Space Sustainability: **Stakeholder Engagement Study**

Outcome Report
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UNITED NATIONS
Office for Outer Space Affairs

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We thank UAESA for its commitment to working with UNOOSA in our joint efforts to put sustainability at the heart of global space activities.

UNITED NATIONS
Office for Outer Space Affairs

وكالة الإمارات للفضاء
UAE SPACE AGENCY

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Executive Summary

This report captures the views of over 50 key stakeholders from the global space community exploring the subject of *'space sustainability'*. The study is structured to address the research question 'where can the UN add the most value to ongoing space sustainability activities'?

As to be expected with such an open approach, the insights shared were widespread. Intersections of commonality were, however, readily identifiable. For example, all respondents felt space sustainability was a concept growing in importance for the global space sector. Consequently, broad agreement was also demonstrated that this issue warranting more attention from both public and private stakeholders and that the response of these stakeholders to space sustainability would have long-term ramifications for the future of global space activities.

In recognition that space sustainability, as both a linguistic label and a theoretical concept, was a relatively new phenomenon, most interviews gathered considerable insights on how the concept may develop in the years to come.

One key outcome of this study was that many felt **sustainability needs to be urgently mainstreamed** across the global space sector. This sense of immediacy appears to be of relevance regardless of whether the term was being applied to an operational, policy, legal, economic, or environmental setting.

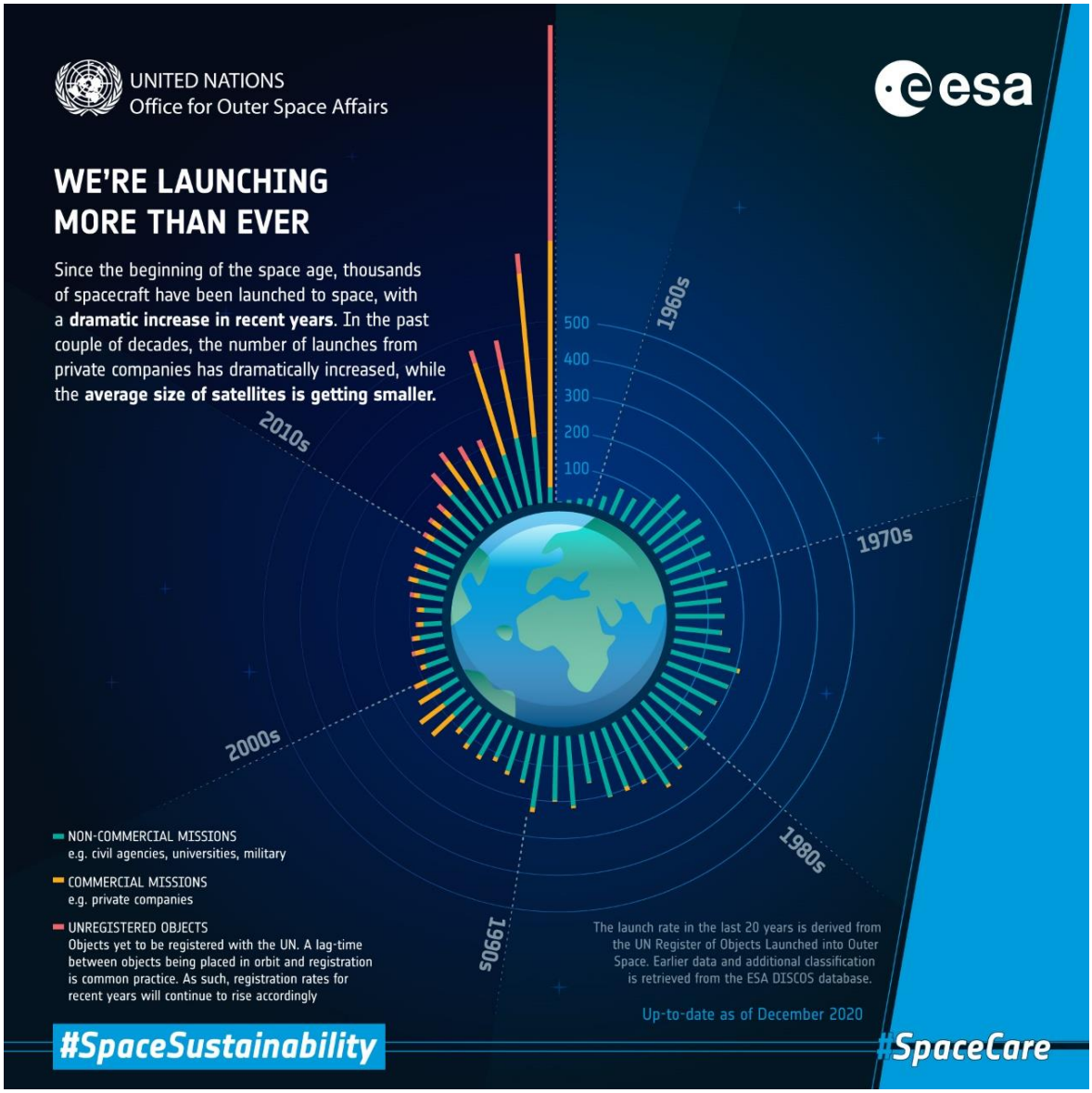
Secondly, the **fundamental role of the commercial space sector** was highlighted throughout the interviews. The right package of technological and financial realities, policy frameworks and incentivisation to ensure private stakeholders remain part of the solution, was presented as a key success driver if we are to meet the space sustainability challenge.

