵

¹⁵ Resolving disputes between a participating government and any private party performing the work

Other elements of a dispute resolution principle, including forum selection, venue and choice of law, could be negotiated in later phases of cooperation to ensure disputes during performance do not derail the project. A number of dispute resolution forum alternatives acceptable to participating governments exist, including the International Court of Justice, Permanent Court of Arbitration, or London Court of Arbitration, and all parties subscribe to the United Nations Convention on the Recognition and Enforcement of Foreign Arbitral Awards (New York Convention). Besides forum selection, the principle should also include a requirement to continue the project during the pendency of a dispute, and to negotiate (in good faith) to an impasse before submitting the dispute to a third-party neutral decider.

H. Preservation of Sovereignty

A principle allowing any government to terminate its participation in the project for its convenience (for any reason at any time) will reinforce the legal notion of sovereignty, subject to paying its share of incurred costs up to the date of termination, and except for binding and enforceable resolution of disputes arising during project performance. Arguably implicit in any cooperative undertaking among nations, a sovereignty principle will explicitly preserve off-ramps while allowing trust to build among participating governments, will facilitate normal diplomatic processes, and will allow planning to begin before any necessary legislative funding decisions have to be made in each participating government to implement its share of project costs. Budget authority and delegation will of course be necessary to undertake initial planning, but those costs and risks will be insignificant before joint remediation begins.

I. Contractual Mechanisms

“Principles for Cooperative ADR”, once offered by one government to others and agreeable politically, could be implemented in bilateral negotiated contracts, in parallel, enabling each government’s role in the project.¹⁶ Assuming equivalent (but not necessarily identical) rights and obligations emerged across all bilateral agreements consistent with the inceptive

could be subject to local law and courts, and also subordinate to the shared purpose principle.

¹⁶ See Note 11, *supra*.

principles, planning for cooperative ADR could begin. Regarding equivalency, it is conceivable that initial principles could be implemented in the bilateral agreements with some variation among them, for example, to accommodate different cost and risk sharing formulas desired by various parties, without harming the overall multinational cooperative spirit.¹⁷ It is also possible that bilateral agreements could lead to an overarching multinational agreement among all partners as occurred in implementation of the International Space Station, which of course would take longer, but would be unnecessarily cumbersome in light of the limited purpose sought to be achieved.

J. Other Matters

A few other matters besides principles of cooperation must be considered in implementation of the cooperative work. For example, developing mutually agreeable operating principles – a Procurement Plan - containing rules for managing the work, more a logistical consideration than a principle, would nonetheless be essential to achieving the overall objective. Creating an acceptable process might require changes or waivers to local law or regulation, but it would not require changes to international law. To illustrate, if each participating government sought to impose its own procurement regulations on cooperative performance of ADR projects, including domestic preferences, competition requirements and socio-economic priorities, making procurement decisions cooperatively could lead to frustration and deadlock. Simply agreeing to waive domestic preference requirements and other local contracting rules for this purpose could be sufficient to overcome this hurdle, or the parties could agree to use an independent private party to manage performance of the work, or they could establish an intergovernmental entity like the Inter-Agency Space Debris Coordination Committee (IADC) for management and oversight of project contractor selection and performance (generally less efficient and more costly than using a private entity), or each country could remediate its own objects using shared funding (this would be the least efficient alternative). Likewise,

¹⁷ Allowing equivalency instead of requiring all bilateral agreements to be identical would further distinguish “Principles for Cooperative ADR” from Artemis Accords, and facilitate cooperation. By leading or participating, Russia (or China) would not be tacitly endorsing the Artemis Accords approach to

technical decisions about target selection, order of remediation and remediating contractor selections could be addressed by a private independent party project manager, or by an intergovernmental agency established for the purpose (generally more costly and less efficient than using a private party).

VI. “Principles for Cooperative ADR” Participation and Leadership

As noted above, there are a limited number of constituents for cooperative ADR, namely, Russia, China, the U. S., Japan, India, France and ESA. These governments collectively use space the most today, and have contributed the most to the debris problem facing the world today. They have much to gain, and much to lose, depending on how they meet this challenge, but each is arguably obligated to participate because they have created the problem, and because they share responsibility to preserve space for future generations.

