Space Sustainability

17

Peter Martinez

Contents

Abstract

Space sustainability is a concept that has emerged within the past 15 years to refer to a set of concerns relating to outer space as an environment for carrying out space activities safely and without interference, as well as to concerns about ensuring continuity of the benefits derived on Earth from the conduct of such

P. Martinez (✉)
Secure World Foundation (SWF), Broomfield, CO, USA
e-mail: pmartinez@swfound.org

K.-U. Schrogl (ed.), *Handbook of Space Security*,
https://doi.org/10.1007/978-3-030-23210-8_51

space activities. As such, it encompasses the concerns of both space actors and those who are not space actors but who nevertheless benefit from space activities. This chapter reviews the role of the various relevant United Nations entities in ensuring space sustainability and provides a detailed review of the process and discussions held in the Working Group on the Long-Term Sustainability of Outer Space Activities within the Scientific and Technical Subcommittee of the United Nations (UN) Committee on the Peaceful Uses of Outer Space (COPUOS). Finally, the chapter discusses the relationship of the work in UN COPUOS with related work done in the Conference on Disarmament, the UN Group of Governmental Experts (GGE) on Transparency and Confidence-Building Measures in Outer Space Activities, and the initiative by the European Union to propose a Draft International Code of Conduct for outer space activities.

Space Security and Space Sustainability

The terms *space security* and *space sustainability* are sometimes used interchangeably to encompass a set of largely overlapping concerns as seen from two somewhat different perspectives. Underlying both of these perspectives is the acknowledgment that space systems underpin the modern information society and now form part of the critical infrastructure of most nations, whether they are spacefaring or not, and that this infrastructure is exposed to a series of risks of natural and anthropogenic origin. Regardless of the perspective from which one sees the problem, the point is that coordinated global action will be required to address these concerns. Acknowledging and addressing these different perspectives is one of the challenges that will be faced by multilateral initiatives to promote either space security or space sustainability. Hence it is instructive in the context of this chapter on space sustainability in a book devoted to space security to elaborate on this issue of the two perspectives.

Space Security

Security is, in general terms, about being free from danger or threat. In practical terms, this means freedom from doubt, anxiety, or fear based on well-founded confidence that there are mechanisms and processes in place to ensure security as a condition.

However, attempts to pin down exactly what is encompassed by the word *security* prove to be elusive as there is no single universally accepted definition of the concept of "security." In some countries the understanding of the term encompasses human security, environmental security, food security, and so on, while in others the term has a narrower meaning, referring primarily to military and defense-related issues.

Space security is a term that is used among space actors to refer to preserving order, predictability, and safety in space and avoiding courses of action that would ultimately undermine mission assurance, operational safety, and freedom of action in outer space. Another key dimension of this dialogue is the notion that, because

of growing reliance on space systems in every facet of modern life, security on Earth (regardless of how one defines it) is increasingly underpinned by security in outer space. Hence one of the key aims of the space security dialogue is to ensure freedom from threats (either ground-based or space-based) to the effective access to and utilization of outer space. For some actors this is closely coupled to concerns about the potential weaponization of outer space, although it is difficult to progress beyond a general acknowledgment of the potential problem to practical measures to avoid it, because of disagreements around the definition of what constitutes a space weapon.

An important point to note is that the space security discourse has, up until recently, been dictated by the national interests and concerns of the major space powers, who are the ones who most heavily invested in space-based infrastructure to support their national security. For some sitting on the sidelines of the debate, space security has sometimes been perceived to be predominantly the preoccupation of the advanced space actors and thus far-removed from the day-to-day concerns of the non-space nations. Others, particularly those from emerging or aspiring space nations, have seen the promotion of multilateral space security discussions as an attempt by the leading space actors to advance and preserve their national space interests and advantages by raising entry barriers to aspiring newcomers on the pretext that the space environment is already "saturated" with actors. Neither of these perceptions has helped to build multilateral consensus on normative rules of behavior for all space actors. However, there are promising signs of middle space powers beginning to play a more active role in promoting multilateral space security dialogues in the future and hence helping to bridge the gap between these different perceptions of space security.

Space Sustainability

The word *sustainability* is derived from the Latin verb *sustinere* (*tenere*, "to hold"; *sus*, "up") and is usually used in the context of being able to maintain an activity at a certain rate or level. Since the 1980s the concept of sustainability has been applied to human habitation and utilization of planet Earth and its resources. This has given rise to the widely used term *sustainable development*. This term was coined in the book *Our Common Future*, which contains the report published by the Brundtland Commission in 1987 (UN GA 1987). The definition for sustainable development given in that book is worth quoting here:

> *development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*

Notice the emphasis on "needs" in this definition. The Brundtland Commission's report placed emphasis in particular on meeting the essential needs of the world's poor, rather than satisfying the nonessential desires of the well-to-do.

The connection of *sustainability* with *outer space* arises from the perspective that space systems are now major global utilities that meet various societal needs. When

seen in this light, *space sustainability* is understood to be about using outer space in such a way that all humanity will be able to continue to use it in the future for peaceful purposes and for societal benefit. The sustainability concern here is driven by the realization that the Earth's orbital environment and the electromagnetic spectrum are limited natural resources. This realization leads naturally to a concern for how to ensure that the benefits of space activities will continue to be accessible to future generations and to all nations and raises issues about the equitable and responsible access to and use of space resources.

In other words, from this perspective, space sustainability is seen in the context of wider sustainability discussions and is perceived to be the concern of all beneficiaries of space activities. It is thus an intrinsically multilateral issue. This is a significantly and fundamentally different point of departure for addressing a very similar set of issues driving the space security discourse.

The United Nations and Space Sustainability

The space arena today encompasses a much larger and much more diverse group of space actors than was the case in the first few decades of the space age. These include the "traditional" space actors, such as national space agencies and other national civilian agencies and the military, and a growing number of non-state actors, such as private sector commercial entities, academic and research institutions, and civil society organizations. We are also seeing the emergence of new kinds of space activities, many of which involve operations of space objects in close proximity to each other. Since the actions of a single actor can have consequences for all other actors, no single country (or even a group of like-minded countries) can control the space environment by its (or their) behavior or power alone; collective multilateral action is required.

