Awareness-raising and capacity-building related to the implementation of the Guidelines for the Long-term Sustainability of Outer Space Activities (LTS Guidelines)

Stakeholder Study Report

May 2022

UNITED NATIONS
Office for Outer Space Affairs

The UNOOSA project *"Awareness-raising and capacity-building related to the implementation of the LTS Guidelines"* was made possible through the generous support of the Government of the United Kingdom.

UNITED NATIONS
Office for Outer Space Affairs

UK SPACE AGENCY

Contents

Executive Summary

In 2021, the United Nations Office for Outer Space Affairs (UNOOSA), with generous support from the Government of the United Kingdom, established a project entitled "*Awareness-raising and capacity-building related to the implementation of the LTS Guidelines".* The Project has been implemented in two phases.

In the first phase, UNOOSA organized a series of events convening space stakeholders to exchange experiences and to collect operational case-studies on the implementation of the Guidelines for the Long-term Sustainability of Outer Space Activities of the Committee on the Peaceful Uses of Outer Space (COPUOS). UNOOSA also released a user-friendly publication of, and an infographic series on, the Guidelines for the Long-term Sustainability of Outer Space Activities, available on a dedicated website.

Starting in November 2021, the second phase focused on the preparation of a stakeholder study report on the implementation of the Guidelines. UNOOSA held 42 anonymous interviews asking States members of the Committee on the Peaceful Uses of Outer Space and international intergovernmental organizations about implementation experiences, challenges they had faced in implementing the Guidelines, actions that might improve implementation, and assistance they might need for further implementation.

The present report highlights key elements captured from the various responses during the interviews.

Overall, interviewees considered the adoption of the Guidelines by COPUOS a landmark achievement in space policy and space diplomacy, as well as an important step to protect outer space and ensure equitable access to the benefits that it provides.

When discussing **Section A** on policy and regulation framework for space activities, interviewees flagged the increasing attention being paid to safe and sustainable activities in space, including in the context of national space law and policy. In some jurisdictions, the Guidelines have already been formalized in national space strategies, policies and laws. In other cases, national experts are in the process of conducting studies on implementation of the Guidelines, including on proposed actions to adopt, amend and revise domestic rules and regulations. One challenge highlighted was, for instance, balancing legal robustness of the public sector and ad hoc flexibility to boost opportunities for industry and the private sector. Multiple interviewees, however, agreed that legal and regulatory certainty is one of the best incentives that a State can offer its space sector.

Interviewees highlighted that **Section B** on safety of space operations provides a clear list of what topics should be addressed to ensure the safety of space operations, something that had not previously existed at the international level. Interviewees expressed that while the Guidelines provided overall direction, it is the task of those that implement the Guidelines at the national or regional level to establish and document

deeper, more specific, technical implementation practices, which some interviewees flagged as challenging given the technical nature of this section. Among others, information sharing and cooperation were mentioned as conditions for success in this area of work.

Section C on international cooperation, capacity-building and awareness was indicated as one of the key building blocks for implementing the Guidelines. Interviewees highlighted many examples of international cooperation, including the open sharing of information and tools free of charge. They linked such cooperation and communication with increased trust and confidence-building within the international space community. They highlighted the importance of not working in silos, flagging, inter alia, the value of cooperation and knowledge sharing between international intergovernmental organizations supporting the Guidelines' implementation. Interviewees also highlighted the value of the public in general, and decision and policymakers specifically, understanding that space is no longer a niche area, with space applications and technology used in the daily lives of people around the globe.

On **Section D** on scientific and technical research and development, interviewees agreed on the importance of related activities. Interviewees shared that States with few space assets generally focus on applied sciences, meaning that their research activities need to address concrete, existing issues, and lead to practical solutions and direct socio-economic benefits. It was also felt that when good sustainability practices are initiated at the research and development phase, they frequently continue and flow into the operational phases of space activities.

Overall, experiences shared throughout the interviews identify different elements. For some interviewees it was a priority to first develop a mutual understanding of the Guidelines, in order to then effectively raise awareness about them and to ensure their implementation, while other interviewees stressed the voluntary nature of the Guidelines, noting they would begin by implementing the "low-hanging fruit" and/or those Guidelines that best suited their national context. Transparent, efficient and direct communication and information sharing were elements that cut across all the Guidelines. Engagement of industry and the private sector was also highlighted across most sections, including examples of how companies can play a role in supporting and even encouraging institutional actors to implement the Guidelines, fostering sustainable practices.

Despite current international cooperation, capacity-building and awareness efforts, some stakeholders remain unaware of what they should do or from whom they can seek assistance when operationalizing the Guidelines. Interviewees stressed that there is a need for ongoing international, multi-stakeholder coordination, which may be supported by regional and international organizations.

More detailed observations are available in the report.

Context

There have been increasing levels of interest in space in recent years, with record political and economic capital invested in space activities. Space may seem vast, but the orbits around Earth are a limited natural resource. The rapidly growing number of space activities, the proliferation of space debris, the increasing complexity of space operations, the emergence of large constellations, and the increased risks of collision and interference with the operation of space objects, are among the pivotal factors that have been recognized by the global space community as affecting the long-term sustainability of space activities.

The Working Group on the Long-term Sustainability of Outer Space Activities was established in 2010 under the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space (COPUOS) (A/AC.105/958, para. 181) to identify areas of concern for the long-term sustainability of outer space activities, propose measures that could enhance sustainability, and produce voluntary guidelines to reduce risks to the long-term sustainability of outer space activities.

In June 2019, the Guidelines for the Long-term Sustainability of Outer Space Activities, which had been negotiated by the Working Group on the Long-term Sustainability of Outer Space Activities, were adopted by COPUOS (A/74/20, para. 163 and annex II). At the same session, the Committee also decided to establish a new working group under the long-term sustainability agenda item of the Scientific and Technical Subcommittee (A/74/20, para. 165). The Guidelines were subsequently addressed at the United Nations General Assembly level.[1]

The United Nations Office for Outer Space Affairs (UNOOSA) collaborates with stakeholders from across the global space sector to promote safe and sustainable activities in space for the benefit of everyone, everywhere.

[1] In operative paragraph 2 of Resolution 74/82, the United Nations General Assembly, "Welcomes with appreciation the adoption by the Committee of the preamble and 21 guidelines for the long-term sustainability of outer space activities, as contained in annex II to the report of the Committee, and the establishment, under a five-year workplan, of a working group under the agenda item on the long-term sustainability of outer space activities of the Scientific and Technical Subcommittee of the Committee, notes that 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, and emphasizes that the Committee serves as the principal forum for continued institutionalized dialogue on issues related to the implementation and review of the guidelines".

The Project

In 2021, the United Nations Office for Outer Space Affairs (UNOOSA), with generous support from the Government of the United Kingdom, established a project entitled "*Awareness-raising and capacity-building related to the implementation of the LTS Guidelines".* The Project has been implemented in two phases.