Thirdly, this study highlights a pressing need to **enhance the data infrastructure** on space sustainability issues. Quantitative metrics to measure space sustainability practices need to be expanded and consolidated. Such research will improve our ability to both discuss and evaluate space sustainability activities. They will also support reinforcing a crucial empirical evidence-based to support future policymaking on the subject.

Overall, respondents were clear; now is the time to scale up our focus on space sustainability issues. Only by putting sustainability at the heart of global space activities, we will ensure the investments being made in space today, can deliver returns for generations to come.

Context

Global space activities are booming. In 2020 the world registered 1,260 new satellites and other space objects with the United Nations Office for Outer Space Affairs (UNOOSA). This is nearly 10% of all objects - ever registered - with the UN since 1957. Over 65 countries now conducting space activities. Satellite mega-constellations are an operational reality. Globally, unprecedented levels of both up and downstream space activities are being unlocked.



Credit: UNOOSA/ESA Space Debris infographic series, 2021.

See here for further info. on the series.

We are witnessing exceptional levels of interest in space, with record political and economic capital being invested in the space environment. At the UN, membership of the Committee on the Peaceful Uses of Outer Space (COPUOS), the leading UN intergovernmental forum for space policy discussions, has seen membership rise by over 25% since 2017 – one of the fastest-growing multilateral policy-making fora in the entire UN system.

With such increasing interest - and investment - comes a heightened level of reliance and risk. This dependency is testing the existing normative and institutional structures that underpin the stable, secure, and sustainable space environment. Indeed, the Earth's orbital space environment is a limited resource, the continuous creation of space debris, the increasing complexity of space operations are all example trends affecting the long-term sustainability of space activities. These pressures collectively point to a clear need for reinforced discussion, dialogue, and the exchange of good practices. Established and emerging space-faring nations alike have work to do so we can ensure increasing global interest in space can be further nurtured while also ensuring the long-term sustainability of the space environment is maintained.

For the UN's Sustainable Development Agenda, this increasing magnitude of space-based infrastructure is having a huge impact on global socio-economic development. Joint UNOOSA and European Union research show that around 40% of the 169 targets behind the 17 Sustainable Development Goals (SDGs) benefit from the use of Earth Observation and Global Navigation Satellite Systems. With telecommunication satellites included, this statistic rises even further. In this context, more countries are accessing space services, information, and data to accelerate their sustainable development, including the implementation of the 17 SDGs, the Paris Agreement and the Sendai Framework for Disaster Risk Reduction. The international community has recognised the importance of space technology on several high-profile occasions, including in 2018 at UNISPACE+50 and more recently during ongoing discussions towards finalising a 'Space 2030 Agenda'.

Recognising this growing global investment – and reliance - on space, the international community also recently came together at the United Nations level to adopt the Guidelines for the Long-term Sustainability of Outer Space Activities (LTS Guidelines) by the Peaceful Uses of Outer Space (COPUOS) in 2019. The LTS Guidelines reflect the latest global consensus on what responsible and sustainable space activities look like in practice.

To deliver on both the potential of space to accelerate sustainable development and the need to maintain the long-term sustainability of space activities, we need a step-change in global dialogue and sharing of implementation good practices. As the UN's home of space, UNOOSA works with stakeholders from across the global space sector to promote responsible and sustainable activities in space for the benefit of everyone, everywhere

The UAESA/UNOOSA partnership

In 2020, UNOOSA, with generous support from the UAE Space Agency (UAESA), established an ambitious initiative to inject new energy into the global discussion on space sustainability. Looking at both the policy side of promoting sustainable space activities in space, as well as using space technology for sustainable development on Earth, the Space Sustainability Initiative unites the international space community to put sustainability at the heart of the global space sector.

The UNOOSA/UAESA partnership is implemented in two stages. The first 'Start-Up Phase' stage, initiated for 12 months, studies the current stakeholder landscape working on space sustainability topics. We also look at existing activities and other initiatives, identifying and securing new partners to support the Initiative itself. In the second stage, the Initiative will switch into a more operational phase as we look to convene stakeholders to share and gather good practices on space sustainability, deliver the capacity building for emerging space-faring countries and support research into this crucial topic.

Methodology

To facilitate an open and rich engagement process during this Stakeholder Engagement Study, each interview was conducted in an informal and non-attributable manner. Considering the wide-ranging nature of the space sustainability concept this approach was undertaken to maximise the opportunity for a full exchange of opinion and perspectives.

A diverse selection of stakeholders was identified. Care was taken to ensure broad representation in terms of both geography and gender (see: Acknowledgements, for a full list of participants). The sectorial background was also considered, with space agency, commercial space sector, civil society, academic and other professional stakeholders from across the global space sector, all included.

The interviews were conducted over four months from November 2020 to February 2021.

Each interview was framed around the same set of five questions, which interviewees received in advance. This methodology provided consistency and thus increased the affinity for comparative qualitative analysis across the process.

The interview framework was based on the following questions:

- *Question One: What components come to your mind when dealing with space sustainability?*

- *Question Two: How central do you think the concept of space sustainability is embedded in current space activities?*

- *Question Three: Of the following, which are the most effective in maintaining sustainable space activities?*

    - *Adherence to existing international space law.*
    - *Applications of new space technologies.*
    - *Steps to mitigate the economic cost of space sustainable practices.*
    - *Increase transparency and information sharing practices between actors.*
    - *Enhance platforms for multi-stakeholder dialogue.*
    - *Increasing public awareness and interest in space sustainability issues.*

- *Question Four: What role do you think the private space sector has to play in supporting sustainable space activities?*

- *Question Five: Looking ahead to the next 15 years, what element(s) does the international space community have to get right to ensure space sustainability is delivered over the medium term?*

The interview was designed to gradually shift the line of inquiry from the conceptual to the practical. This achieved clarity, in the opinion of the interviewee, on where and how added value could be best delivered at the UN level with regards to enhancing global space sustainability.