In terms of international space law, states bear international responsibility for all space activities, including the activities of non-state entities (Outer Space Treaty 1967: Article VI). Hence, in spite of the growing number of non-state actors, the United Nations as a forum for states remains the relevant international forum to discuss such issues. Notwithstanding the preeminent role of states in the legal framework for outer space activities, it is worth reflecting on the contribution of civil society to the discussion on space sustainability, since this sector is playing an increasingly prominent and catalytic role in space activities and is in some respects more responsive to the rapidly changing space arena than the "traditional" fora established by states. This sector also has the access to a great deal of expertise, particularly in the conduct of space operations.

Space in the UN System

At present, there are four principal fora at which space issues are discussed multilaterally in the UN system: (i) the United Nations Committee on the Peaceful Uses of

Outer Space (COPUOS) in Vienna; (ii) the Conference on Disarmament (CD) in Geneva; (iii) the UN General Assembly in New York (and two of its committees, the Disarmament and International Security Committee (First Committee) and the Special Political and Decolonization Committee (Fourth Committee)) ; and (iv) the International Telecommunications Union (ITU) in Geneva, which deals with spectrum and geostationary orbital slot assignments. In addition to these, the World Meteorological Organization in Geneva makes use of space systems for monitoring and predicting terrestrial weather and also supports international coordination of space weather activities, an area of growing importance since space weather affects all space systems.

Space is widely used in the UN system and its entities. Each year approximately 20 UN entities and specialized agencies hold the United Nations Inter-Agency Meeting on Outer Space Activities. They discuss matters of mutual interest in the applications of space technologies to address human needs. Considerations include the implementation of the recommendations of the UNISPACE conferences and space-based contributions of the United Nations entities to the achievement of the Sustainable Development Goals as well as to the implementation of the recommendations of various world summits. The meeting issues a report on its deliberations for the consideration of COPUOS.

The United Nations Committee on the Peaceful Uses of Outer Space

The United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) is the principal international forum for the development and codification of laws and principles governing activities in outer space. It is a standing committee of the UN, established in 1959 by 24 member states and given its mandate in UN General Assembly resolution 1472 (XIV). The Committee currently comprises 95 member states and a large number of permanent observers that enrich its work. The technical work of COPUOS is carried out by two subcommittees, the Legal Subcommittee (LSC) and the Scientific and Technical Subcommittee (STSC). Decisions in COPUOS and its subcommittees are reached by consensus. The Secretariat of COPUOS is the UN Office for Outer Space Affairs (UN OOSA), which is situated at the United Nations Office in Vienna.

During the 60 years of its existence, the deliberations in COPUOS have resulted in a number of very positive developments to advance international cooperation in the peaceful uses of outer space. A full discussion of all the activities and outcomes of COPUOS is outside the scope of this chapter, but it may be found in the paper by Hedman and Balogh (2009). Here, we focus on the aspects of COPUOS pertaining specifically to the long-term sustainability of outer space activities.

The International Legal Framework for Space Activities

COPUOS is the only international forum for the development and codification of international space law. Since its inception, the committee has concluded five

international treaties and five sets of legal principles governing space-related activities. The five United Nations Treaties are:

- *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies* (known as the "Outer Space Treaty"), adopted by the General Assembly in its resolution 2222 (XXI), opened for signature on 27 January 1967, entered into force on 10 October 1967;
- *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space* (known as the "Rescue Agreement"), adopted by the General Assembly in its resolution 2345 (XXII), opened for signature on 22 April 1968, entered into force on 3 December 1968;
- *Convention on International Liability for Damage Caused by Space Objects* (known as the "Space Liability Convention"), adopted by the General Assembly in its resolution 2777 (XXVI), opened for signature on 29 March 1972, entered into force on 1 September 1972;
- *Convention on Registration of Objects Launched into Outer Space* (known as the "Registration Convention"), adopted by the General Assembly in its resolution 3235 (XXIX), opened for signature on 14 January 1975, entered into force on 15 September 1976;
- *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies* (known as the "Moon Agreement"), adopted by the General Assembly in its resolution 34/68, opened for signature on 18 December 1979, entered into force on 11 July 1984.

The 1967 Outer Space Treaty laid the general legal foundation for the peaceful uses of outer space and provided a framework for developing the law of outer space. The four other treaties deal more specifically with certain concepts contained within the Outer Space Treaty.

It is instructive to review some of the principles in these treaties that provide the legal context for discussions on space sustainability and space security. These include the non-appropriation of outer space by any country; the freedom of exploration, scientific investigation, and the use (and even exploitation) of natural resources in outer space; state liability for damage caused by space objects; the avoidance of potentially harmful interference with space activities of other states; the sharing of information on space activities; and the registration of space objects.

The treaties affirm the agreement of states that the domain of outer space is a *res communis* and that the activities carried out therein and the benefits arising therefrom should be devoted to enhancing the well-being of all countries and humankind. Article I of the Outer Space Treaty is of particular relevance to the space sustainability discussion:

> *The exploration and use of outer space, including the Moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind.*

Outer space, including the Moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies.

There shall be freedom of scientific investigation in outer space, including the Moon and other celestial bodies, and States shall facilitate and encourage international cooperation in such investigation.

These principles provide the reference points for many delegations in COPUOS against which they will judge the relevance and legitimacy of the space sustainability discourse and its outcome.

In addition to the codification of these treaties and principles, progress has also been made in developing a common understanding on other issues related to the exploration and peaceful uses of outer space. All in all, 132 UN General Assembly resolutions or recommendations relating to outer space have been adopted from 1958 to 2018 (UN OOSA 1958–2018). These resolutions have been complemented by additional instruments containing more technically detailed guidance. These instruments include a set of voluntary Space Debris Mitigation Guidelines (UN OOSA 2010) adopted in 2007 and a Safety Framework for Nuclear Power Source Applications in Outer Space, developed jointly by the Scientific and Technical Subcommittee of COPUOS and the International Atomic Energy Agency, which was adopted in 2009 (UN COPUOS and IAEA 2009).