In the first phase of the Project, UNOOSA organized three virtual events with the participation of various stakeholders of the global space community reflecting on their activities related to the Guidelines for the Long-term Sustainability of Outer Space Activities. UNOOSA also released a user-friendly publication of, and infographic series on, the Guidelines. Additionally, UNOOSA gathered and highlighted operational case studies focusing on how the Guidelines have been put into practice by industry and private sector, States, international intergovernmental organizations, non-governmental organizations, academia, and other entities. An open call for case study collection, including the template for the case study submission, the publication and infographics, as well as other relevant information may be found on, and downloaded from, the dedicated Project website (spacesustainability.unoosa.org).

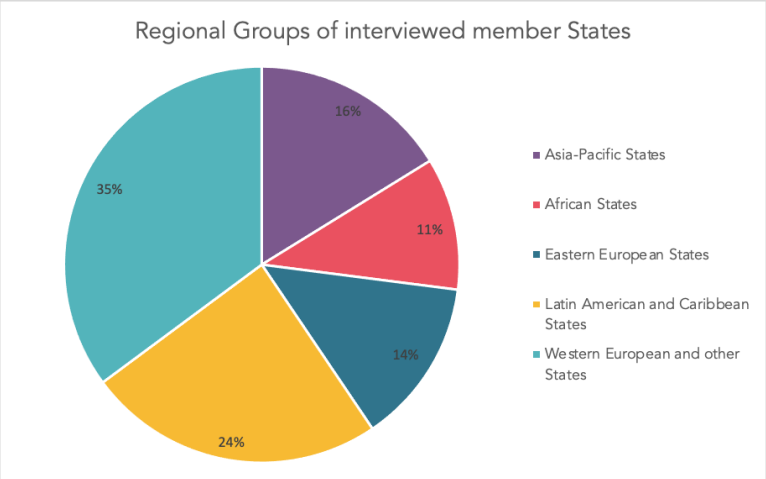
In the second phase of the Project, UNOOSA conducted a series of interviews with States and international intergovernmental organizations focusing on their experiences in implementing the Guidelines. The information gathered in the interviews is found in the present stakeholder study report. The report compiles and shares information on experiences implementing the Guidelines, including challenges faced and potential capacity-building needs.

Methodology

To facilitate an open and rich stakeholder engagement process, each interview was conducted in a confidential manner through an online platform.

A diverse selection of stakeholders was identified. All States members of the Committee on the Peaceful Uses of Outer Space Affairs (COPUOS) were invited to participate, as were a number of relevant international intergovernmental organizations. It was the decision of the States and international intergovernmental organizations who they wished to include in the interview. The United Nations Office for Outer Space Affairs (UNOOSA) advised the stakeholders to nominate national experts and representatives who have first-hand knowledge of, and/or direct experience in, implementing the Guidelines for the Long-term Sustainability of Outer Space Activities to participate in the interviews. Interviewees included experts from the science, technology, engineering, legal, policy, regulatory and diplomatic communities.

A total of 42 interviews took place, 37 with States members of COPUOS and five with international intergovernmental organization (see Acknowledgements for a full list of participating States and organizations). Altogether, UNOOSA engaged with eighty-eight representatives and space professionals from all geographic regions (see the chart below) on their implementation practices, their interpretations of the Guidelines, and their short- as well as long-term aspirations in connection with the Guidelines. Efforts were made to balance the views of interviewees representing the largest and most well-established space programmes, those representing medium-sized space programmes and those representing new or emerging space actors.[2]



[2] The report attempts to use neutral and balanced language to describe States, interviewees and the capabilities of space programmes. Efforts were made to reproduce terms used by the interviewees themselves and to avoid categorizing States or their space activities in ways they may not elect to categorize themselves. It is acknowledged, however, that not all interviewees or those reading the report may use or understand terminology in the same way.

UNOOSA was able to offer a dedicated number of interview slots benefiting from interpretations services. Interpretation was offered in all the official languages of the United Nations.

The interviews were conducted over a period of three months, from December 2021 to February 2022.

Each interview was framed around the four sections of the Guidelines for the Long-term Sustainability of Outer Space Activities (A-D) and the substantive preamble, with the same questions posed in each interview. Follow-up and clarification inquiries were also used.

The report focuses on anonymized analysis/summaries taken from interviews that:

- share implementation experiences of States so as to understand the applicability of the Guidelines in national contexts;
- demonstrate implementation challenges that States have experienced/are experiencing;
- contain views on any specific assistance that States consider necessary to help them implement the Guidelines; and
- present views on both short- and mid-term actions that could be taken to improve/drive forward LTS Guidelines implementation.

Observations

This section of the stakeholder engagement study presents the views expressed during the interviews, capturing key elements from the various responses. The comments, opinions and the selected quotations are not attributed to the specific interviewees.

Section A: Policy and regulatory framework for space activities

I. Institutional set-up – the role of public institutions in the enhancement of national space policy and strategy

"Addressing the implementation of the LTS Guidelines is like changing our country's philosophy and approach in carrying out outer space activities."

Interviewed States maintain various **institutional systems** when it comes to managing and leading domestic space affairs and policy. Whether and how a country's institutional set-up might relate to the effectiveness of its implementation of the Guidelines for the Long-term Sustainability of Outer Space Activities was raised by States. During the interview process, the following public entities in charge of space affairs were described by interviewees.

- Some countries recognized the ultimate need for a *space agency* dedicated to a country's space capabilities. It is important to note, however, that the role of space agencies varies based on numerous factors. In nations with well-established space programmes, space agencies tend to be responsible for scientific and technical projects and activities with well-established facility and technical expertise, while guidance of space policy and supervision of the private sector usually remains with other ministerial institutions. In some cases, the main focus of space agencies was interinstitutional coordination and external representation in the context of space matters. In other instances, the space agencies' main task was to cooperate with industry and the private sector on funding, policy and regulation. There were even cases where space agencies had regulatory power over space activities. In countries where space agencies exist, they are usually the focal points in regional and international organizations. Their roles in awareness-raising and lobbying for a *space-driven public policy* through numerous media channels were also apparent.
- States interviewed also generally carried out their space activities with the involvement of up to *six relevant ministries,* usually with one department serving as a central coordinator. In most cases the central ministerial institution was the ministry of economy as a home for space affairs coordination. Other ministries in charge included: the research, science and education ministry; the climate

ministry; the development and technology ministry; the ministry of transportation; and the foreign affairs (and trade) ministry.