Findings

This section of the Stakeholder Engagement Study presents the results of the interviews, with the answers provided across the interview programme amalgamated, analysed for both commonality and divergence. These findings capture the key elements of the various responses received. The comments and opinions are non-attributable, except for a selection of quotations that spotlight some of the more fundamental observations shared with the interview team and published with consent.

Question One: What components come to mind when dealing with space sustainability?

Broadly speaking most respondents focussed on applying the concept of space sustainability to what is happening 'in' space itself, i.e. the space operations themselves rather than what is happening 'from' space, i.e. how space is supporting sustainability on Earth. This meant that question one most often saw respondents describing how we can enhance access and utilisation of space more sustainably. This meant that Question One most often saw respondents describing how we can enhance access and utilisation of space more sustainably. This inevitability led to most interviews focussing on a discussion of space sustainability as a core component of the wider theoretical notion of space governance and how, as actors, we conduct space operations in a manner that can be considered sustainable.

"As we promote dialogue on making access to space faster and cheaper to enable a new generation of space start-ups, we should do so by first talking about space sustainability."
Kshitij Gokul Khandelwal, Pixxel (India)

The most common way of breaking down this complex concept was into three perspectives, broadly categorised as a) **environmental**, b) **economic** and c) **political** factors. Of these three, an 'environmental' perspective was most often expressed across the interview programme. In this sense, central to many responses was the concept of the need to reconcile this distinction between the political and economic short terms needs for return on investment, with the political, economic and social preservation and management of the space *environment* over the long term.

The thoughts and opinions shared across these three perspectives are summarised below.

a) **Environmental Space Sustainability**. This long-term 'management' perspective was the most prominent angle respondents felt should be taken care of by the international space community.

Within this category, the interviewees differentiated between the following sub-topics with distinct priority levels:

- **Sustainability of the near-Earth environment** - Many respondents reflected, that within the near-Earth group we can find the most pressing issues that needed to be handled with priority in a multi-stakeholder and international forum. It is this sub-topic that the greatest need for urgency was expressed by respondents including with regards to the need for prompt mitigation measures. The following key elements were offered in support of this perspective: exponential increase of space debris and large constellations, cluttering our extremely limited usable orbits, which are Low Earth Orbit (LEO) and Medium Earth Orbit (MEO), also jeopardizing humanity's access to space.

  Additionally, it was suggested that we should not only consider physical interferences but potential radio frequency interferences as well (be that intentional or unintentional) when we consider the need to keep the near-Earth environment sustainable. Moreover, the impact of large constellations and existing space debris on ground-based astronomy was highlighted, by some participants, as a specific issue for further consideration.

  Further elements mentioned throughout the interviews were: space weather, space tourism, night sky and light pollution, Space Situation Awareness (SSA), Space Traffic Management (STM), space-debris prevention, mitigation and remediation, the 'carrying-capacity of the near-Earth environment, space traffic footprint, and the predictability of operations'. These reoccurring concepts came up repeatedly during the interviews and are unpacked further in this report.

"The positive message for engaging with people and decision-makers on this stark challenge should be: 'we can have a long-term future for space'".
Dr Kevin Madders (KU Leuven; Systemics Network International)

- **Sustainability of celestial bodies** - even though in-situ resource utilisation or 'space mining' is a rising subject on the policymaking agenda, it was seldom mentioned among the respondents, from a sustainability point of view. Most commonly when a respondent referred to the topic, they labelled it as a less pressing issue, compared to the increasing population of space objects. However, insights were shared in this opening question we should keep in mind that contamination of celestial bodies is also an imminent and inevitable challenge associated with future human and robotic exploration activities.
- **Sustainability of socio-economic growth on Earth** was another, final, 'sub-group identified by a minority of respondents as part of the broader concept of an environmental approach to the concept of space sustainability. This was most often presented in terms of linking such concepts to the protection of our socio-economic systems that are increasingly exposed to the threat presented by unsustainable use of the space environment.

"You cannot do space without thinking long-term."
Dr Patricia Lewis (Chatham House)

b) Economic Space Sustainability. A notable proportion of respondents, in answering the opening question, chose to underline the factor of sustainability in terms of the economic aspects of space activities. For example, the financial cost for space operations, which – if high – can be a great hindrance to the growth of the space economy. Respondents highlighted that this was especially relevant when "additional sustainability constraints" are added to the spacecrafts' design. Within this category, the dichotomy between the importance of regulation and free, but reliable, use of space came to the forefront, especially in terms of incentivizing Small and Medium Space Enterprises, CubeSats and non or emerging space-faring nations. Such factors were often presented as an asymmetrical challenge across the global space sector with this challenge being more apparent, for example, where small satellite operations form a majority of space-related activities.

In this context, most respondents drew on economic factors when defining the concept of 'space sustainability', referencing a perceived lack of necessary guidance and capacity-building options available to the emerging sector for responsible and sustainable space economy growth as a mitigating factor.