The UN also maintains a Register of Objects Launched into Outer Space that contains information provided by member states and intergovernmental organizations that are party to the Registration Convention (UN Register). As of 1 January 2019, 69 states had acceded to or ratified the Convention, and another four states had signed it. As of 30 August 2019, the Register contained 8737 space objects launched by 87 states or international intergovernmental organizations, for which an international space object designator had been assigned. It is worth noting that only 7859 of those space objects had been registered with the United Nations.

COPUOS and Space Sustainability

Introduction of the Long-Term Sustainability of Outer Space Activities on the Agenda of COPUOS

Although several aspects of the work of COPUOS are directly relevant to space sustainability, prior to 2010 these topics were being addressed in isolation; the emergence of a more holistic view of these issues goes back to 2005, as the Committee was approaching its 50th year. In that year, Mr. Karl Deutsch of Canada (Chair of the STSC from 2001 to 2003) presented a discussion paper to the Committee on the future role of COPUOS in its next 50 years. Deutsch made the connection between the sustainability of life on Earth and the cooperative international use of space systems; the very subject COPUOS was established to address.

In 2006–2007, the Committee was chaired by Mr. Gérard Brachet of France. He highlighted the issue of space sustainability during his term as Chairman of COPUOS. At the 50th session of the Committee in 2007, Brachet presented a working paper by the Chair (UN GA 2007) that identified the long-term sustainability of outer space activities as one of the key challenges facing the future peaceful uses of outer space. The working paper further suggested that a working group could be established within the STSC to produce a technical assessment of the situation and to suggest a way forward.

In their sessions during 2008, the STSC and COPUOS discussed the introduction of an agenda item dealing with the long-term sustainability of outer space activities and what such an agenda item might encompass. Subsequently, in 2009, at the 46th session of the STSC, a proposal was put forward by the delegation of France to include a new agenda item on the long-term sustainability of outer space activities on the agenda of the STSC.

At its 52nd session in 2009, COPUOS agreed that the STSC should include, starting from its 47th session in 2010, a new agenda item titled "long-term sustainability of outer space activities" and it proposed a multi-year work plan that was to culminate in a report on the long-term sustainability of outer space activities and a set of best-practice guidelines for presentation to and review by the Committee.

In 2010 the STSC established the Working Group on the Long-Term Sustainability of Outer Space Activities under the chairmanship of Mr. Peter Martinez of South Africa. The first issue to be addressed was reaching agreement on the terms of reference, scope, and methods of work. These deliberations were concluded at the 54th session of COPUOS in June 2011.

This is a very condensed review of the emergence of the long-term space sustainability work in COPUOS. Readers interested in a more detailed review are referred to the article by Brachet (2012).

COPUOS Working Group on the Long-Term Sustainability of Outer Space Activities

The terms of reference for this Working Group (UN GA 2011) mandated it to examine the long-term sustainability of outer space activities in the wider context of sustainable development on Earth, including the contribution of space activities to the achievement of the Millennium Development Goals, taking into account the concerns and interests of all countries. (Nowadays we would refer to the Sustainable Development Goals (SDGs), but the terms of reference for the Working Group predated the adoption of the SDGs at a special UN Summit of Heads of State in September 2015. The SDGs are in a sense the successors of the Millennium Development Goals, and hence the same importance (if not more) is attached to ensuring continuity of space-derived data and services to meet these developmental goals.)

The Working Group was mandated to consider established practices, operating procedures, technical standards, and policies associated with the long-term sustainability of outer space activities throughout all the phases of a mission life cycle. The

Working Group took as its legal framework the existing UN treaties and principles governing the activities of states in the exploration and use of outer space; it did not consider the development of new legally binding instruments.

The Working Group was tasked to produce a report on the long-term sustainability of outer space activities and a consolidated set of voluntary best-practice guidelines that could be applied by states, international organizations, national nongovernmental organizations, and private sector entities to enhance the long-term sustainability of outer space activities for all space actors and for all beneficiaries of space activities.

It is instructive to quote from the terms of reference regarding the expected character of the guidelines to be produced. These guidelines should:

(a) *Create a framework for possible development and enhancement of national and international practices pertaining to enhancing the long-term sustainability of outer space activities, including, inter alia, the improvement of the safety of space operations and the protection of the space environment, giving consideration to acceptable and reasonable financial and other connotations and taking into account the needs and interests of developing countries.*
(b) *Be consistent with existing international legal frameworks for outer space activities and should be voluntary and not be legally binding.*
(c) *Be consistent with the relevant activities and recommendations of the Committee and its Subcommittees, as well as of other working groups thereof, United Nations intergovernmental organizations and bodies and the Inter-Agency Space Debris Coordination Committee and other relevant international organizations, taking into account their status and competence.*

Consideration of Topics

In developing its terms of reference, the Working Group identified a wide range of topics of relevance to the overall considerations of space sustainability, spanning from developmental issues to operational issues, space debris, space weather, and also regulatory issues.

The topics were clustered to allow more efficient consideration of related matters, and four expert groups were established to consider these related sets of topics. These expert groups were populated with experts nominated by their national governments. However, the experts served in an ad hominem capacity and did not necessarily represent their governments' positions in all matters. The expert groups were tasked to contribute inputs to the report of the Working Group and to propose candidate guidelines for consideration by the Working Group. The Working Group was to consider these inputs from the expert groups and take any necessary decisions. In this way, a clear separation was established between the expert groups as technical deliberative fora and the Working Group as a diplomatic negotiating forum.

Based on the inputs from the individual experts and other external inputs (see the subsequent sections titled "Coordination with Other International Intergovernmental Entities and Processes" and "Contributions by Non-state Actors"), the expert groups were tasked to identify issues for which sufficient international expert consensus could be found to recommend guidelines based on established best practices. Where the experts identified issues pertinent to the long-term sustainability of outer space

activities, but for which the state of knowledge was such that the experts were not yet able to recommend consensus guidelines based on any operational experience, those issues were referred to the Working Group for its attention and possible future consideration.

