Applying Ostrom's Nobel Winning Study to International Cooperation in Space Activities

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Abstract

The 2009 Nobel Prize in Economic Sciences Laureate, Elinor Ostrom, studied diverse institutional arrangements for governing common-pool resources (CPRs) and public goods. Ostrom found strong empirical proof, in lab and in the field, across countries and sectors, that collective action is feasible and that decentralized local institutions perform better than their counterparts. The research also suggested that the core goal of public policy should be to facilitate the development of such institutions, rather than impose rules from above. As the Nobel committee noted, "[Ostrom's] observations are important not only to the study of natural resource management, but also to the study of human cooperation more generally." Ostrom's research is in the micro level of persons, and it can be applied to the micro level of states and even firms. Another important lesson from Ostrom is that large-scale cooperation can be amassed gradually from below.

Given the division of international society and the obstacles for achieving international cooperation, Ostrom's research brings good news: encouraging users' only management of space sub-systems such as the ISS, a loonar base or space habitat and promoting multiple bilateral, regional and multilateral space cooperation schemes is the only feasible way and the most efficient path en-route global-scale cooperation.

International cooperation has been a fundamental principle in space law ever since the first UN Resolution on space exploration. Clusters of international cooperation exist and thrive, but a full-scale global cooperation is yet to emerge and calls for an international space agency have not been answered. Applying Ostrom's findings to international cooperation in space activities suggests a model for promoting the basic

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norm of international cooperation not by a strong, central, global institution, nor by rules imposed from above, but rather by (i) facilitating and encouraging users' management of space sub-systems, which may be interconnected by a joint coordinating forum; and (ii) clusters of cooperation which will together encompass the vast majority of countries. This polycentric model will create the basis for larger scale cooperation on a global level. The overlapping and crossing of cooperation schemes are not a hazard but an advantage, creating an expanding net and paving he way to meta-clusters.

I Background: The Basic Norm of 'international Cooperation'

I.I 'International cooperation' as a basic norm in space law

The precept of international cooperation captures the spirit of space exploration. However, it is more than that. It is a legal and practical imperative. The principle of international cooperation was introduced in the first instrument on space law (a 1958 UNGA resolution[1]) and in practically every subsequent instrument, including treaties, 54 (!) UNGA resolutions – all of which are titled *International co-operation in the peaceful uses of outer space* - and the 1996 UNGA Declaration on International Cooperation[2]. No other principle has been stipulated as much in Space Law, nor close to that. The above instruments and their aggregate effects suggest that international cooperation is a prime constitutional norm of in the field.

Moreover, international cooperation is arguably a legal duty. Article 1 of the 1967 Outer Space Treaty (OST) provides that "…States shall facilitate and encourage international co-operation in [the scientific investigation of outer space, including the moon and other celestial bodies]..." (emphasis added). Rüdiger Woflrum asserts that the 1967 OST introduced a "far-reaching" general obligation to cooperate: "It obliges States which are active in outer space not only to co-operate with each other for the exchange of information but also to develop the knowledge and research capabilities of all States. The Outer Space Treaty resembles the Charter of Economic Rights and Duties of States in that it supersedes the formal equality among States so as to promote substantive equality among them"[3].

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1 UNGA Resolution 1348 (XIII): Question of the peaceful use of outer space, adopted December 13, 1958.

2 UNGA resolution 51/122: *Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries*, adopted on December 13, 1996. For a current account on the 1996 Declaration see Elena Carpanelli and Brendan Cohen, *A Legal Assessment of the 1996 Declaration on Space Benefits on the Occasion of Its Fifteenth Anniversary*, 38(1) Journal of Space Law (2012), 1.

3 Rüdiger Wolfrum, *International Law of Cooperation*, in: Rüdiger Wolfrum, ed, *Max Planck Encyclopedia of Public International Law* (Oxford, online ed 2008). But see Carpanelli and Cohen (cited in note 2) who assert that the 1996 Declaration is not legally binding.

I.II Barriers to cooperation and the need for an effective model

Implementation of the basic norm of international cooperation has barriers far beyond it being a vogue principle, including political and economic competition and export control regulation.