Further, the creation of economically self-sustaining space sectors was explained by a selection of the interviewees, stating that emerging nations often focus on ensuring space activities are part of a wider ecosystem of domestically driven and retained socio-economic development. As national and regional space programs enter a self-propelling cycle, they generate revenue or economic benefit back to the economy. This enables sustained investment in the country, or region while seeking to avoid the so-called innovation trap when the economic ecosystem fails to emerge despite the initial governmental investment.

In addition to regional space sustainability, it was touched upon by a few respondents that more space companies are seeking to build up their sustainable space capabilities. Trends were noted that sees an increasing number of satellites being launched even though similar services (i.e. 24/7 Earth Observation coverage with similar technical capabilities) are offered by other companies, creating a competition on our trajectories, which can be worrisome in the medium-term, keeping in mind the limited nature of our orbital environment.

"We need to preserve the orbital environment,
a bit like keeping a national park safe.
We may need 'park rangers' to monitor and clean up space."
Christopher D. Johnson (Secure World Foundation)

c) The view that **political space sustainability** is important also came to mind to various stakeholders. These perspectives centred on how the global political climates can disrupt the curve of ongoing space activities, as medium and long-term processes are key in the space sector. Interviewees drew on examples of the need to 'make the case for space' as a key component of the policymaking process. In this regard, maintaining political interest and focus on sustainability was raised as an additional element when unpacking the concept of space sustainability in the broadest sense. Such political elements can, in the view of the respondents, add to the question that the international space community is facing; whether approaching space sustainability from a more neutral, "space safety" perspective would be powerful enough to bring a long-lasting, solid change in the near-Earth environment, or the three elements (environmental, economic and political) are so intertwined, that we cannot and should not address one without the others if we want to bring about a lasting approach.

Question Two: How central do you think the concept of space sustainability is embedded in current space activities?

It was a common understanding by the vast majority of the respondents that space sustainability is still not present in everyday discussions among the space community players. It was noted however that recently (characterised by within the last five years) awareness is growing steadily, from both within and outside the space sector. Overall though the central takeaway from respondents was that if work is to be done to further cement the concept of sustainability into the community, further steps and concerted global efforts need to take place.

In terms of the private sector, it was conveyed by one respondent that all stakeholders should realize that even though, entities may not be factoring in the cost to become more sustainable now, they are already paying the cost in the medium and long term. For example, having to move their satellites away from potential collisions, or considering additional insurance cost, etc. In this line of thinking, some respondents highlighted that to connect the economic value of sustainability with the operation itself, we have to bring down the issue from the policy level into the business and design engineering level, which takes a lot of effort and work.

"If space becomes critically unsafe,
it will not be selectively unsafe,
but unsafe for everyone."
Prof. Nayef Al-Rodhan (Geneva Centre for Security Policy)

The interview stakeholder sample also allowed the opportunity for discussion with downstream space industry actors. These respondents, who take part in data processing rather than space operations themselves, gave insights that even though in the background they are aware of the importance of the situation, they still feel that their actions are not necessarily relevant in the promotion of sustainability in space.

These insights become critical in the process of mapping out the policy context for space sustainability, with such views underlining the 'hidden reliance' on space sustainability. By the same token, a downstream space operator may – very reasonably – think that space remains an available source for them to operate in, as they are not the ones who necessarily deal with the satellites that collect the data they work with, let alone the launching of such satellites. However, we arrived at the point where our assumptions may turn the other way around. All interview participants

acknowledged if the space environment is used unsaustainably, both upstream and downstream operators will share the impact.

Moreover, when respondents were asked to focus on "embeddedness", it became clear that we cannot expect a uniform approach to space sustainability. The concept will always be embedded in a manner that is consistent with the technological, political, economic and social reality of any actor. It was reflected that such mentality is said to be changing after a few years and that it is important to ensure sustainability standards are not a barrier to non and emerging space-faring nations.

In general, even though, we cannot say that space sustainability is embedded per se, there are signs through the experience shared by the respondents that space sustainability has become a 'front burner issue' for many stakeholders in the space community.

At the same time, insights were also shared that whenever space sustainability is addressed, it is rather dealt with locally, as there is an increasing tendency to find practical implications on what sustainability means for the actors in terms of requirements and applications in their domestic contexts.

"As car engineers focus on the car, and they don't worry too much on the tarmac of the motorways being built correctly, even though they know it is critical, they assume and hope that it is managed elsewhere."
David Taverner, Caribou Digital

Finally, it is important to note that several respondents highlighted an associated trend specific to the commercial space community, with the private sector also said to be paying more attention to space sustainability over the past couple of years. It was speculated during these related interviews that such increased attention is being driven by changing economic considerations and the emergence of both publicly and privately funded markets that would directly address the operator needs to enhance sustainable practices. However, the perception was underlined by several respondents that such trends seemed to be largely driven not by environmental concerns or notions of social responsibility, but more due to emerging economic returns based on principals being the logic that it is more cost-efficient to reuse than to rebuild. This line of reasoning was often characterised as an understudied area that would benefit from both more qualitative and quantitative analysis of the incentives behind enhanced sustainability in the commercial space sector and – by extension – speculation on the factors driving shifts in commercial attitudes to space sustainability.

Question Three: Of the following, which are the most effective in maintaining sustainable space activities?