The four expert groups and their scopes were as follows:

(a) *Expert Group A: Sustainable space utilization supporting sustainable development on Earth*
Co-chaired by Mr. Filipe Duarte Santos (Portugal) and Mr. Enrique Pacheco Cabrera (Mexico)
This expert group addressed the societal benefits of space activities and their contribution to sustainable development on Earth. It considered space as a shared natural resource, the equitable access to outer space and to the resources and benefits associated with it, as well as access to the benefits of outer space activities for human development. This expert group also considered the role of international cooperation in ensuring that outer space continues to be used for peaceful purposes for the benefit of all nations. This expert group proposed seven candidate guidelines and four topics for further consideration by the Working Group.

(b) *Expert Group B: Space debris, space operations and tools to support collaborative space situational awareness*
Co-chaired by Mr. Richard Buenneke (United States of America) and Mr. Claudio Portelli (Italy)
This expert group considered the issues that make the space environment unpredictable and unsafe for space actors. This included an analysis of risks from space debris and measures to reduce the creation and proliferation of space debris. The implementation of such measures requires strengthened cooperative space situational awareness, which in turn requires the collection, sharing, and dissemination of data on space objects, such as orbits, pre-launch, and pre-maneuver notifications. This expert group also considered tools to support collaborative space situational awareness, such as registries of operators and contact information and procedures for sharing relevant operational information among space actors. This led to a recognition of the importance of developing common standards and practices for information exchange. This expert group proposed eight candidate guidelines and three topics for further consideration by the Working Group.

(c) *Expert Group C: Space weather*
Co-chaired by Mr. Takahiro Obara (Japan) and Mr. Ian Mann (Canada)
This expert group focused on ways to reduce the risks of detrimental effects of space weather phenomena on operational space systems. Such risks may be reduced through the sharing and dissemination of key data on phenomena related to space weather in real or near-real time, as well as sharing of models and forecasts. This expert group proposed five candidate guidelines and two topics for further consideration by the Working Group.

(d) *Expert Group D: Regulatory regimes and guidance for actors*
Co-chaired by Mr. Anthony Wicht (Australia) and Mr. Sergio Marchisio (Italy)
This expert group considered the contribution of international and national legal instruments and regulatory practices to promote the long-term sustainability of outer space activities. This included considerations of how the existing treaties and principles that define the international legal framework for space activities are being implemented at the national level through legal and regulatory regimes and how such national regulatory frameworks for space activities could be developed or further strengthened to support the long-term sustainability of space activities. This expert group proposed eleven candidate guidelines and five topics for further consideration by the Working Group.

The expert groups did not work in silos. Several issues under consideration by the expert groups were intrinsically multidisciplinary in character and therefore fell within the competence of more than one of the expert groups. For this reason, the expert groups held joint meetings to discuss overlaps and gaps.

The expert groups met during the sessions of COPUOS and its STSC from 2011 to 2014 and also took the opportunity of meeting at the International Astronautical Congress in Cape Town in 2011, Naples in 2012, and Beijing in 2013. The four expert groups concluded their work in 2014 and submitted their reports to the Working Group, containing a total of 33 proposed draft guidelines.

Coordination with Other International Intergovernmental Entities and Processes

The Working Group was mandated to liaise with the UN Group of Governmental Experts on Transparency and Confidence-Building Measures in Outer Space Activities, the Conference on Disarmament, the Commission on Sustainable Development, the International Civil Aviation Organization, the International Telecommunication Union, and the World Meteorological Organization, as well as relevant intergovernmental organizations, such as the European Space Agency, the European Organization for the Exploitation of Meteorological Satellites, the Asia-Pacific Space Cooperation Organization, and the Group on Earth Observations.

The overarching principle behind these interactions was that the Working Group should avoid duplicating the work being done within these international entities while at the same time identifying areas of concern relating to the long-term sustainability of outer space activities that were not being covered by them.

Contributions by Non-state Actors

Although the discussions within the Working Group occurred at the intergovernmental level of COPUOS, states recognized that non-state actors play an important role in the space arena and have much knowledge and experience to contribute to the formulation of guidelines based on the best practices.

A number of international organizations and bodies, such as the Consultative Committee for Space Data Systems, the Inter-Agency Space Debris Coordination

Committee, the International Space Environment Service, the International Organization for Standardization, the International Academy of Astronautics, the International Astronautical Federation, and the Committee on Space Research, also provided inputs into the work of the Working Group and its expert groups.

Commercial operators have extensive experience in running their fleets of spacecraft and in dealing with space weather and other on-orbit operational issues. A case in point was the industry coordination that took place during the Galaxy-15 "zombie sat" episode in 2010 (Weeden 2010). Industry associations and entities such as the International Astronautical Federation provide access to the collective expertise of the space industry and space agencies.

Finally, there are institutional actors focusing on the governance of space activities, such as the European Space Policy Institute or the Secure World Foundation, that analyze certain topics in depth and prepare position papers. These entities also made valuable contributions to the space sustainability dialogue in COPUOS.

The role of non-state actors is at times a contentious issue in COPUOS. Some member states (usually those with a well-established space industry) are comfortable with engaging the private sector in issues on the COPUOS agenda, while others (usually the ones without a space industry) are concerned that the agenda of COPUOS should not be dictated by the interests of commercial entities. Those states are of the view that COPUOS is a forum of states and that states should direct the agenda and discussions in COPUOS.

Because consensus could not be reached on the direct participation of non-state entities in the Working Group, the solution that was agreed upon was to continue with the established practice that states could choose to include in their delegation representatives of their own national non-state entities. In this way, the contributions of experts from non-state entities were made possible. The inputs of national nongovernmental organizations and private sector entities were thus obtained through the member states of COPUOS.

Negotiation of the LTS Guidelines

Following the expert group phase, the Working Group began developing the draft guidelines based on the recommendations of the expert groups. A number of member states also proposed draft guidelines for consideration by the Working Group. By the start of 2016, through a process of consolidation and streamlining, the Working Group had narrowed its focus to 29 draft guidelines, all at various stages of maturity.