Implementation of the principle of 'international cooperation' should be made in the most efficient manner that conforms to the principles of international law and space law. It is expressly provided in Article 4 of the 1996 Declaration on International Cooperation:

"International cooperation should be conducted in the modes that are considered most effective and appropriate by the countries concerned, including, inter alia, governmental and non-governmental; commercial and non-commercial; global, multilateral, regional or bilateral; and international cooperation among countries in all levels of development."[4]

However, so far international cooperation in space activities has been either deep but narrow, in the sense of a subset of few countries having meaningful cooperation, or wide but shallow, in the sense of many countries having limited cooperation. It logically follows that research inquire into the barriers that have so far prevented better implementation of the principle and seek a regime that will overcome these barriers.

II. Ostrom's Nobel winning study

II.I Common-pool resources

Ostrom's life work was the research of diverse institutional arrangements for governing common-pool resources (CPRs) and public goods.

Definition of CPR: common-pool resources, or simply 'commons', are resources used by more than one actor. Examples often used in the literature are fish stocks, pastures, woods and water (for drinking or irrigation).

"Commons is a general term that refers to a resource shared by a group of people. In a commons, the resource can be small and serve a tiny group (the family refrigerator), it can be community-level (sidewalks, playgrounds, libraries, and so on), or it can extend to international and global levels (deep seas, the atmosphere, the Internet, and scientific knowledge). The commons can be well bounded (a community park or library); transboundary (the Danube River, migrating wildlife, the Internet); or without clear boundaries (knowledge, the ozone layer)."[5]

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4 *Declaration on International Cooperation in the Exploration and Use of Outer Space* (cited in note 2).

5 Charlotte Hess and Elinor Ostrom, *Introduction: An Overview of the Knowledge Commons*, in Charlotte Hess and Elinor Ostrom, *Understanding Knowledge as a Commons: From Theory to Practice* (MIT 2011), 3. Subtractability, meaning one actor's use of a resource diminishes another actors' potential use, is often referred to as a key feature of a CPR. However, s Hess and Ostrom note regarding knowledge as commons it is not necessary and not present in every CPR (id at 5).

It is important to differentiate between commons as a resource and commons as a property-rights regime. The first is a resource used by multiple users, such as a lake used by numerous fishermen. The second refers to the ownership of the resource, or who has the property rights over it. A common-pool resource in the first meaning (such as the lake) may be owned and managed as government property, private property, a community property, or owned by no one.[6] Today, outer space is commons in both meanings; it is a CPR, and it is generally related to as community property – the common heritage of mankind. This may change if private property rights are introduced in outer space. However, even in such a case, outer space as an environment and resource will still be a CPR by the first meaning.

II.II From Hardin to Ostrom

The proper exploitation of common pool resources is an old issue, occupying social thinkers for at least two millennia[7], with new and nouvelle findings and conclusions. The prevailing pre-Ostrom view was that CPRs that are common property (common in the second meaning) will inevitably be over-used until exhaustion; that often individual actors have a strong incentive to act in ways that are detrimental to the group interest (the free-rider problem); that rational actors will maximize short-term self-benefits, and that this will *inevitably* lead to an unsustainable over-use of the common pool resource. This chronicle of this fatality was expressed in the dramatic words of Hardin in his influential 1968 article *the tragedy of the commons*:

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[6] There are various theories on the essence of property rights. A modern leading theory is of bundles of rights rather than a single right. In the context of CPR Ostrom identified five kinds of property rights that actors using a CPR might cumulatively have" (i) access—the right to enter a specified property, 4 (ii) withdrawal—the right to harvest specific products from a resource, (iii) management—the right to transform the resource and regulate internal use patterns, (iv) exclusion—the right to decide who will have access, withdrawal, or management rights, and (v) alienation—the right to lease or sell any of the other four rights" (Elinor Ostrom, *Beyond Markets and States: Polycentric Governance of Complex Economic Systems*, American 100 Economic Review (2010), 1, 10); on differentiating between CPR as a resource and a commons as a property-rights regime and the kinds of property rights regime see also Daniel W. Bromley, *Closing Comments at the Conference on Common Property Resource Management*, in *Proceedings of the Conference on Common Property Resource Management*, Washington, DC 1986 (National Academies Press) 591–98.