- *Adherence to existing international space law.*
- *Applications of new space technologies.*
- *Steps to mitigate the economic cost of space sustainable practices.*
- *Increase transparency and information sharing practices between actors.*
- *Enhance platforms for multi-stakeholder dialogue.*
- *Increasing public awareness and interest in space sustainability issues.*

It was agreed across the interview participants that all the six options seemed to go a long way to forming the core component of any policy response to space sustainability. However – as highlighted in Question Two responses – we need to keep in mind that there is no one-stop solution or mitigation mechanism for the global space community when tackling space sustainability topics. In other words, not all space actors have the capacity to implement the required range of components to deliver space sustainability. On that thought, one of the interviewees made the distinction between emerging space actors without a distinguished space programme and matured space-faring nations with a space programme when addressing the different methods of implementing the six elements and what might be therefore perceived as 'effective'.

Consequently, in the former case, it was stressed the priority should be engaged through global discussions, i.e. actively taking part in COPUOS meetings. By extension efforts to raise awareness from an early stage in national space activities would prove imperative to installing sustainable approaches from the beginning.

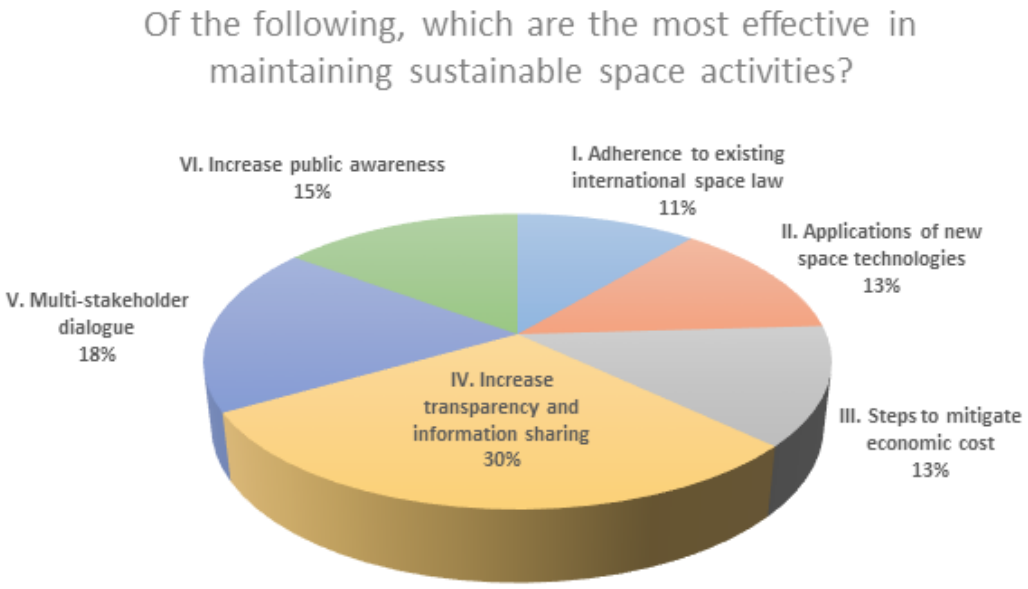
When considering the differing management of developed and emerging space actors' activities, many participants drew an analogy between space sustainability and the SDGs on Earth and the Paris Agreement, fighting climate change. As known, through the Paris Agreement, under its built-in flexibility mechanism, concessions are given to countries with less carbon emission which then could be the subject of trade negotiations. Some of the respondents found the approach efficient, which then could be a good analogy to both the emerging and space-faring nations in terms of the satellites quantity and quality sent to orbit. We heard, however, counterarguments as well, stating that we should learn lessons from other policy areas – such as the Antarctic Treaty System – outside of the spatial context to find solutions to the externality problem of space debris and to save our trajectories from the "tragedy of the global commons".

Besides the six options provided to the interviewees (and reproduced above), an additional option was posed by several respondents, namely the need for engaging in more research and study into standardizing a common set of space sustainability indicators. Several technical operations experts we interviewed argued forcefully that there was much research to be done to develop specific metrics. One illustrative example of this lack of empirical assessment methods given is that the actual 'carrying-capacity' of LEO and MEO orbital pathways is a relatively unknown and chronically understudied concept. Interviewees openly speculated if policymakers had enough of an evidence base to know how far we were from, for example, reaching the limits of certain orbits. In the absence of such metrics, nobody can understand the actual impact of the objects being in the same orbit at the same time. In accordance, until sufficient metrics and definitions (i.e. carrying capacity or space traffic footprint) are established, it was brought forward by some respondents that space sustainability measures cannot be sufficiently embedded into the regulatory and licencing processes. The interviewers did, however, identify a counterargument emerging from some responders, stating that sufficient metrics do exist to ensure space sustainability, the problem is rather finding consensus on which metrics to use.

"The UN can play a role
in encouraging the emerging space actors to have space sustainability
as a central element in their activities, and not just as an afterthought."
Peter Martinez (Secure World Foundation)

Settling such a dialogue, it was argued, is crucial to meet any aspirations of international standard-setting bodies to quantify and measure space sustainability practices. Further, it was also shared that such limits on agreeing on which metrics to use for measuring space sustainability could be exasperating by underlying theoretical agreement on what space sustainability means as a concept itself.

In conclusion, such views introducing the idea of focussing on the development of a more quantitative approach to enhancing space sustainability was a key concept beyond the original six options proposed under question three.



Returning to the original six options proposed, in summing up the ranking of all the – more than 50 participants' – answers, it can be confidently stated that the most popular choice in terms of an effective method to address space sustainability was, transparency and information sharing among space actors (iv.), with the second most favoured choice being multi-stakeholder dialogue (v.). Respondents considered public awareness (vi.) also very important and underlined how this is also essential to galvanizing effective political action. While mitigating the economic cost of space sustainability practices (iii.) and application of new space technologies (ii.) were considered most times a secondary objective for which, a common understanding, trust and multistakeholder, international and interdisciplinary dialogues are prerequisites. Adherence to existing international law (i.) was commonly viewed as a crucial driver for responsible and sustainable activities yet, interestingly was viewed by most as an already existing element of the policy response and therefore not a high priority when looking for a way to enhance sustainable practices beyond the status quo.