From the start of the Working Group in 2010 to the end of its mandate in 2018, the membership of COPUOS grew from 70 to 92 states. Moreover, as the LTS discussions gained momentum in COPUOS, more states became actively engaged in the debates. Since COPUOS takes decisions by absolute consensus of its member states, all member states had to reach agreement on the text of each one of these guidelines, in all six official languages of the UN. Progress was gradual and uneven, but by June 2016 COPUOS reached agreement on the first 12 guidelines (UN COPUOS 2016). In February 2018, at the 55th session of the STSC, agreement was reached on a further nine guidelines and the text of a politically significant context-setting

preamble that included the following definition of space sustainability (UN COPUOS 2018a):

> *The long-term sustainability of outer space activities is defined as the ability to maintain the conduct of space activities indefinitely into the future in a manner that realizes the objectives of equitable access to the benefits of the exploration and use of outer space for peaceful purposes, in order to meet the needs of the present generations while preserving the outer space environment for future generations.*

Readers will notice the parallels between this COPUOS definition of space sustainability and the definition of sustainable development mentioned earlier in the section titled "Space Sustainability."

In addition to the 21 agreed guidelines, there were a further seven draft guidelines (UN COPUOS 2018b) for which the Working Group could not reach consensus during its mandate, which expired in June 2018. Discussions at the 61st session of COPUOS in June 2018 were inconclusive because the Committee could not reach consensus on the way forward and some states could not agree to decoupling the already agreed guidelines from those still under discussion. The session ended in a stalemate, with all states however agreeing that the LTS discussions should continue in 2019.

At its 62nd session in June 2019, the Committee adopted the preamble and 21 guidelines for the long-term sustainability of outer space activities (UN GA 2019). The Committee encouraged states and international intergovernmental organizations to voluntarily take measures to ensure that the guidelines were implemented to the greatest extent feasible and practicable.

The Committee also agreed on the establishment of a new Working Group with a 5-year work plan under the STSC to advance the work on LTS. The Committee decided that this new Working Group would agree on its own terms of reference, methods of work, and dedicated work plan at the 57th session of the STSC, in February 2020. This new Working Group is expected to focus on:

(a) Identifying and studying challenges for the long-term sustainability of outer space activities and to consider possible new guidelines, including those proposed but not agreed within in the previous Working Group;
(b) Sharing experiences, practices, and lessons learned from voluntary national implementation of the already adopted guidelines;
(c) Raising awareness and building capacity to implement the adopted LTS guidelines, in particular among emerging space nations and developing countries.

The Guidelines

The 21 agreed guidelines (UN GA 2019) comprise a collection of internationally recognized measures for ensuring the long-term sustainability of outer space activities and for enhancing the safety of space operations. They address the policy,

regulatory, operational, safety, scientific, technical, and international cooperation and capacity-building aspects of space activities. They are based on a substantial body of knowledge, as well as the experiences of states, international intergovernmental organizations, and relevant national and international nongovernmental entities. Therefore, the guidelines are relevant to both governmental and nongovernmental entities. They are also relevant to all space activities, whether planned or ongoing, as practicable, and to all phases of a space mission, including launch, operation, and end-of-life disposal.

The purpose of the guidelines is to assist states and international intergovernmental organizations, both individually and collectively, to mitigate the risks associated with the conduct of outer space activities so that present benefits can be sustained and future opportunities realized. Consequently, the implementation of the guidelines should promote international cooperation in the peaceful use and exploration of outer space.

These 21 agreed guidelines represent the low-hanging fruit of the LTS discussions, but they also mark a significant step forward in that they represent the tangible progress that has been made in COPUOS in addressing space sustainability. This first set of agreed guidelines creates a foundation for further consensus building in COPUOS.

The guidelines are intended to support the development of national and international practices and safety frameworks for conducting outer space activities while allowing for flexibility in adapting such practices and frameworks to specific national circumstances. They are also intended to support states and international intergovernmental organizations in developing their space capabilities in a manner that avoids causing harm to the outer space environment and the safety of space operations.

The guidelines are voluntary and not legally binding under international law. The existing UN treaties and principles on outer space provide the fundamental legal framework for these guidelines. However, despite their non-binding status under international law, the guidelines can have a legal character in the sense that states may choose to incorporate elements of the guidelines in their national legislation, as has been the case with the COPUOS Space Debris Mitigation Guidelines.

The titles of the 21 agreed guidelines are indicated below. The full text of the guidelines is available in UN document A/74/20, Annex II. The remaining seven draft guidelines that did not reach consensus during the mandate of the Working Group are contained in UN document A/AC.105/C.1/L.367. The progress made in discussions of those draft guidelines will inform future discussions of space sustainability in COPUOS.

A. *Policy and regulatory framework for space activities*
   - Guideline A.1: Adopt, revise and amend, as necessary, national regulatory frameworks for outer space activities
   - Guideline A.2: Consider a number of elements when developing, revising or amending, as necessary, national regulatory frameworks for outer space activities

Guideline A.3: Supervise national space activities
Guideline A.4: Ensure the equitable, rational and efficient use of the radio frequency spectrum and the various orbital regions used by satellites
Guideline A.5: Enhance the practice of registering space objects

B. *Safety of space operations*
Guideline B.1: Provide updated contact information and share information on space objects and orbital events
Guideline B.2: Improve accuracy of orbital data on space objects and enhance the practice and utility of sharing orbital information on space objects
Guideline B.3: Promote the collection, sharing and dissemination of space debris monitoring information
Guideline B.4: Perform conjunction assessment during all orbital phases of controlled flight
Guideline B.5: Develop practical approaches for pre-launch conjunction assessment
Guideline B.6: Share operational space weather data and forecasts
Guideline B.7: Develop space weather models and tools and collect established practices on the mitigation of space weather effects
Guideline B.8: Design and operation of space objects regardless of their physical and operational characteristics
Guideline B.9: Take measures to address risks associated with the uncontrolled re-entry of space objects
Guideline B.10: Observe measures of precaution when using sources of laser beams passing through outer space

C. *International cooperation, capacity-building, and awareness*
Guideline C.1: Promote and facilitate international cooperation in support of the long-term sustainability of outer space activities
Guideline C.2: Share experience related to the long-term sustainability of outer space activities and develop new procedures, as appropriate, for information exchange
Guideline C.3: Promote and support capacity-building
Guideline C.4: Raise awareness of space activities

D. *Scientific and technical research and development*
Guideline D.1: Promote and support research into and the development of ways to support sustainable exploration and use of outer space
Guideline D.2: Investigate and consider new measures to manage the space debris population in the long term

Implementation and Updating of the Guidelines

States and international intergovernmental organizations are encouraged to implement these guidelines to the greatest extent feasible and practicable, in accordance with their respective needs, conditions and capabilities, and with their existing obligations under applicable international law.