[7] The Economic Sciences Prize Committee of the Royal Swedish Academy of Sciences, *Scientific Background on the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2009: Economic Governance*, (12 OCTOBER 2009) available online at http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/2009/advanced.html (viewed January 15, 2014), 8

"Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all"[8].

Hardin' assertion was consistent with the prediction of no cooperation in a prisoner's dilemma and other social dilemma games. Hardin's article is one of the most influential and often cited articles in the social sciences. Several scholars have tried to apply Hardin's tragedy to outer space issues[9].

The prevalent view further asserted that centralized management of such resources (by a government or a single private owner) is necessary for a sustainable use thereof. This may take the form of (i) privatization, or (ii) government management[10]. Most economists rejected the option of letting the users manage the resource by themselves.[11] This last option was the focus of Ostrom's study.

II.III Ostrom's Nobel Winning Study

"Ostrom has challenged the conventional wisdom that common property is poorly managed and should be completely privatized or regulated by central authorities." [12] Ostrom studied diverse institutional arrangements for governing common-pool resources (CPRs) and public goods. Her research included theoretical framework, extensively using concepts from a more advanced non-cooperative game theory, especially that of another Nobel Laureate for Economic Sciences, Robert Aumann[13]. Moreover, her research included a wide empirical base of lab experiments, field studies and meta-

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8 Garrett Hardin, *The Tragedy of the Commons*, 162(3859) Science (1968), 1243, 1244.

9 See for example: Jared B. Taylor, *Tragedy of the Space Commons: A Market Mechanism Solution to the Space Debris Problem*, 50 Columbia Journal of Transnational Law (2011), 253; Scott J. Shackelford, *The Tragedy of the Common Heritage of Mankind*, 27 Stanford Environmental Law Journal (2008), 101; Peng Wang, *Tragedy of Commons in Outer Space: The Case of Space Debris*, presented at the 64th IAC, Beijing 2013, available online at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2260856 (viewed September 9, 2014). Chaddha, on the other hand, described the problem of space debris as a 'tragedy of the commons' in the Hardinian sense and suggests, on the basis of Ostrom's study, alternative governance arrangements to successfully address the debris problem - Shane Chaddha, *An Inquiry for Alternative Governance Regimes for Outer Space* (Scholars' Press, 2014).

10 This second solution is associated with Pigou - is to let the central government own the resource and levy a tax extraction. See Arthur C. Pigou, *The Economics of Welfare* (New York: Macmillan 1920). Coase rejected Pigou's suggestion, see Ronald H. Coase, *The Problem of Social Cost*, 3 Journal of Law and Economics (1960), 1.

11 Nobel Committee report (cited in note 7), 9-10.

12 Id.

13 Id, at 10.

analysis of a vast database of existing case studies made by others from around the world [14], and in this lays the strength of her study.
Ostrom's presented her findings in her 1990 book *Governing the Commons: The Evolution of Institutions for Collective Action*[15]. Ostrom rejected and refuted the presumption that users' management of CPRs inevitably ends in a tragedy. Ostrom found the contrary to be true: users' management is more effective and efficient in most, but not all, cases. Analyzing the vast empirical database, Ostrom concluded that users achieve and sustain cooperation and envisage rules and enforcement mechanisms that result in sustainable outcomes. Larger scale cooperation can be gradually amassed from below, and it does not need to be enforced from above. By contrast, governmentally imposed rules are often counter-productive because central authorities lack knowledge about local conditions and have insufficient legitimacy. Moreover, in many cases government intervention has created more chaos than order.[16] Ostrom's study further helps to clarify the conditions under which local governance is feasible and effective.
The main lessons from Ostrom relevant to international cooperation in space activities are the feasibility of effective collective action; the model of decentralized users' management; amassing cooperation from below. The aforementioned lessons are reviewed below with their suggested application to space.

III. The Relevance of Ostrom's Study to International Cooperation in Space Activities

As the Nobel committee noted, "[Ostrom's] observations are important not only to the study of natural resource management, but also to the study of human cooperation more generally."[17] There are also space-specific reasons why Ostrom's study is relevant and can be extended to international cooperation in space activities.