The next section comments and explanations are summarised across each of the six options presenting alongside this question:

i. Adherence to existing international space law

It was expressed by many space policy professionals that the implementation of current international law does remain a crucial part of the global response to delivering space sustainability. For example, raising awareness and adherence to existing instruments has a tangible impact on providing the conditions to enhance sustainable space operations. When asked to provide examples of this point, respondents often raised the Registration Convention (1976) as an example that increases more transparency and information sharing, and through its implementation is crucial for sustainable space practices.

As could be expected, besides adherence to existing legal instruments, the interviewees found a broad consensus on the value of new focused, international soft law instruments. Here many respondents welcomed the establishment of the COPUOS Guidelines for the Long-term Sustainability of Outer Space Activities (LTS Guidelines) as a significant step. Such comments were often complemented by the extension that small sets of technical agreements, targeting specific policy challenges would be more effective, than a larger, overarching, comprehensive framework as a next step. Furthermore, it had been asserted by some respondents that there is a continuing need for the development of more definitions and a common understanding of basic terminologies regarding space sustainability. It was presented that achieving progress here, would unlock further evolution in new norm-setting processes going forward.

"***The international community has to carefully monitor how the commercial space sector can thrive without jeopardizing space sustainability***"
Robin Pradal (PwC)

There was a sense of broad unanimity among the respondents on the importance of national legislation being responsive to both international legal frameworks and developing industry-led best practices. Many respondents offered remarks that indicated such an approach could be best for creating predictability for both service providers and users. Furthermore, the encroaching policy challenge of 'forum shopping' entering space activities was often underlined, as a potential consequence of the non-centralised nature of current international space law. The feasibility of a common, minimum baseline for the entire global space sector was naturally depicted as an attractive, but immensely challenging, normative response to enhancing space

sustainability. Such an approach, it was remarked, would increase fair competition between companies, which would also create more confidence in applying sustainable measures. Furthermore, commentators indicated such frameworks are useful to incentivise and drive innovative tech to meet evolving legal and regulatory frameworks. Last but not least, besides standard-setting to support sustainability action by industry, how to act appropriately, the importance of public-private dialogue in the policy-making process was highlighted by many respondents as a key factor to making adherence to existing international space law as effective as possible to enhance space sustainability.

"Don't reinvent the wheel; stick to the existing guidelines, and don't make the problem worse before making it better."
Stijn Lemmens (ESA)

There was a sense of further potential legislative element mentioned by some respondents looking towards a 'bottom-up' approach, based on the private sector's and the international industrial community's perspectives. Accordingly, with the increasing role of international standards in voluntary consensus among the private companies, some interviewees pointed to evidence of industry effort around best practices and voluntary commitments to operating responsibly. Putting such actions through the international standard process and getting an international consensus commitment to them was suggested as one way forward to instil sustainable operating best practices within the industries' operating context.

ii. Applications of new space technologies

Most of the respondents expressed supportive views regarding the influential capabilities of new technologies. Dependence on external, often public, funding was also noted almost unanimously as a key factor in this underlying assumption that new technologies can contribute to enhanced space sustainability. It was pointed out with respect, for example, to emerging space nations' deorbiting capabilities that such satellite technologies would not be necessarily available nationally. In other words, several respondents distinguished availability and access to technology to conduct space operations, as compared to technology to conduct space operations *sustainably*. Respondents here underlined the pressing need for further democratization of space sustainability technologies to reduce 'entry barriers' to *sustainable* space operations.

"Technology by itself will never solve the problem, rather adherence to good and new practices shared by everyone will."
Laurent Francillout (CNES)

Space tracking capabilities were also emphasized as a key part of the space sustainability picture. The expansion of such capacity and services were offered by many respondents as being a high priority, even when compared to recent high-profile technological developments dealing with space debris. To use such technological innovations efficiently, however, views were shared that often there the technological development precedes regulatory and policy frameworks. Many interviewees reflected that such a disconnect between practice and policy was heightened most at the international policy-making level. It was noted by a few respondents that some areas of technological advancement addressing issues of space sustainability had not even been addressed at the international level, yet.

In addition, transparency and information sharing requirements in the current political climate, due to security concerns and the shadow of the dual-use applications of such technologies, was also described as concerning. Enhancing multi-stakeholder dialogue was one of the elements that may help to tackle some of the barriers and to create transparency on how the technologies can be used to support sustainable practices across the global space sector. Awareness about space sustainability technology is also important, as it was raised by many private companies, on top of the sharing of certain operational examples of space sustainability innovations. When it comes to the role debris removal can play in space sustainability, it was raised by several commentators that only a handful of actors are leading the way in investing in existing space debris removal missions.

In summary, when discussing the role of technology in supporting sustainable practices many respondents noted that we must avoid the trap of focusing too much on technological fixes to issues that, have policy roots. In other words, respondents were clear that prevention is always better than mitigation. Technology was therefore often characterised as a "trick" for the symptoms that can sometimes lead us to forget about the underlying problem. Indeed, as one interviewee recounted, there is sometimes so much public communication on the technology side, a general audience might think that there is already a complete solution for our shared space sustainability challenges.

iii. Steps to mitigate the economic cost of space sustainable practices.