- Some governmental officials from smaller States, who are responsible for liaison with the non-governmental sector, expressed that it was relatively easy for them to keep in touch with and monitor their non-governmental space entities, some even having direct and daily contact with them.
- Some States articulated that it is a challenge to exactly assess their country's space-eco system, as in many cases, non-governmental entities might not even know they carry out a "space activity". It, therefore, requires an extra effort and resources from the responsible authority to assess and register all related stakeholders and to maintain connection with them.
- Some interviewees stated that the scope of competences in terms of space activities are somewhat blurred between military and civilian institutions in their countries. The interviewees also stated that this dual-use characteristic can lead to challenges for the industry and the private sector, such as knowing who to talk to and how to navigate internal bureaucracy.
- Among some of the interviewed respondents, *research organizations / universities* were recognized as pivotal in their national space ecosystem. It was highlighted that in nations with few space capabilities, it is the technical university staff and students that put together satellites and operate them, with the help of the government. A State also elaborated on the initiative role that their technical university played in developing the country's first satellite, and it was that institution that later started running activities related to space in the country. State officials also hoped that such university could develop into a space agency later. In other cases, universities created spin-off companies leveraging their knowledge in the private sector (links with **Guidelines D.1**[3]).
- *National space committee* – some States established an advisory body representing all space stakeholders in the country, including with interdisciplinary backgrounds. Such committees usually consist of various agencies and ministries that have a stake in space activities and include voices from space industry and the private sector. The aforementioned institutions help facilitate and direct information sharing on the needs and challenges of all stakeholders in the space field, while also undertaking high-level awareness-raising.
- The role of *representatives of Permanent Missions to the United Nations* was also highlighted by some interviewees, as Permanent Missions often provide the direct link to, or take the lead in, space diplomacy. The representatives of Permanent Missions in Vienna can have direct influence, inter alia, in discussions within the Working Group on the Long-term Sustainability of Outer Space Activities. As it was emphasized, sufficient reporting to the capital on the development of

[3] While references to links with specific Guidelines or sections of Guidelines are meant to highlight relevant connections, they do not represent an exhaustive list.

international space policy, and on discussions related to the long-term sustainability of outer space activities, can influence a country's overall approach to the Guidelines.

II. National regulatory framework

Ratification of international space law treaties was widely recognized by States as a first step to developing space activities. Some international intergovernmental organizations also highlighted their unilateral acts, accepting the rights and obligations of space law treaties to demonstrate the same level of responsibility as their Member States have.

The significance of formulating national space policy and space strategy as guidance for all stakeholders in the space domain, and for the public, was underlined during almost each interview. The sustainable and accountable use of space has received increasing recognition in such areas as specific space projects and programmes. The Guidelines as a driving instrument for internal space activities has also been acknowledged in some States' space policies and space strategies.

Despite being a fairly new and voluntary instrument, the Guidelines had already been referred to in national space law sources among some of the interviewed States. Other States expressed that their relevant domestic experts are in the process of conducting studies related to the implementation of the Guidelines, including the adoption, amendment and revision of domestic rules and regulations (**Guidelines A.1** and **A.2)**, in accordance with the instrument.

In connection with drafting and legislation of national regulatory frameworks, the following resources and elements were highlighted by interviewed States:

- Application of the Sofia Guidelines for a Model Law on National Space Legislation of the International Law Association (ILA).
- Use of the dedicated webpage on the website of United Nations Office for Outer Space Affairs (UNOOSA) with the collection of national space laws and the application of elements most fitting for national institutions and priorities during the drafting of national space laws.[4]
- Bilateral consultations with international partners as an important element in the national space law drafting process.
- The role of international intergovernmental and regional organizations – some international intergovernmental organizations can provide direct legal advice for their Member States upon request, and they can also create the necessary fora and networks to discuss experiences, concerns, lessons learnt and actual challenges. In this context, collaboration with the UNOOSA Space Law for New Space Actors project was mentioned as an existing avenue already available to Member States for capacity-building support and services.

[4] Updates to the national space law collection remain ongoing. UNOOSA welcomes further submissions by States in this regard.

- The need for national space law experts who are both aware of international policy directions and at the same time understand national perspectives, priorities and challenges was highlighted. Such skilled individuals are essential in guiding national governments in the space field. In order to train such experts, both interdisciplinary, and space law and policy focused courses are necessary, considering the widening scope and complexity of space activities worldwide.

The abovementioned points demonstrate strong interlinkages with the Guidelines in **Section C**.

Some interviewed States highlighted that they had done a national evaluation based on their implementation of the Guidelines, and they are planning to carry out periodical revisions. When asked about the ideal time between revisions, one representative stated that it is not a matter of intervals, but rather the scope and details of the re-evaluations that should be considered.

III. Supervision of national space activities

"…of course, we want sustainable space,
but are we really ready as a country to impose a regulation
which will be detrimental to our industry and companies,
just for the sake of being more sustainable?"

An overall challenge highlighted by interviewed States when discussing **Guideline A.3** on supervising national space activities was balancing legal robustness of the public sector and ad hoc flexibility to boost opportunities for industry and the private sector. Some states highlighted that they do not want to overburden the private sector with administrative duties and extra costs because this could hinder space activities of private entities, but they still want to make sure that everything is done properly due to their responsibility for operators' activities. In general, however, it was frequently stated by interviewees, especially those from established space-faring nations, that "*legal certainty is one of the best incentives that a Member State can offer to its space sector*".

Elements raised when interviewees discussed legal certainty in connection with the non-governmental space sector included: the need for national rules and regulations on space activities to be in place; the need for transparent and predictable licensing practices for the non-governmental sector; the need for established liaison channels with the relevant public authorities; and the need for additional ways to inform the space sector on their rights and obligations (e.g. publicly available, periodically updated websites, with clear, simple messaging, in both national and English languages).

"How to deal with the commercial sector is something that we constantly need to re-evaluate."

In terms of supervision of national space activities through licensing practices, the following points were flagged during the interviews:

- There are several types of space activities that can be licensed by a State. Interviewees cited the licensing of a launch payload facility (in countries with such facility); the launches themselves (ignition into space); re-entry; payloads; and spacecraft (e.g. satellite) operation, etc.
- States with an established space sector usually have a central licensing procedure in place.
- Some States hope that licensing and inspection processes generate revenue for their space authority to inject back into their space programmes.
- Some State representatives expressed the view that making the licensing application a fast, predictable process, free of charge is something that incentivizes the establishment of a responsible and sustainable space sector.
- Separate licensing rules and requirements based on the purpose of the space activity, and size and activity of a space object, were present in some States' regulations. This means, for example, that purely scientific non-governmental operators, such as universities, might not have to pay for the application process, they may have a simplified process, or even an exemption from the authorization process or the insurance requirements, compared to commercial operators. Difference based on the size and activity of a space object included lower requirement for cubesats compared to constellations, for instance. Such separation often occurred in licensing frameworks.
- One respondent also emphasized that good licensing practices might be considered by customers as a credible indicator that a particular operator is a responsible space actor. In order, however, for this to be more of an incentive for the private sector to be sustainable, potential customers also need to be positioned to be able to demand that space operators follow good sustainability practices, such as those detailed in the Guidelines (links to **Guideline C.4**).
- States use different terminology to describe the authorization processes, which precedes license issuance. Some countries include in the administrative procedure an *Environmental Impact Assessment* (EIA)[5], which emphasizes that an operator is required to assess the potential effects of its space activities, including on the Earth, in the atmosphere and in outer space prior to licensing, and needs to demonstrate to the authority that its activity is reliable, and it will be compliable with applicable international standards accepted by the given State. Additionally,

[5] The general meaning of Environmental Impact Assessment is found under the Convention on Environmental Impact assessment in a Transboundary Context (Espoo Convention), 25 February 1991. Accordingly, "Environmental Impact Assessment means a national procedure for evaluating the likely impact of a proposed activity on the environment".

during the space activities, the license authority can request additional environmental impact assessments to make sure that the activity is carried out in compliance with the authorization, or that there is no additional risk having appeared since the launch[6]. (Environmental impact assessments may be connected with, inter alia, **Guideline D.1**, in particular **paras. 2 and 3**.)