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[14] The studies were conducted by anthropologists, economic historians, engineers, historians, philosophers, and political scientists. They studied local governance of smaller to medium scale common-pool resources over long periods of time. The studies followed different types of resources located in many countries, including Bolivia, Colombia, Guatemala, India, Kenya, Mexico, Nepal, Tanzania, Thailand, Uganda, Ethiopia, China and the United States. See Elinor Ostrom, *Beyond Markets and States: Polycentric Governance of Complex Economic Systems*, American 100 Economic Review (2010), 1, 17.

[15] Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action* (Cambridge 1990).

[16] Nobel Prize Committee, *Economic Governance*, (cited in note 7), 9-10.

[17] Id, 2.

III.I Ostrom's Study is, In Essence, about Cooperation

The management by (local) users of CPRs, which is the focus of Ostrom's study, is 'collective action', according to her own account. 'Collective action' may be defined as actors working together to achieve a common objective[18] and is thus, in other words, cooperation. Indeed, all that has been learned about the users' management is about cooperation. Actors may cooperate in the management of a CPR or a joint project like the ISS. Actors may cooperate for the management and distribution of scientific knowledge (e.g. space science and engineering) and for the management and exploitation of natural, terrestrial and extraterrestrial, resources. Actors may also agree on rules-of-use such as the suggested Code of Conduct for Outer Space Activities promoted by the European Union, and the making of the rules is in itself a collective action.

Collective action has an inherent problem, the 'collective action problem', meaning that actors have an incentive to free ride, which may collapse the collective action. The collective action problem is long known and was discussed, for example, in the 18th century by David Hume in his *Treatise of Human Nature*[19]. Ostrom study has interesting findings regarding collective action that can be applied to collective action, or cooperation, in space activities.

III.II Outer space as a CPR

Outer space, including celestial bodies, is in itself a common pool resource. It has long been declared as the "Common Heritage of Mankind." However, even this vague declaration is set aside, much of outer space, the natural (and, as will be demonstrated, artificial) objects therein and the exploration and use thereof are, by economic standards according to Ostrom, common pool resources.

What makes a resource a common pool are the characteristics and mode of use. As noted above, it is a resource shared by more than one user. The sharing of the resource is due to natural circumstances, technological barriers or legal rules. The geostationary orbit, the moon and all other celestial bodies and space between are all resources shared by mankind, and thus CPRs.

Furthermore, many artificial space objects are also CPRs. There are only few suppliers such as state agencies and private enterprises that offer access to outer space. All who wish to access outer space must use the limited supply of transportation means to orbit and beyond. These few "corridors" to outer space, regardless of their ownership (state owned or privately owned), serve many states and firms. Access to space is, therefore, a kind of a CPR. The

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[18] Encyclopedia Britannica, *collective action problem*, online at http://www.britannica.com/EBchecked/topic/1917157/collective-action-problem, viewed September 5, 2014.

[19] David Hume, *A Treatise of Human Nature* (1740).

International Space Station (ISS) is a common project of numerous *states* users. Finally, a typical space habitat will be used by numerous persons/users. Even the knowledge accumulated from space science and the technology developed may also be considered as commons. Hess and Ostrom view knowledge as "a shared resource, a complex ecosystem that is a commons - a resource shared by a group of people..." [20]. This knowledge, according to Space Law, should be shared with all states.

III.III From micro level to macro level

Ostrom's research is in the micro level of persons, and it can be applied to the micro level of states and firms or a mixture thereof. In fact, it might be more salient with regards to states and firms, due to the rationality factor. Decisions of states or firms are necessarily taken by (the authorized) persons, which is why Ostrom's study is relevant for states and firms. Ralph Waldo Emerson suggested that "There is properly no history, only biography." Furthermore, Ostrom's study is expected to be more salient for states and firms because peoples' decisions tend to be more rational when they act as authorized organs making decisions for a state or a firm, than when they make decisions for themselves. Indeed, after substantiating her theory, Ostrom and colleagues have set to study whether her theory, empirically based on the study of small local commons, can be applied to larger scale commons.[21]

IV. Lessons from Ostrom to international cooperation in space activities

The following are the lessons from Ostrom's study, as applied to international cooperation in space activities.