International cooperation is required to implement the guidelines effectively and to monitor their impact and effectiveness. However, COPUOS recognizes that not all space actors have equal capability or capacity to implement these guidelines. Therefore, the guidelines place a strong emphasis on international cooperation and information sharing. States and international intergovernmental organizations with extensive experience in conducting space activities are encouraged to support developing countries to strengthen their national capacities to implement the guidelines.

COPUOS also recognizes that these guidelines should be a "living document" that is periodically updated to ensure that, as space activities evolve, the guidelines continue to reflect the most current state of knowledge of pertinent factors influencing the long-term sustainability of outer space activities. This "living document" aspect of the guidelines is especially important given that the rapid evolution in space activities makes space sustainability a dynamic, multi-scale problem.

States and international intergovernmental organizations are encouraged to share their practices and experiences with COPUOS regarding the implementation of the guidelines. States are also encouraged to promote and/or conduct research on topics relevant to these guidelines and their implementation.

COPUOS envisages that it may periodically review, revise, or add to these guidelines to ensure that they continue to provide effective guidance to promote the long-term sustainability of outer space activities. Proposals for revising this set of guidelines, or for new guidelines, may be submitted by any COPUOS member state for consideration by the Committee.

Other Multilateral Initiatives with a Connection to Space Sustainability

The COPUOS work on space sustainability did not occur in a vacuum. There were, in fact, several concurrent discussions in other fora that related to space security and space sustainability. Those initiatives were (and some still are) to some extent addressing a set of largely overlapping concerns from the perspectives of different groups of actors and different fora. In this section we briefly consider how the work of COPUOS on space sustainability relates to those other initiatives.

Conference on Disarmament

Given the importance of military and civilian space systems in modern warfare, there is a technical possibility that such systems could be targeted in a conflict situation. The possibility that space-based weapons might be developed and deployed in outer space has given rise to concerns that this could lead to an arms race in outer space. Given that COPUOS focuses exclusively on the peaceful uses of outer space, questions of space weaponization and related security implications are dealt with at the Conference on Disarmament (CD), the sole multilateral body for negotiating arms control issues.

Within the CD, a number of delegations, notably China and Russia, have raised the issue of the Prevention of an Arms Race in Outer Space (PAROS). However, the CD has effectively been stagnant since 1988, since the member states have been unable to agree on the annual program of work. Not only do the members of the CD disagree over its priorities, but also the consensus rule, which served this body well in the past, is now being used to maintain the deadlock. It is against this backdrop that in 2008 China and Russia introduced a Draft Treaty on the Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects (PPWT). However, not all countries agree that new legal instruments to prevent space weaponization are warranted or even beneficial. So, for the time being, the PAROS discussions in the CD are making no progress because of differences of opinion on some fundamental issues. However, there is agreement on the urgency to make progress in those areas where there is consensus, even if such progress must be made outside the CD.

This impasse in the CD had an influence in COPUOS in the sense that the countries supporting the PPWT proposals in the CD did not want the LTS discussions in COPUOS to be used as a pretext to circumvent the need for discussions on the prevention of an arms race in outer space and the development of a legally binding framework to prevent the placement of weapons in outer space. Thus, the terms of reference for the LTS Working Group called for "appropriate liaison" with the CD. The mandate of COPUOS covers only the peaceful uses of outer space, but some of the LTS guidelines could be seen as de facto transparency and confidence-building measures to enhance collective space security. In this way the implementation of the COPUOS LTS guidelines could potentially be useful for improving mutual understanding and for reducing misperceptions and mistrust, thereby ultimately promoting a more favorable climate for arms control and nonproliferation discussions in the CD.

UN Group of Governmental Experts on Transparency and Confidence-Building Measures (TCBMs) in Outer Space Activities

In 2010, the UN General Assembly adopted resolution A/Res/65/68 (UN GA 2010), which called for the establishment of a Group of Governmental Experts (GGE) on "Transparency and Confidence-Building Measures in Outer Space Activities." The GGE was to conduct a study on outer space TCBMs, making use of the relevant reports of the UN Secretary-General, and without prejudice to the substantive discussions on the prevention of an arms race in outer space within the framework of the CD, and to submit to the General Assembly at its 68th session a report with an annex containing the study of governmental experts.

The GGE, which comprised 15 experts selected on the basis of their knowledge and geographical representation, began its work in July 2012 and submitted its final consensus report (document A/RES/65/68) to the First Committee of the UN General Assembly in October 2012. The report was adopted as resolution 68/50 by a unanimous vote in the First Committee and on 10 December 2012 by the General Assembly. This resolution welcoming the GGE report and endorsing its

content was co-sponsored by China, Russia, and the United States and represented a diplomatic breakthrough since the United States had never before voted in favor of the annual TCBM resolution.

The LTS Working Group was tasked in its terms of reference to consider appropriate linkages with the GGE. This was done by the Chairs of two respective processes providing formal briefings to each other's groups. It is instructive to identify some interlinkages between the LTS guidelines and the recommendations contained in the GGE report (UN GA 2010).

The GGE report refers in paragraph 39 to exchanges of information on orbital parameters of outer space objects and potential orbital conjunctions. Reference is also made to the registration of space objects. The LTS guidelines concerning the exchange of contact information, exchange of data on space objects, and risk assessments relating to space objects address such matters.