- One of the States interviewed elaborated on its voluntary pre-license engagement procedure, based on a traffic light system. This is a free service, provided by the regulator, and consists of an initial set of standardized questions that the applicant answers, on the regulator's publicly available website. By answering those questions, the regulator then forms an initial, non-binding, high level assessment and provides feedback on the safety risks. This procedure encourages potential operators to approach the regulator at the earliest possible time to discuss their ambitions, and to troubleshoot any obstacles at the early stage.
- A mutual and related challenge, widely referred to by interview respondents, is the growing complexity of space operations as space becomes increasingly accessible to all. In many cases governments do not have influence on how non-governmental entities build their satellites (**Guideline B.8**) without specific licensing rules in place. In such instances, ad hoc decisions are made without the required monitoring, even though States are responsible for their operators' actions.
- National policies and regulations regarding the procurement of launch services were also underlined as challenges by some States who did not have their own launch capacity.
- Some States interviewed make a distinction between license requirements based on principles and core values, such as safety, orbital space debris, national interest, international obligations, responsibility, and security. A *flexibility clause* also appears in some jurisdictions, which allows the application of additional conditions to the license to mitigate risks not included in the regulation. Some interviewees expressed the view that it was challenging to translate the Guidelines into operational terms, including in the areas of licensing and regulating the non-governmental sector.
- It was also emphasized that supervision activities require additional trained human resources and that small countries are less likely to have them.

License revision practices were also mentioned. They included making inspections at the operator's site once a year or more frequently, if the authority becomes aware of any problems. The inspection requests operators to demonstrate the health of their space objects and that they still have contacts with such objects; in another case, the relevant authority requests regular annual reports from the operators.

[6] The possibility of a third Environmental Impact Assessment, as described by one interviewee, can in some jurisdictions be initiated by the licensing authority in connection with the reentry or de-orbiting of the satellite, to make sure that reentry has not caused any impact on the Earth's environment.

A State interviewed also explained how international intergovernmental organizations can play a role in encouraging countries entering the space arena to implement the Guidelines. In the example given, the international intergovernmental organization financed and assisted the first satellite launch of a country. The international intergovernmental organization stipulated that the country's space law would need to be ready by the date of launch, convincing the national legislators of the need for a domestic space act to focus on safety of space operations. The domestic legal act came into force within a year.

Engagement of industry and the private sector was also highlighted by several interviewees. It emerged that these actors can foster sustainable practices by encouraging institutional actors to implement the Guidelines or support information-sharing in that regard.

One example described by an interviewee is a launcher company that abides by the Registration Convention through its State's requirements, and which may condition the launch of another country's satellite to a guarantee that the satellite would be registered by the contracting State. In case the State, that is otherwise not party of the Registration Convention, wants to become a space-faring nation and launch its satellite with that company, it must comply with the higher requirements of the launcher company. This experience shows that those actors that are guiding practices of the safe and sustainable use of space, standards, and obligations can directly affect other entities.

Another example illustrates the complex interplay between national regulation and industry and the private space sector. In this context, an emerging space-faring nation, at the beginning of drafting its national space act, asked for input from one of the largest space companies dealing with satellite design and operation. The company was asked to elaborate on the necessary conditions and incentives that the space industry and private sector needed, so an attractive market could be created for them.

Continuous communication and consultation with the private sector are necessary to fully understand evolving challenges in space activities. National chambers of commerce, trade associations, and international coalitions were suggested as various types of advocacy institutions that can act as intermediaries between government and the private sector, representing the interest of the industry. In all these associations, the Guidelines can be, and in some cases are already, used as a major consensus document to point to universally agreed, safe and sustainable actions in outer space.

IV. Registration of space objects

"Registration triggers a lot of practical questions that will have to be addressed at COPUOS."

The Convention on Registration of Objects Launched into Outer Space entered into force in 1976. States and international intergovernmental organizations that agree to abide by

the Convention are required to establish their own national registries and provide information on their space objects to the Secretary-General for inclusion in the United Nations Register. Responsibility for maintenance of the Register was delegated by the Secretary-General to the United Nations Office for Outer Space Affairs. The United Nations Register of Objects Launched into Outer Space and the Online Index of Objects Launched into Outer Space provide quick and efficient means to access information provided to the United Nations in accordance with the Registration Convention.

Among the interviewees, the registration of space objects, as well as **Guideline A.5** on enhancing the practice of registering space objects, were considered crucial elements in ensuring the long-term sustainability of outer space activities and most respondents had observations and remarks on the practical implementation of **Guideline A.5**[7]**.**

According to some of the interviewees, the role of UNOOSA was, for instance, not clearly enough elaborated in **Guideline A.5**. Some States interviewed wished for instruction on how they can support UNOOSA, as requested in **paragraph 5 of Guideline A.5**. Some interviewees were confused as to who are the national focal points on registration and expressed uncertainty about who they could call for other services (e.g. requesting launching services). The idea for a *phonebook of operators* was also put forth, with acknowledgement that protection of confidential information was also a concern.

Respondents from States where the quantity of satellite launches is rapidly increasing recommended both national and international automation of the registration process.

One interviewee explained how using metrics to clearly demonstrate the delays that existed between launch and registration had raised awareness at the national level and led to more timely registration practices.

[7] The importance of registration of orbital slots and radio frequency spectrum at the International Telecommunication Union (ITU) was also touched upon during the interviews.

Section B: Safety of space operations

"We all know that the orbits are getting really saturated,
and if we don't address the guidelines in Section B soon,
there will not be space activities anymore."

I. Information on space objects and orbital events

The willingness to cooperate and share information on space objects and events in a transparent manner (**Guidelines B.1** and **B.2**) were cited by interviewees as an important prerequisite for success in this area of work.

Although the term *space situational awareness (SSA)* is itself not in the Guidelines for Long-term Sustainability of Outer Space Activities, the term was frequently used by interviewees. There were, however, notable differences in topics discussed in connection with space situational awareness[8] and differences in the use of related terminologies. It was argued by some representatives that utilizing space situational awareness capabilities can cover almost all elements of the safety of space operations or **Section B** of the Guidelines.

A respondent claimed that spacecraft operators have the most accurate information when it comes to implementation of **Section B** of the Guidelines. The existence of related multi-stakeholder processes and international cooperation systems can help ensure that more data and information is available, including that provided by industry and the private sector, which is essential, given the complex nature of outer space activities. Two surveillance and tracking or collision avoidance domains, the United States Space Surveillance Network[9] and the European Union Space Surveillance and Tracking (EU SST) Consortium[10] were widely referred to during the interviews when discussing tracking space objects.

Most space debris monitoring (**Guideline B.3**) and collision avoidance services (**Guidelines B.4** and **B.5**) are limited to assisting regional or national services. The U.S. Space Surveillance Network platform, however, allows global and direct communication between satellites operators in case they receive conjunction data messages (CDMs). Many States with satellite capabilities shared how they have already received warnings

[8] Space situational awareness topics mentioned by the interviewees included: information sharing on orbital space objects, orbital events and space debris; collision avoidance or conjunction assessment capabilities; space weather monitoring and forecast, and near-Earth objects (NEO) monitoring.