IV.I The feasibility of collective action

The notoriously famous prisoner dilemma denies the potential of rational actors to organize and solve dilemmas that are best solved by cooperation. However, whereas in the prisoner dilemma the police investigator keeps the prisoners separated and they cannot communicate, users of CPRs and the actors in space can and do communicate. As Ostrom noted:

"The classic models have been used to view those who are involved in a prisoner's dilemma game or other social dilemmas as always trapped in the situation without capabilities to change the structure themselves. This analytical step was a retrogressive step in the theories used to analyze the human condition. Whether or not the individuals, who are in a situation, have capacities to transform the external variables affecting their own

[20] Hess and Ostrom, *Introduction: An Overview of the Knowledge Commons* (cited in note 5, 3.

[21] For such an attempted application see Thomas Dietz, Elinor Ostrom and Paul C. Stern, *The Struggle to Govern the Commons*, 302 Science (2003), 1907.

situation varies dramatically from one situation to the next. It is an empirical condition that varies from situation to situation rather than a logical universality. Public investigators purposely keep prisoners separated so they cannot communicate. The users of a common-pool resource are not so limited."[22]

Actors facing collective actions dilemmas do, at least in some of the cases, talk, reach agreements and keep them. Even prisoners do not always confess. Actors can create and sustain collective action and regulate their use of a resource better than the government. As Ostrom further noted:

"*In summary, experiments on CPRs and public goods have shown that many predictions of the conventional theory of collective action do not hold. More cooperation occurs than predicted, 'cheap talk' increases cooperation, and subjects invest in sanctioning free riders.* "[23]

Collective action, or cooperation, is therefore feasible. But what is the efficient institutional model for cooperation?

IV.II Cooperation within and among sub-system in a polycentric system

The world has no single sovereign or a strong global authority, and there is no strong authority that can push for global scale cooperation in space activities. The Moon Treaty with its provisions on a central authority has failed and calls for an international space agency have not been answered. However, Ostrom found that local management by collective action is more efficient than rules imposed by a central government. It is therefore suggested, that each space sub-system will be self-managed by way of cooperation of its users, as explained below.

A sub-system here refers to a space system, resource, projects and issue, such as: the Moon, Mars, asteroids, the International Space Station (ISS), a space base, a space habitat, the geostationary orbit. Some of these sub-systems are already self-managed by their users. The ISS is managed solely by the states members in the project and the geostationary orbit is managed by the ITU which represents all users, in this case all states. In contrast, there is no governance system for the Moon and other existing and prospective sub-systems. What is therefore suggested is that each sub-system be self-managed by way of cooperation of its users. This suggests that if three states will establish a moon base, these three states will manage the moon habitat. Rules-of-use will be made by these states, and only by them. Other states will be free to establish their own moon base, according to the 1967 OST, and if they do so they will also join the collective, local management. The Antarctic Treaty System provides such a framework, whereby amendments and supplements to the system are made by those states nations that are active in Antarctica, *and only by them*. The main limitation on the local management

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[22] Ostrom, *Beyond Markets and States* (cited in note 14), 8.

[23] Id, 16.

will be that rules-of-use to be made by the users and their application will need to be in conformity to the norms and rules set in the 1967 OST.
We can envision that even a commercial entity active in space and even and persons who populate space habitats will participate in making the rules, if they are independent actors and not emissaries. Whether such users will have the same rights and duties as a state or a diminished set thereof is an issue to be considered.
The interrelations between the separate local management centers of sub-systems are the complex question of polycentric[24] governance (rather than central governance) and a main challenge. The many separate management centers may be entirely independent or, more likely, interconnected. They may be interconnected in a center-less web, such as the internet, or have a polynomic level or system - a joint / central coordinating forum.
The interests of prospective users, i.e. states who are not yet spacefaring nations, but have serious intentions to join the club, will not be ignored. These potential users will have standing, however not in the sub-systems but within the higher-polynomic level. Furthermore, motions for distribution of space benefits do not prevent application of users' management since management and ownership are not necessarily congruent. Such motions may be decided at the polynomic level.
This lesson from Ostrom and the polycentric model of governance is also consistent with Regime Theory. Keohane[25]studied international cooperation and analyzed the institutions, or "international regimes," through which cooperation has taken place in the world political economy. Keohane refuted the idea that a hegemon is necessary for cooperation. Referring to the decline in American hegemony, he asserted that international regimes are not weak substitutes for a world government but rather devices facilitating decentralized cooperation among egoistic actors.
The suggested model means breaking down 'international cooperation' to local, sub-systems cooperation, where the sub-systems are interconnected with cooperation in the polynomic level. Another breakdown of 'international cooperation' is the amassing of cooperation from below, to be discussed next.