Many space policy experts, as well as space industry representatives, argued for the focus on the economic side in dealing with space sustainability. In a general sense, bringing down the economic cost may be one of the most neutral, yet still decisive ways for civil space actors to be sustainable.

It has been argued in some interviews that we need to reach a point to bring down the cost of sustainable activities, which then can be widely adopted. However, the interdependence between cost and technology should be also underlined, as we try to achieve something economically viable, but for that, we also need technology. It is not only SMEs and startups who can benefit the most from cost reduction, however, but emerging and established space-faring countries alike. Some of the possible practical elements of mitigating the cost mentioned were the standardization of technical elements for transparency; governmental support in R&D; regulations; and rewards. On the contrary, when it comes to actors in more established space-faring nations, cost mitigation of space sustainability is perceived as only one component of an overall package of incentives. In this sense, for established space actors, ultimately, motivation matters more than cost mitigation. A potentialincentive offered by the participants, included the idea of Corporate Social Responsibility (CSR) efforts.

"As seatbelts are mandatory in every car,
every space asset needs to have a deorbiting mechanism."
Kranthi Chand Musunuru (Dhruva Space)

Two further perspectives also emerged when considering how sustainable space practices can be supported financially:

The 'sacrificial' approach	*The 'inherent' approach*
Convince space players that we need to take shared sacrifices by paying for the extra cost to protect the near/medium-term future of our space environment	Automatically incorporates the sustainability cost to the baseline design of a project development plan from the very beginning, which then can be included in the service price.

The difference between the two thinking seems to be insignificant, however, it suggests a different frame of minds. In the latter case, you do not see space sustainability measures as an external option that you can exclude. This kind of approach may be the most significant when constructing such narratives. In this sense, especially in the emerging space sector, it is crucial to incorporate the latter thinking from the outset of the operation, many professionals argued. For that, however, the financial sector also needs to be aware of the importance of space sustainability and need to consider it as a central element in their investment decisions.

There is another emerging challenge for championing space sustainability related to the new market trend towards miniaturization and cost-efficient small and microsatellite production and launch. Adding a costly space sustainability element to such a small spacecraft goes against the market demand. As the space market specialists interviewed predicted – it is very likely such costs will not be supported by the current global space market. By extension, there appears to be rationality to establish and apply financial incentives in these frame market evolution in favour of sustainability.

Respondents also advised focusing our attention on the space insurance sector, which may have a financial interest to track objects in space which is essential for accountability. In this sense, the insurance and private sector might be able to work with the public sector regarding space sustainability in the future and drive responsible behaviour.

iv. Increase transparency and information sharing practices between actors

Transparency was viewed by many as a bare minimum for delivering space sustainability. Indeed, transparency and information sharing were often identified by respondents as a golden thread that runs through all the other elements, ensuring space sustainability. Transparency and information sharing help to gain trust and build confidence among the space community, which, several interviewees reflected was mandatory to build space sustainability practices. Additionally, it was remarked that transparency can also help to avoid duplicity and overlaps of our efforts and expedite the process of reaching a mutual understanding on space sustainability measures. Further, it helps information to flow quickly and easily, shared in the same format and standard. At the same time, transparency is also the most delicate

component in terms of its dependence on political willingness, potential dual-use technologies and space security.

Going into the more practical way of increasing transparency, it was recommended to enhance existing Transparency and Confidence Building Measures (TCBMs) to develop greater confidence and political trust, especially between spacefaring and emerging space nations. Also, in such instruments, it was suggested by some respondents on the value of addressing the questions on what kind of info should be shared, and identifying what is sufficient in terms of both timeliness and quality.

By extension, the same commentators often concluded with reflections on the importance of establishing what could be the potential mechanisms for scaling up the sharing of such information. Several respondents expanded on this institutional architecture element in terms of how to facilitate advanced information-sharing between the global space community. For example, the idea of a hotline communication strategy was mentioned as part of transparency measures, established among the countries to discuss any type of action of threats that are taking place in space. In this context, as a complement to the SSA mechanism, it was suggested to look at the Disaster Charter, which might give ideas to use a similar mechanism to allow the release of information with the sole purpose of avoiding collisions or 'disasters' in space.

Respondents also noted that transparency and information sharing are also important in terms of technological innovation, especially in emerging space-faring nations.

One private-sector interviewee shared the idea to invite successful space operators, engineers, etc. from different countries to share their experiences and their best practices, how and what they have done for space sustainability. Furthermore, it was emphasized that sometimes for operators there are very low levels of awareness on the guidelines that are in force for them to know what they can and cannot do to contribute to space sustainability activities.

v. Enhance platforms for multi-stakeholder dialogue

A reflection of the wide stakeholder sample, this final option of 'multi-stakeholder dialogue' was given prominence by many interviewees in the response to question three. Even though all the respondents expressed their support in taking part in multi-stakeholder dialogues, a stronger need to push discussions beyond 'dialogue' and into

action was asserted uniformly. This element was also considered to be key, since all actors may par-take in this action regardless of their space heritage.

"The UN should serve as a benchmark as to what should be done for the health of LEO, and engage with all sectors."
Awais Ahmed (Pixxel)

As space sustainability is a global phenomenon, many interview participants stressed, that it cannot be handled by any single actor alone, efforts should be channeled with others. Time and again interviewees stressed that multi-stakeholder dialogue is, simply put, a prerequisite to success.