[9] The United States Space Surveillance Network is operated by the Unite States Space Force and can be found at www.space-track.org.

[10] The Space Surveillance and Tracking (SST) Support Framework was established by the European Union in 2014. The Consortium's Member States have networked their assets to provide a set of SST services to all EU countries, EU institutions, spacecraft owners and operators, and civil protection authorities. The SST services assess the risk of in-orbit collisions and uncontrolled re-entry of space debris into the Earth's atmosphere and detect and characterize in-orbit fragmentations.

on risk of collision – through their operators – from the mechanism. One of the challenges with the USSTRACOM collision avoidance ad-hoc and voluntary procedure mentioned during the interviews was that operators, especially those who operate small or nano satellites, sometimes do not reply to e-mail or phone inquiries in case of close approaches, or do not provide sufficient contact information. Furthermore, some States and operators are not sure what they can legally expect from the parties under close encounter conditions, especially in a situation where one of the parties does not reply to the requests. Some of the legal questions in such an incident were whether the parties involved have an obligation to respond to each other, and what information should be shared among each other.

Some States interviewed either did not aspire to build their own space situational awareness capacity or spoke in future terms when discussing surveillance and tracking capabilities. In these cases, States highlighted their intention to either join their region's independent regional space surveillance and tracking infrastructure or to be part of a global space surveillance and tracking framework.

Some respondents highlighted the need for *automated collision avoidanc*e and standardization, which would not only enable the safety of space operations but could also encourage the global space community to directly address the "rules of the road" on the subject. One interviewee, when discussing collision avoidance, expressed the view that in order to achieve long-term and meaningful results, a philosophy shift is necessary – from the protection of one's own satellite to the perspective of orbital space environmental protection. The interviewee emphasized that space-debris neutrality and transparency measures, such as the Space Sustainability Rating[11] are needed to ensure the long-term sustainability of outer space activities at the macro (global) level.

In terms of **Guidelines B.2** and **B.3** the *astronomical community* expressed unique thoughts and challenges. One State emphasized the importance of improving accuracy of orbital data to conduct astronomical observations. There needs to be an accurate data system on space objects to ensure that telescopes can avoid such objects, or if this is not possible, experts should improve astronomical data processing to remove objects from the images.

Light pollution by satellites and the subject of *dark and quiet skies* also came up many times during the discussions, with the indication that the quantity and volume of future space objects should also be seriously considered in all orbits.

During the interviews, those States whose territories have already been affected by *uncontrolled re-entry* of objects expressed more concern about taking measures to address risks associated with such uncontrolled re-entries (**Guideline B.9**). Through surveillance and tracking capabilities, and through other means, such as the Inter-Agency Space Debris Coordination Committee's (IADC) Re-Entry Database, mentioned during an interview, uncontrolled re-entry can be monitored. However, as an interviewee asserted,

[11] The Space Sustainability Rating is an initiative that seeks to foster voluntary action by satellite operators to reduce the risk of space debris, on-orbit collisions, and unsustainable space operations.

the uncertainty problem is intrinsic to re-entry and predictions of the final impact remain difficult. The interviewee highlighted that those undertaking space activities are not able to be precise enough with predictions of where the re-entry of a space object will occur in order to successfully alert a potentially affected population in time to make a significant difference to the outcome.

II. Space Weather

Space weather monitoring and forecasting (**Guideline B.6** and **B.7**) were explained by one of the interviewees as activities used to provide impact assessment due to solar effects on different domains, such as on the operation of spaceborne and ground systems and on human health. In general, States interviewed were highly aware of the significance of space weather and space weather capabilities, and in most States some space weather activities were carried out, at least in a research and development phase (links to **Section D**).

III. Design and operation of space objects

The view was expressed that the list of topics covered under **Section B** can be examined at the mission design phase, with the knowledge that all aspects are going to appear during the mission.

Regarding design and operation of space objects (**Guideline B.8**), States interviewed that have few space capabilities and do not have a technical space agency, usually do not have central oversight of space objects manufactured in the country. Research institutions, technical universities, international intergovernmental organizations, or private sector companies may, in some cases, fill this gap. Some interviewees stated that companies, especially traditional large multinational ones, sometimes know more than the government when it comes to technical implementation.

"Sometimes the private sector leads the public domain in terms of design and operation."

Some interviewees provided examples where public authorities either administer licensing requirements after the design phase or rely on the information provided by the applicant stakeholders due to the lack of technical experts in public institutions (links with **Section A**).

In some cases, international intergovernmental organizations with sufficient technical and human resources provide their Member States with supervision expertise and act as

technical advisors upon request[12]. International intergovernmental organization supervision was considered to be a good way of showcasing implementation practices while also training national experts. One interviewee felt it was "*the best certification of sustainable space practices*". Another interviewee stated that it should not be the task of international intergovernmental organization to directly deliver information on long-term sustainability practices to companies, rather that is the role of each nation to spread the word within their territories on the required safe and sustainable approaches to the use of space. The view was expressed that awareness of such requirements should be encouraged at national level through clear and simple messaging in various media channels, as well as through supervision and licensing practices.

Some interviewees shared that the Space Debris Mitigation Guidelines of the Committee of the Peaceful Uses of Outer Space have already been set out in their national laws. One interviewee stressed how their national requirements related to the Space Debris Mitigation Guidelines have helped space manufacturers to follow a comprehensive approach with regard to the design, building and operation of a spacecraft to ensure that the infrastructure corresponds to the operational requirements (interlinkages between **Guideline A.2** and **Guideline B.8**).

Some interviewees also noted the deep interconnections between national and regional work on the design and operation of space objects. One interviewee shared the example of how satellite operations in Europe are usually not incorporated in national programmes but are rather carried out through the activities of the European Space Agency. National programs of European States typically concentrate on payload development, payload capabilities and the development of technologies.

End-of-life disposal (related to, inter alia, **paragraph 11** of the **preamble**, **paragraph 5** of **Guideline B.7**, **paragraph 2** of **Guideline B.8**, and **paragraph 3** of **Guideline D.2.**), making sure that the spacecraft either reaches its intended graveyard orbit or de-orbits appropriately, is key to protecting the space environment. Interviewees expressed differing views on the global space community's approach to implementing the Guidelines for the Long-term Sustainability of Outer Space Activities, the Space Debris Mitigation Guidelines, and the Inter-agency Space Debris Coordination Committee (IADC) Space Debris Mitigation Guidelines in terms of end-of-life disposal practices. An interviewee stated that when looking globally at spacecrafts that reach their end-of-life, there is insufficient implementation of the available guidance. According to the respondent, higher reliability should be expected, in particular in case large-constellation operators start replenishing their satellites. Other interviewees noted that they had

[12] An interviewee described the following example: the Member State of the international intergovernmental organization sends the application they received from their operator to the international intergovernmental organization, the organization then compares the data received with their own activities and procedures, makes an evaluation for the Member State, and the operator pays for the advice.

witnessed in recent times an overall greater willingness among various stakeholders to follow reliable practices concerning end-of-life disposal.