While they all should participate to resolve the problem, any one of them could lead, by first unilaterally proposing “Principles for Cooperative ADR” to the others. Russia might be better situated to lead the process, partly because they would have the most to lose if they remediated their own objects without cooperation under a fault-based narrative (while others would benefit without having to pay their fair share), and also because they would have less difficulty approaching China to cooperate in light of the U. S. Wolf Amendment restriction that would not absolutely prohibit, but could constrain, U. S. leadership and interaction with China. U. S. leadership is further inhibited by the present lack of legislative authority designating one agency with responsibility (and funding) for ADR. Regardless who leads, and regardless how the cooperation mechanism is effectuated (i. e., with or without an independent project planning coordinator), the principles would be the same.

international law-making because the “Principles for Cooperative ADR”, unlike the Artemis Accords, rest entirely within the bounds of existing international space law.

VII. Conclusion

Adopting a principled, bilateral transactional approach for cooperative remediation of high mass debris in high-LEO, or “Principles for Cooperative ADR”, would constitute a giant step towards remediation of the most concerning debris in space. Principles for debris remediation are far less contentious than Artemis principles, ADR “like-mindedness” seems unanimous among all potential participants, and no changes to international space law would be necessary to enable and implement them.

“Principles for Cooperative ADR” could actually lead to meaningful risk reduction in space benefitting all nations before the next collision; they would help lead to a sustainable future in space. Their adoption could also undercut fault-based narratives which threaten to devolve either into unilateral programs (clean up your own without any commitment of reciprocity) that would not alone produce meaningful risk reduction, or counterproductive demands that Russia clean up its own debris alone. Finally, a cooperative plan would enable efficiencies in action and burden-sharing that would make the entire problem affordable and achievable.

Turning Principles into Reality

“Traveler, there is no path. Paths are made by walking.”¹⁸

Self-interest and the “common good” are intertwined for the purpose of debris remediation. Any government concerned about preserving its own future in space could initiate “Principles for Cooperative ADR”, just as any government desiring to improve space for the benefit of humanity could start the process. Moreover, cooperating on debris remediation would bind us together as humans in space, transcending political differences and the conflicts that arise from competing national priorities. Who knows where that might lead.

¹⁸ Antonio Machado, “Proverbios y Cantares XXIX”, “Campos de Castilla” (1912).

¹⁹ A Procurement Plan including six planning Phases leading to ADR of selected objects in Phase 7 was described in Dickey, [*“Three Country-Trusted Broker”: An Effective Public-Private Model for Orbital Debris Remediation – Part Two: Country Contracting Phases*](#), (IAA-UT-STM-02-04), IAA-UT

TCTB – Assistance Along a Cooperative Path to ADR

Cooperative ADR among the countries who share the risk of debris and the opportunity of space was first proposed by a private company, Three Country-Trusted Broker (TCTB, LLC), in June, 2019, as a way to overcome legal, political, national security, economic and funding hurdles to ADR. TCTB provided formal contracting proposals to Russia, China and the U. S. to begin planning for and then accomplishing remediation of high mass debris in high-LEO on their behalf. Today, TCTB, along with its Russian partner, Valentin Uvarov, republishes that offer.

As its name suggests, TCTB proposes to act as a “broker”, or intermediary “prime contractor”, to select and manage remediating “subcontractors” to accomplish ADR of dangerous objects on behalf of participating governments who would share costs and risks among themselves with TCTB. Originally envisioned as a way to bring the three countries who own most of the debris (and opportunity) in space together, China, Russia and the U. S., TCTB’s model could just as easily channel cooperation to include France, Japan, India and ESA.

While remediation using “Principles for Cooperative ADR” could be accomplished without an intermediary, using TCTB as an independent “broker” between two or more countries under separate but interdependent, “prime” contracts between TCTB and each participating country could ameliorate problems that would arise in direct multi-country ADR interaction such as avoidance of domestic preferences in selecting “subcontractors” for performing projects, country political restraints on direct interaction with certain other countries, and national security issues embedded in the debris chosen for remediation or in the competitively selected remediation technology that might limit direct country involvement in a particular cooperative ADR mission.¹⁹

Space Traffic Management Conference, February 2020. These Phases are generic and would be required in any single government or cooperative multi-government planning process for ADR, whether carried out directly or by an independent private third party on behalf of the participating government or governments. TCTB estimates the planning process

TCTB's business model, plans and processes for cooperative remediation of high mass debris in high-LEO, addressing many of the same principles discussed in this paper, and including fully drafted government "prime" contract clauses mirroring the principles discussed in this paper, can be found on TCTB's website, threecountrytrustedbroker.com.

Formation of TCTB II in Russia is planned in the near future.

For further information about TCTB, contact Chuck Dickey at jcdickey@threecountrytrustedbroker.com, or Valentin Uvarov at uvarov.valent@yandex.ru.

will take more than three years if led by a private party like TCTB, and longer if not.