IV.III Amassing cooperation from below

Another important lesson from Ostrom noted above is that large-scale cooperation can be amassed gradually from below. As the Nobel Committee noted:

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[24] For a definition of polycentric see Vincent Ostrom, Charles M. Tiebout, and Robert Warren, *The Organization of Government in Metropolitan Areas: A Theoretical Inquiry*, 55(4) American Political Science Review (1961), 831, 831-2.

[25] Robert O. Keohane, *After Hegemony: Cooperation and Discord in the World Political Economy* (Princeton 1984).

"A final lesson from the many case studies is that large-scale cooperation can be amassed gradually from below…Once a group has a well-functioning set of rules, it is in a position to collaborate with other groups, eventually fostering cooperation between a large number of people. Formation of a large group at the outset, without forming smaller groups first, is more difficult… Needless to say, Ostrom's research also prompts a number of new questions. It is important to investigate whether cooperation must be built from below, or whether other approaches are feasible when dealing with large-scale problems." [26]

This lesson is directly applicable to international cooperation in space activities. It suggests a model for promoting the basic norm of international cooperation neither by a strong, central, global institution, nor by rules imposed from above, but rather by facilitating and encouraging clusters of cooperation which will together encompass the vast majority of countries. The clusters of cooperation will be the multiple bilateral, multilateral and regional space cooperation schemes including ESA, APSCO, ISS and many bilateral and multilateral agreements. The overlapping and crossing of cooperation schemes are not a threat but an advantage, creating an expanding net and paving the way to meta-clusters. The existing international organizations and institutions should encourage and support the creation of many small and medium scale cooperation schemes en-route global scale cooperation.

V. Conclusion and a way forward

Promotion of international cooperation faces obstacles: the international society has no central government; there are multiple and diverse actors; wide forums are sometimes paralyzed; Space Law is experiencing a long halt in new hard-law making. Ostrom's study brings good news for cooperative space activities because it is shows the way for cooperation in an anarchic international society.

Another important factor is that applying Ostrom's findings is consistent with current space law and there is no need to introduce new treaties or amend existing ones. The OST does not provide for a central authority or organization that manages outer space and therefore users' management and a polycentric regime are not overruled by the treaty but rather in line with it. In addition, the rules that will be set by the users will all have to be in accordance with the legal norms set in the OST and elsewhere. The OST can and should remain the normative framework of the space quest.

International cooperation in the emergence of mankind from its cradle to all other territories is a great project, perhaps the greatest in mankind's history.

[26] Nobel Prize Committee, *Economic Governance* (cited in note 7), 12.

The study of this project, how such a project might be facilitated and promoted, is a research agenda of the utmost importance.

We cannot afford to be foolish optimistics as to presume that the magnitude of the goal and its immense benefits for all will smooth the way forward. Earlier attempts have shown surprising success, even in the heights of the Cold War, but the breakthrough is still ahead. The complex reality requires that prospective thinking shift from using simple models to using more complex frameworks, theories, and models to study and handle the diverse challenges facing future space exploration.

Applying Ostrom's insights will enable the promotion of international cooperation in space activities, in a feasible and efficient manner and with no need to introduce new treaties or amend existing ones. The relevant UN organs and other international organizations and institutions can and should encourage bilateral, multilateral and regional cooperation, enabling users' self-management and the establishment polycentric governance of space sub-systems. The may further take the role of the polynomic level.