The idea of satellite sharing was raised during the interviews as positive modus operandi. One example was a service provided by an international intergovernmental organization, through which one State only uses a part of a satellite, allowing other States to use the remaining available space on the spacecraft. It was claimed to be an economically logical and sustainable step, with the possibility to reduce the overall number of satellites in geosynchronous orbit (GSO), and possibly in other trajectories as well (related to **Guidelines A.4, B.8** and **D.1**).

A recurrent challenge brought up by the respondents was the issue of equitable responsibility across space operators regarding those spacecrafts that have propulsion to conduct potential manouvre versus those (usually nano satellites) that do not have fuel and are non-maneuverable. Some interviewees asked, whose responsibility was it to move their satellite in case a risk of conjunction occurs.

Some interviewees linked orbital locations with the maturity of space operators. Some respondents, for instance, tended to be more confident relying on the expertise of "well-known and long-established" telecommunication satellite operators when conducting activities in geostationary and geosynchronous orbits (GEO and GSO). One interviewee stated that "*such [well-established] manufacturers and operators would never risk something which is not in compliance with high standards*". Alternatively, activities in low-Earth orbit (LEO) included more start-ups, companies in the incubation phase, research entities, universities that mostly focus on small- and nano-satellite production. The entities tended to require technical assistance on sustainable practices both in terms of design and operation.

IV. Laser beams passing through outer space

Views expressed on **Guideline B.10** varied. An interviewee expressed that the probability of accidental illumination by a laser station through laser beams of a passing space object is extremely low. Another interviewee expressed worries that current regulations are not sufficient due to the seriousness of laser usage and the likely future proliferation of ground-to-space optical communications. The same interviewee felt the current situation can lead to high-power lasers being carelessly fired into space, and therefore there is a need for a solution and structured approach in the medium-term.

In addition, some interviewees drew attention to the lack of a framework on the use of lasers. According to some, this should be also regulated.

Section C: International cooperation, capacity-building and awareness

V. International cooperation and exchange of information and experience

"When space is sustainable, everything is possible –
all other developments, all other applications,
all connected to socio-economic achievements.
If something is not sustainable, all applications,
the whole of technological development,
collectively, for everybody, is at stake."

Interviewees agreed that *international cooperation* (**Guideline C.1**) is one of the key building blocks for implementing the Guidelines for the Long-term Sustainability of Outer Space Activities. Some representatives of States expressed the view that all technical Guidelines within **Section B** are implemented through international cooperation.

Additionally, to some interviewees, transparent, efficient, direct communication and information sharing (**Guideline C.2**) were elements that cut across most of the Guidelines. Knowing who to talk to, being comfortable talking to them, and communicating effectively are all essential to gaining trust and building confidence among the international space community, and consequently to building a sustainable space environment.

"This is a global domain –
we must think globally."

Various bilateral, regional and other multilateral partnerships and operation mechanisms were highlighted during the interviews, with a main emphasis put on active participation in the Committee on the Peaceful Uses of Outer Space (COPUOS), the United Nations intergovernmental forum for discussions on the peaceful uses of space.

A specific project-focused example of international cooperation that was emphasized by African interviewees was the African Development Satellite Initiative, which aims to have six African countries build small satellites for climate change detection.

When asked about international cooperation beyond regional groups, one interviewee gave an example of how space-related international cooperation efforts between some States had developed over time. The collaboration, which had begun with a focus on addressing space debris in military and security contexts had shifted to coordination and cooperation on space safety and sustainability.

Collaboration among educational institutions and research centers was also frequently mentioned as a pivotal point of international cooperation, facilitating knowledge sharing

to strengthen national capacities. The Regional Centres for Space Science and Technology Education, affiliated to the United Nations, were also flagged in this connection.

It was highlighted during the discussions that space-faring nations do not currently have a formal global process to channel queries on space activities to the right person dealing with a specific project or activity. International inquiries usually go to Permanent Missions to the United Nations and then through an ad hoc and circuitous path until the person in charge of the right administration is found. Interviewees felt that creating a consolidated list of contacts of who to get in touch with on what topic would improve speed and efficiency.

One additional element related to the exchange of information was mentioned in relation to disaster management. One interviewee emphasized the need for a central database, and an appropriately staffed office, to gather information and data in case of natural disasters and to share them with countries in need.

"Looking at our regional microcosmos,
we [IGOs] probably see something
that may be a bigger problem in the global scale."

International intergovernmental organizations play various roles supporting their Member States in the space field. They frequently provide legal, technical or scientific information sharing to assist their Member States in taking informed domestic decisions. One international intergovernmental organization representative shared that helping States implement the Guidelines has come to the forefront of the organization's work, becoming one of the organization's strategic objectives.

One international intergovernmental organization representative elaborated their organization's role as a coordinator between States with similar requests related to implementation of the Guidelines. This coordination helps States to learn directly from each other how they interpret the Guidelines, especially with respect to the more technical applications.

A further example of information sharing raised in the interviews was informal multilateral knowledge exchange taking place during meetings or interactions within designated organs or fora of an international intergovernmental organization, during which States can consult on current space-related policy questions – e.g. implementation of the Guidelines.

The idea of cooperation and knowledge sharing between international intergovernmental organizations, on how they tackle similar challenges in the context of the Guidelines, and how they assist their Member States in their implementation practices, was also raised by some interviewees.

A general challenge highlighted by international intergovernmental organizations was the different levels of capacity among their Member States, and how this affects the prioritization of activities.

One interviewee wished to dispel a misunderstanding regarding States newly entering the space field and international cooperation on the sustainability of space activities. The interviewee felt that there was often a perception that States with emerging space capabilities are not concerned with sustainability, and simply wish to carry out their experiments and build their satellites without considering any non-essential factors (such as the long-term sustainability of outer space). According to the interviewee, emerging space-faring nations are rather concerned about long-term sustainability. For them, it may take one to two decades to develop new technology and applications, and be ready to undertake high-level exploration missions (i.e. to the Moon or Mars). Therefore, such States have strong incentives to work with and learn from major space-faring nations now to ensure that the space environment remains safe and suitable for use and exploration in the long-term.

VI. Awareness raising and outreach

"People think that satellites and rockets are for big countries, and not for our country. That is why we go to schools, work with students, and encourage them to pursue their degrees in space-related fields - to increase general interest of the population."

Interviewees stated that outreach activities (**Guideline C.4)** generally focused on two areas: general benefits of space activities and protection of the orbital space environment.

States with few space assets are likely to focus on outreach activities that aim to increase the general understanding of the benefits of outer space activities, conveying the message that space technology and its applications have become pivotal for everyday life. They also tend to focus on encouraging the public, and youth in particular, to choose studies in the science, technology, engineering and mathematics (STEM) disciplines and to pursue career opportunities in the space field.

"First, we need to build the bridge between the benefits of space and the daily needs of the citizens."

Some interviewees emphasized how space technology and its applications supported sustainable development on Earth[13] (see, inter alia, **paragraph 2** of the **preamble**) and noted how clearly demonstrating this helped convince decision-makers of the urgency of protecting the space environment and ensuring the sustainability of space activities. Some respondents noted that this was a necessity for all States, whether they are small or large, whether they have emerging or established space programmes, as similar doubts about the importance of space activities often emerge among the public.