The GGE report refers in paragraph 40 to exchanges of information on forecast natural hazards in outer space. The LTS guidelines on sharing of operational space weather data, forecasts, and best practices address this issue.

Paragraph 42 of the GGE report refers to notifications relating to scheduled maneuvers that may result in a risk to the fight safety of space objects of other states. The LTS guidelines on the safety of space operations address such matters.

Section V of the GGE report refers to international cooperation and touches, inter alia, on international cooperation for capacity-building and confidence-building. The LTS guidelines on international cooperation in support of long-term sustainability and capacity-building address such issues.

The EU Proposal for an International Code of Conduct for Outer Space Activities

More or less at the same time as the multilateral discussions in COPUOS on the long-term sustainability of outer space activities started, the European Union began a political initiative to develop a Code of Conduct for Outer Space Activities. This initiative was pursued outside of the existing multilateral fora, motivated at least in part as a means to bypass the stalemate on the PAROS issue in the CD and the difficulties posed by the consensus rule in both COPUOS and the CD. The EU expressed its intent to open the code for signature at an international diplomatic conference, to be convened for this purpose.

Outside of Europe, no other major space powers openly endorsed the initiative until January 2012, when US Secretary of State Hillary Clinton announced that "the United States has decided to join with the European Union and other nations to develop an International Code of Conduct for Outer Space Activities" (US Secretary of State 2012). Australia's Foreign Minister, Kevin Rudd, soon followed with a similar statement. However, the initiative was not embraced by a significant number of non-EU space-capable states (notably Brazil, Russia, India, China, and South Africa, the so-called BRICS countries), largely because of concerns about the process and the intent of the EU in having kept this initiative out of multilateral fora. (During the development of the draft code, the EU held numerous bilateral

consultations, but no multilateral consultations in the UN format, until 5 June 2012, when the EU External Action/Information Service held an information session on the margins of COPUOS.) This meant that the Code of Conduct initiative had no formal multilateral mandate, unlike the GGE on space TCBMs and the COPUOS LTS processes. This lack of a formal multilateral mandate ultimately led to the demise of the Code of Conduct initiative, on procedural grounds, at a special meeting held at the United Nations in New York in July 2015.

The failure of the late attempt by the EU to "multilateralize" the code through this special UN meeting had a positive ripple effect on the LTS discussions in the COPUOS. From the start of the LTS discussions in COPUOS, a number of delegations had questioned how the long-term sustainability work related to the EU's efforts to promote a Code of Conduct and whether such a Code of Conduct would in some way "trump" the long-term sustainability discussions in COPUOS. This had caused a number of delegations to hold back from full engagement in the LTS discussions, waiting to see how the Code discussions were going to play out. With the demise of the Code discussions, COPUOS became the only forum holding productive multilateral space sustainability discussions.

It is worth noting that, although some observers saw the Code of Conduct and LTS discussions as competing processes, a closer examination would show that, although the underlying goals were the same, their approaches were diametrically opposed. The COPUOS LTS work was a technically based, bottom-up approach of developing guidelines based on the collected best practices of established space actors. The Code of Conduct initiative was a more political, top-down approach. The two approaches could, in fact, have complemented each other if the 2015 efforts to multilateralize the Code of Conduct had succeeded.

Since July 2015, the EU has not actively promoted the Code of Conduct, but it has not given up on the idea either. In several statements delivered in multilateral fora in the past 2 years, the EU has expressed the view that it still believes there would be value in agreeing on an instrument that encourages States to make a voluntary political commitment not to undertake activities detrimental to the safety, security, and sustainability of outer space activities. Such a voluntary instrument, potentially to be negotiated within the framework of the UN, should, in the EU's view, not duplicate the work of COPUOS as the UN's mandated norm-creating body for the peaceful uses of outer space and should respect its role in the further development of the legal regime governing space activities. Such a voluntary instrument would build upon the COPUOS LTS guidelines and would be complementary to these guidelines. As of this writing (August 2019), it is not yet clear whether or how the EU intends to translate these ideas into diplomatic initiatives.

Group of Governmental Experts on Further Practical Measures for the Prevention of an Arms Race in Outer Space

For completeness, we will mention here the Group of Governmental Experts on further practical measures for the prevention of an arms race in outer space. This GGE was established pursuant to resolution 72/250, adopted by the General

Assembly on 24 December 2017, and was tasked to "consider and make recommendations on substantial elements of an international legally binding instrument on the prevention of an arms race in outer space, including, inter alia, on the prevention of the placement of weapons in outer space." This GGE, which comprised experts from 25 nations, carried out its work in 2018 and early 2019 under the leadership of Brazil's ambassador to the Conference on Disarmament, Guilherme de Aguiar Patriota.

In accordance with its mandate, the GGE considered recommendations on substantial elements of an international legally binding instrument on the prevention of an arms race in outer space, including on the prevention of the placement of weapons in outer space. Pursuant to this mandate, it discussed (a) the international security situation in outer space; (b) the existing legal regime applicable to the prevention of an arms race in outer space; (c) the application of the right to self-defense in outer space; (d) general principles; (e) general obligations; (f) definitions; (g) monitoring, verification, and transparency and confidence-building measures; (h) international cooperation; and (i) final provisions, including institutional arrangements.

The sessions of this GGE took place against a backdrop of elevated political rhetoric around the counterspace developments in recent years, and the Indian anti-satellite (ASAT) test of March 2019 took place during the final session of the GGE, further adding to the grim disarmament climate. The GGE considered several drafts of a substantive report. No consensus was reached on a substantive report, so the GGE's final report was simply a procedural report issued as UN document A/74/77. Although this outcome was disappointing, the process itself was important in that the GGE held substantive discussions on space arms control.

Concluding Remarks

The golden thread running through the processes in COPUOS, the GGE on space TCBMs, and the Code of Conduct initiative is that they were all aiming to produce instruments that are voluntary in nature. However, although such instruments may be legally non-binding, they are politically binding. Another important point to appreciate is that *non-binding* does not mean *non-legal*, in the sense that states can choose to domesticate their politically binding agreement to such voluntary frameworks in their domestic regulatory practices.