Regarding the protection of the orbital space environment, it was the view of some interviewees that States and decision-makers with a long tradition of climate and environmental protection on Earth were usually more inclined to emphasize the protection of the orbital space environment, even at an early stage of their space sector development.

One interviewee expressed the view that it was a priority to first develop a mutual understanding of what the Guidelines mean, in order to effectively raise awareness about them and to ensure their global implementation. The respondent also discussed the role of regional implementation, stressing that, "*for technical management, a very clear translation and understanding might be necessary, which might come from regions… however, the more coherent the interpretations are at international level, the more efficient they will be*".

One interviewee stated that the Guidelines do not guide States where to start their implementation, as every paragraph is equally important in its own way in the document. However, the view was expressed that especially emerging space-faring nations need help in recognizing those Guidelines that they can more easily implement as an initial step - the low-hanging fruit[14].

International intergovernmental organizations flagged awareness-raising as key to their work. For instance, by accepting international obligations under international legal regime, some organizations act as examples for their Member States with the hope to encourage them to do the same. Other awareness-raising tools referenced by interviewees included dedicated websites, online articles, newsletters, notes and stories related to space sustainability.

One interviewee described a newsletter of an international intergovernmental organizations that shares information in an easily digestible format and brings space diplomacy closer to national practitioners and operators. One interviewee suggested that UNOOSA establish and maintain an informal and relaxed forum on long-term

[13] Some priorities emphasized by interviewees related to the African context included finding and managing water resources, improving agriculture development and building infrastructure.

[14] The question of whether a complete and absolute implementation of the Guidelines can and should be achieved was brought up by one interviewee: "*This document is not even drafted with the aim of achieving complete implementation (...) rather every country can choose what is feasible and important for them when implementing any of the Guidelines*".

sustainability implementation practices, through which broad conversations could take place, questions could be posed and various solutions suggested.

When it comes to external communications to the wider public, an international intergovernmental organization expressed that *transparency* is key to ensure and encourage safe and sustainable space activities and information sharing (**Guideline C.3**). To encourage sustainable practices therefore, an organization interviewed shared its efforts to make their internally used tools for their missions available to the public, in most cases free of charge.

"We have to make sure that advancement in the space arena is well understood by the decision and policy-makers."

Further remarks on outreach and awareness-raising included the following:

- *Education campaigns* are needed to bring space activities into the public consciousness and to "make the case for space". Related ideas from interviewees included the development and use of promotional movies and materials.
- Teaching and training *the next generation* was a common priority of States. One of the respondents argued that training the next generation is important because they are going to be the ones further developing the usage of space technology. Another interviewee mentioned, it was cheaper to invest in changing children's attitudes regarding such a complex topic as space. The views of an inspired younger generation may also change the views of their parents' generation.
- Separate awareness activities are necessary to influence decision-makers and high-level officials to include space in the public policy agenda. Some of the awareness-raising activities targeted to decision-makers mentioned during the interviews were: proposing parliamentary debate on space debris; organizing events in parliament, explaining how space can contribute to policy-making and decision-making processes; and engaging famous figures involved in the wider public life to talk about space debris.
- It was suggested that creating more user-friendly, simple materials on the subjects covered in the Guidelines could make what is an otherwise dry, legal text more comprehensible and engage even those who are not legal or technical professionals.
- COPUOS conference room papers (CRPs) can contain useful information on interpretations and practices of States members and observers of the Committee, but the information is not always easy to locate.
- Disaster management (**paragraph 4** of **Guideline C.3** and **paragraphs 1** and **2** of **Guideline C.4)** and the role of the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) were also highlighted, along with the potential of leveraging satellite remote

sensing activities, especially by countries where disasters are increasingly apparent due to climate change. Some interviewees agreed that through the usage of remote sensing and downstream applications, disaster management is one crucial means through which a government can showcase to its population how space can support and facilitate their safety and improve their daily life.

VII. Capacity-building

"A nation must first learn that they lack a particular knowledge,
they will then be eager and willing
to receive such knowledge."

According to interviewees, a State first needs an incentive to begin to focus on space activities. State leaders need to understand the benefits of space usage, space exploration, space technology and its applications to be able to "sell" space activities to its citizens and the public. For that, there need to be entities and experts in the country (be they governmental or non-governmental) with the ambition to undertake space activities, which then encourage administrations and ministries to address related matters, such as legal inquiries or international capacity-building assistance.

"A conversation on capacity building needs
and requirements will help all countries
tackle space debris and promote sustainability."

When discussing internal capacity-building, a reoccurring challenge articulated by many of the interviewees was the lack of financial and human resources. It was explained that managing space policy and other space activities in a member State needs a dedicated team with enough people focussed on the topic of space and at a common physical location, ideally within a space agency – not resources spread through different functions and institutions. It was also mentioned that a designated person dealing with national implementation of the Guidelines is necessary for proper implementation.

It was underlined by interviewees that countries that have few or no space assets to operate on their own tend to focus on capacity-building for developing their space technologies (**Guideline C.3)**, often through the establishment of university degree programs and by encouraging students to enroll in the relevant fields.

A pivotal point was raised on capacity development and knowledge-sharing support by international professionals. In cases where a lack of capacity is a particular issue, and skilled national expertise is required, the delivery of capacity assistance by those professionals would need to continue over a period of years to firmly establish that

capacity. As it was put by one interviewee, "the knowledge is considered delivered when local staff are absolutely skilled."

"Capacity utilization means training the appropriate people,
monitoring and following up with them
to see how they are translating the knowledge acquired
in actions when working in the area."

One interviewee referred to the importance of *capacity-utilization*, and not just capacity-building. Consequently, *full knowledge acquisition* includes not only training appropriate people, but also periodic tracking and reviews to see how and if trainees are able to translate the acquired knowledge into action, working in their desired space field.

Working with international intergovernmental organizations can connect Member States with similar needs and help build more systematic, coordinated, and harmonized action plans to assist regional aspirations. As put by one interviewee: *"assisting countries through regional organizations with 'whole capacity-building packages' could help avoid working-in-silos"*, which might have a more effective overall outcome.

"It was a bit shocking to learn
that you – as a space actor - would like to help,
but you don't know how."

Interviewees recognized that a growing number of industry and private sector entities are trying to provide their services to support sustainable development on Earth (**paragraph 2** of **Guideline C.3)**. At the same time, one of the interviewees expressed disappointment, due to the lack of information on how to contribute to such sustainable development. As an example, according to an interviewee, who is in daily contact with multinational space companies, industry and the private sector are eager to provide satellite capacity to support sustainable development, however, it has not been clear for them what exactly they can do, nor to whom they can suggest their solutions.

Participating in technical fora was mentioned as a practical option to offer economically viable ideas and opportunities to new emerging space-faring nations.

Some interviewees highlighted that some States have regulatory, political or other challenges to sending students and researchers abroad for capacity-building and knowledge sharing, and that they thus need to find other means to learn and build space capacities. Sometimes even importing relevant literature, books and materials on international space policy and technology is difficult, therefore international assistance in that regard is appreciated. The need for legal capacity-building connected to national space law drafting was also frequently mentioned by interviewees.

Public practices to incentivize start-ups and new space companies were also mentioned by some interviewees. These included, inter alia: public funding given to start-ups to support technical expertise and best designs on how to operate the spacecraft responsibly; offering collision avoidance services free of charge; providing start-ups with facilities from design to operation until end-of-life of space projects; providing infrastructure, labs and software; actively initiating weekly meetings with companies; encouraging visits at national space agencies; public officials responsible for space affairs answering questions directly and promptly; exploring dialogue between the public and private sectors; economic stimulus packages; engagement in incubation programmes; exploring cooperation opportunities with beneficiaries; establishing company clusters near the space agency and universities; providing visiting experts and professionals; and providing data models, tools and trainings.

Incentives mentioned by international intergovernmental organizations included invitations to tender to win zero-interest loans to implement satellite projects with stipulations relevant to responsible practices, or providing business support for space-related start-ups through their incubation programmes. International intergovernmental organizations also highlighted their capacity to assist or incentivize the space sector to grow and operate in accordance with the Guidelines, either by providing training themselves, or through partnerships agreements with specialists.

Section D: Scientific and technical research and development

Some interviewees acknowledged that countries entering the space domain might start with scientific and technical research and development (**Section D**) before operational implementation of space activities (**Section B**). Section D was also highlighted by some respondents as less expensive to implement. Often research and development activities provide emerging countries with quick results, benefits and learning opportunities, especially when there is relevant support from the global space community (see **Section C**). One interviewee pointed out that if good sustainability practices are initiated at the research and development phase, they will continue and flow into the operational phases of space activities.

"Every penny that is invested in space
needs to be returned for the benefit of the country."

Interviewees representing States with few space assets agreed that research should focus on providing direct socio-economic benefits for the country. States with few space assets, therefore, generally focus on applied sciences, meaning that what they develop through their research activities needs to be applied to real problems, help address concrete, existing issues in the country, and lead to practical solutions for challenges faced by their society. Furthermore, buy-in or active support for space technology through investing in space research and development activities, can have both short and long-term advantages, as one respondent indicated, especially in new-emerging space-faring nations.

Even in more established space-faring nations, it was pointed out by interviewees that not all space capabilities are operational. They can be research oriented, such as with space situational awareness data processing, the development of space debris research programs and development of space debris evolutionary models, accuracy of orbital data, or regarding evaluation of the impact of large constellations on the long-term pollution of the orbital environment[15].

Interviewees provided examples of minimizing the environmental impact of manufacturing and launching space assets (**paragraph 3** of **Guideline D.1**), including working on reusable and eco-design and using materials which are sustainably produced on Earth and burn up in the atmosphere.

Active debris removal missions, developed and carried out in cooperation with industry and the private sector, were flagged by some interviewees in the context of research and

[15] One example given, which demonstrates the importance of research and development, is that in the EU SST Consortium, 80% of the budget goes to R&D, to develop capabilities and upgrade performance, with all other related activities (e.g. collision avoidance, service provision, operation of sensors) only allocated 20% of the budget.

development, as was the work of numerous space weather research groups and research institutions.

Other views shared on scientific research and development included:

- Interviewees explained that there were generally large incentives to promoting research and development of technologies that are in support of sustainable and safe activities, in particular as awareness of risks to space sustainability increases.
- Emerging space-faring nations interviewed, in particular highlighted the link between research and development activities and the launch of their first satellite(s). The vital role of academic institutions such as universities in this work was often flagged. In some instances, assistance through partnerships with foreign universities, research institutions and international intergovernmental organizations (see **Section C**) also contributed to successful first launches.
- Relationships between universities and the State varied. In some cases, the governmental sector works closely with universities on space research, while in other instances, the State preferred to offer *scientific independence* to universities.
- Research is often carried out through grants and research budgets made available to universities and research institutions by the State. Student and research scholarships also enhance national capabilities in the space sector.
- Some States noted the value of workshops, carried out in collaboration with educational institutes and research centers across the globe (see **Section C**), in exchanging knowledge and enhancing the skills required in the space sector in the home country.
- Some interviewees emphasized the need to make sure research and development activities are undertaken, and the results made available, in accordance with *international scientific norms*, i.e. publishing data through technical conferences, undergoing peer review for journal articles, as these practices support transparency across the global space community.
- One challenge and constraint highlighted by an interviewee is that space sector manufacturers and sellers may be based outside their national jurisdiction. Countries that do not have sufficient manufacturing capabilities, therefore need to import component parts, which introduces a large upfront cost, resulting in more protracted and costly space research and development projects. Some member States tried to address such challenges through establishing strong cooperation mechanisms, including with partners with manufacturing capabilities.

Concluding Remarks

The States and international intergovernmental organizations interviewed considered the adoption of the Guidelines for the Long-term Sustainability of Outer Space Activities by the Committee on the Peaceful Uses of Outer Space (COPUOS) a landmark achievement in space policy and space diplomacy, as well as a crucial step towards protecting the Earth's orbital space environment and ensuring equitable access to the benefits of exploration and use of outer space for peaceful purposes. At the same time, interviewees agreed that further steps are needed to support the implementation of the Guidelines – both at national and international levels.

Information sharing was identified as a cross-cutting need relevant to the successful implementation of most, if not all, of the Guidelines. Cooperation with other entities was among the avenues highlighted for States to collect knowledge and learn from the implementation practices, then voluntarily electing to implement what they feel would be best for them in their national context.

Some stakeholders, despite willingness to contribute to safe and sustainable space activities, were not aware of how they could support greater implementation of the Guidelines, or from whom they can seek assistance if needed, which demonstrated a greater need for international, multi-stakeholder coordination and engagement. Regional and international organizations can play a role in linking needs with available capacities. Interviewees expressed the view that the Office for Outer Space Affairs (UNOOSA), in particular, should continue to raise awareness of the Guidelines for the Long-term Sustainability of Outer Space Activities and connect stakeholders involved in their implementation, so that the agreed texts may be effectively translated into action.

Acknowledgements

The United Nations Office for Outer Space Affairs (UNOOSA) would like to express appreciation to the following member States and international intergovernmental organization who gave their time, completing interviews for this stakeholder study report.

States members of the Committee on the Peaceful Uses of Outers Space (COPUOS)

1. Algeria
2. Austria
3. Bahrain
4. Belgium
5. Brazil
6. Chile
7. China
8. Colombia
9. Czechia
10. Denmark
11. Ecuador
12. Finland
13. France
14. Germany
15. Hungary
16. Indonesia
17. Israel
18. Kenya
19. Libya
20. Luxembourg
21. Malaysia
22. Mexico
23. New Zealand
24. Nicaragua
25. Panama
26. Paraguay
27. Peru
28. Philippines
29. Poland
30. Portugal
31. Rwanda
32. Slovakia
33. Slovenia
34. Spain
35. United Arab Emirates
36. United Kingdom of Great Britain and Northern Ireland
37. United States of America

International intergovernmental organizations

1. Asia Pacific Space Cooperation Organization (APSCO)
2. African Union (AU)
3. European Space Agency (ESA)
4. European Southern Observatory (ESO)
5. Intersputnik International Organization of Space Communications (Intersputnik)

For inquiries or further information on the project "*Awareness-raising and capacity-building related to the implementation of the LTS Guidelines"*, please contact UNOOSA - **oosa[at]un.org**