A number of countries have expressed concern that such voluntary instruments are inherently fragile and would not prove effective in preventing the weaponization of and an arms race in outer space. However, there does not seem to be consensus at this point on the desirability of legally binding instruments banning the placement and use of weapons in outer space, so the development of voluntary frameworks for promoting space sustainability provides some scope for making progress. Voluntary frameworks do not necessarily retard the evolution of binding norms and can in fact pave the way for adoption of binding norms. Historically, many legal rules have resulted from the codification of existing practices adopted by consensus.

Progress will also be made in the sense that the states that choose to participate in these processes do so because they recognize the urgency of addressing the problems of space sustainability and space security. That awareness in and of itself may be enough to convince space actors to take corrective and preventative actions on their own. The COPUOS LTS guidelines, while non-binding, have the advantage of being the result of a multilateral consensus-based process and will therefore have a good chance of being implemented by space actors, in their own interest.

References

Brachet G (2012) The origins of the long-term sustainability of outer space activities initiative at UN COPUOS. Space Policy 28:161–165

Hedman N, Balogh W (2009) The United Nations and outer space: celebrating 50 years of space achievements. In: Schrogl K-U, Mathieu C, Peter N (eds) Yearbook on Space Policy 2007/2008: from policies to programmes. Springer, Wien/New York, pp 237–250. ISBN: 978-3-211-99090-2

Outer Space Treaty (1967) The treaty on principles governing the activities of States in the exploration and use of outer space, including the moon and other celestial bodies, of 27 January 1967. http://www.unoosa.org/oosa/en/ourwork/spacelaw/treaties/introouterspacetreaty.html. Accessed 3 Feb 2020

United Nations Committee on the Peaceful Uses of Outer Space (2016) Report of the fifty-ninth session, The first batch of agreed guidelines is contained in the Annex to the report of the 59th session of COPUOS in 2016, contained in UN document A/71/20. http://www.unoosa.org/oosa/oosadoc/data/documents/2016/a/a7120_0.html. Accessed 3 Feb 2020

United Nations Committee on the Peaceful Uses of Outer Space (2018a) Working Group on the Long-Term Sustainability of Outer Space Activities: preambular text and nine guidelines, conference room paper by the Chair of the Working Group on the Long-Term Sustainability of Outer Space Activities. UN document A/AC.105/C.1/2018/CRP.18/Rev.1. http://www.unoosa.org/res/oosadoc/data/documents/2018/aac_105c_1201 8crp/aac_105c_12018crp_18rev_1_0_html/AC105_C1_2018_CRP18Rev01E.pdf. Accessed 3 Feb 2020

United Nations Committee on the Peaceful Uses of Outer Space (2018b) Draft guidelines for the long-term sustainability of outer space activities, working paper by the Chair of the Working Group on the Long-Term Sustainability of Outer Space Activities. The most mature expression of these draft guidelines is contained in UN document A/AC.105/C.1/L.367. http://www.unoosa.org/res/oosadoc/data/documents/2019/aac_105c_1l/aac_105c_1l_367_0_html/V1804974.pdf. Accessed 3 Feb 2020

United Nations Committee on the Peaceful Uses of Outer Space Scientific and Technical Subcommittee and International Atomic Energy Agency (2009) Safety framework for nuclear power source applications in outer space. International Atomic Energy Agency, Vienna. www.unoosa.org/pdf/publications/iaea-nps-sfrmwrkE.pdf. Accessed 3 Feb 2020

United Nations General Assembly (1987) Report of the World Commission on Environment and Development, Annex Our Common Future, UN document A/42/427. http://www.un-documents.net/wced-ocf.htm. Accessed 3 Feb 2020

United Nations General Assembly (2007) Committee on the Peaceful Uses of Outer Space, future role and activities of the Committee on the Peaceful Uses of Outer Space, working paper submitted by the Chairman, UN document A/AC.105/L.268. http://www.unoosa.org/pdf/limited/l/AC105_L268E.pdf with a corrigendum issued in document http://www.unoosa.org/pdf/limited/l/AC105_L268Corr1E.pdf. Accessed 3 Feb 2020

United Nations General Assembly (2010) Resolution adopted by the General Assembly on 8 December 2010, on the report of the First Committee (A/65/410), transparency and

confidence-building measures in outer space activities, A/RES/65/68. https://undocs.org/en/A/RES/65/68. Accessed 3 Feb 2020

United Nations General Assembly (2011) Report of the Committee on the Peaceful Uses of Outer Space, fifty-fourth session (1–10 June 2011), UN General Assembly document A/66/20, Annex II

United Nations General Assembly (2019) Report of the Committee on the Peaceful Uses of Outer Space, sixty-second session (12–21 June 2019), the final combined texts of the preamble and 21 LTS guidelines is contained in UN document A/74/20, Annex II. https://www.unoosa.org/res/oosadoc/data/documents/2019/a/a7420_0_html/V1906077.pdf. Accessed 3 Feb 2020

United Nations Office for Outer Space Affairs (1958–2018) Documents and resolutions database. www.unoosa.org/pdf/publications/st_space_49E.pdf. Accessed 3 Feb 2020

United Nations Office for Outer Space Affairs (2010) Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space. United Nations, Vienna. https://www.unoosa.org/oosa/documents-and-resolutions/search.jspx?lf_id=. Accessed 3 Feb 2020

United Nations Register of Objects Launched into Outer Space. http://www.unoosa.org/oosa/en/spaceobjectregister/index.html. Accessed 3 Feb 2020

United States Secretary of State (2012) Statement of Hillary Rodham Clinton on January 17, 2012. http://www.state.gov/secretary/rm/2012/01/180969.htm. Accessed 3 Feb 2020

Weeden B (2010) Dealing with Galaxy 15: Zombiesats and on-orbit servicing. The Space Review, Edition of 24 May 2010. http://thespacereview.com/article/1634/1. Accessed 3 Feb 2020