However, there is no existing true multi-stakeholder platform on space sustainability. There are for States, and companies separately, but nothing combined. It was noted by many that the UN level is well suited to convene all the sectors to create a discussion around space sustainability.

"We don't have the necessary framework, we need to bring the space sectors all over the world closer to each other, this is where the UN can add the most value."
Aisha Jagirani (APSCO)

Moreover, one of the respondents, from the perspective of an emerging space economy, expressed their need for multi-stakeholder dialogues, as national space agencies often become the central "guides" for emerging space countries. Thus, public-sector led dialogue with the rest of the space sector – including academic institutions dealing with space technology - is crucial for a well-informed space economy.

In conclusion for the multi-stakeholder dialogue aspect, it was uniformly expressed among the respondents who commented on this option that a key element to delivering space sustainability will be a combination of industry-led best practices, and international guidance and national-level regulations. For that, multi-stakeholder dialogue is essential. Additionally, it was also noted that we should not forget the user community, such as the downstream market is also able to gain access to such platforms for discussion, as well as the astronomy and science community to participate in the process. Therefore, the value of not only cross-sectoral but also multidisciplinary discussions was highlighted as a core component of the road ahead.

vi. Increasing public awareness and interest in space sustainability issues

Some stakeholders emphasized the connection between public awareness and fostering political action on sustainability. More specifically, it was suggested that extending the conversation beyond the space sector to the general public could – apart from it being appropriate in view of space being the "province of all humankind" – help push the often painfully slow policymaking process forward more quickly and decisively. It was noted that, if the message on the importance of space sustainability is well-crafted, it can be truly penetrating. Sufficient tools exist to develop a suitable communication strategy. The arts and entertainment industry in particular has already implicated itself with the underlying issue (as demonstrated by the film *Gravity*) and could help improve conditions for policymaking on the back of heightened public understanding of the space sustainability challenge.

A preceding necessary step in the awareness cycle was suggested from the perspective of a respondent from an emerging space-faring nation, since awareness of outer space, in general, is yet not mainstream. Such situations, it was offered, lend themselves to ensuring that education on space sustainability at the citizen level can be an influential aspect of ensuring the shift from emerging to the established space-faring nation is one that has sustainable concepts in-built from the start. Nevertheless, it was of a general view from across the sustainability professionals that society's critical dependency on space applications should be directly brought to the attention of the public when addressing the issue.

Additionally, we must keep in mind that awareness or education is not only important regarding the public per se, but among decision-makers, governmental officials, professors and educators, and the public, private space operators, and others. In terms of the private actors, and the necessity of enlightenment on space sustainability was also touched upon, including financial investors, shareholders and engineers, so awareness and the necessary realities of space sustainably are embedded into the entire ecosystem of public and private actors engaged in space.

"We are about to decide
what type of species we want to be.
Future generations will thank us
if everybody plays by some simple rules."
James Parr (Trillium Technologies)

In terms of the message, many suggestions were gathered by the participants to induce a mindset change regarding the responsible use of space. It was mentioned that we need to make space actors understand the scope of their dependencies; how sustainability issues are directly affecting them, and what would happen if they lost their space capabilities.

Another communication element was also suggested, as feeding human curiosity should also be added to the message, creating a whole human experience, and associate it with our shared duty, to protect space sustainability. Furthermore, UNOOSA received recommendations on its space sustainability communications approach; it should refer not only to the environmental aspect and the negative externality this represents, but ought to add a direct, inclusive, positive, and cognitively appealing message, and around that message a clear vision should be built of the opportunity for the future that tackling this issue promises.

Some interviewees also pointed out that, it is worth demonstrating the economic benefit of space sustainability practices combined with a long-term perspective when creating awareness. In that sense, if you act responsively now, in the short-term, it is an additional cost, but in the long-term, it is a cost-avoidance strategy. In other words, responsible behaviour today means prosperity tomorrow.

Question Four: What is the role of the private space sector in supporting sustainable space activities?

In this question, we unpacked the role the private sector is playing in this subject area. Specifically, these questions explore the relationship between the public and private actors in space, the notions of delivering both economic and environmental gain for space and finally, the concept of incentivisation.

As the private space sector becomes the operators for the greatest number of satellites, with the biggest access to space, this sector is now a key stakeholder in framing the future of space sustainability. The views on the private space sector's role in space sustainability were often characterised by respondents as bring two-folded. Some highlighted that the private sector may add to the complexity of the "space sustainability conundrum". In this context, it was asserted that the companies' ultimate goal is economic and that an implicit challenge when space companies try to reconcile environmental, national, political, and security interest with profitability. On the contrary, respondents also attributed many benefits to the private sector. Some viewed that companies might alleviate the current geopolitical landscape. Space companies are often more agile than public sector entities, and they can actively develop new technologies to lower the cost of implementing best practices. Such attributes carry challenges, as well, as the regulatory community involves the industry in the multilateral dialogues. To know where the space industry is going, what types of activities they are pursuing, and what are the near-term governance questions to be addressed was underlined as a public led endeavour.

"Companies should integrate space security into their service and product, and they should have a sense of sustainability as part of their corporate vision."
Takeshi Hakamada (ispace)

Interviewees highlighted a further differentiation between two sets of private space actors addressing space sustainability, through active or passive engagement. When it comes to passive engagement companies, we can talk about the industry which otherwise has different primary business goals but are still conscious of space

sustainability when carrying out their main space activities. In terms of active engagements, three types of activities were highlighted during the interviews:

- developing automation with AI for data handling and processing.
- development of innovative sensors to observe and collect data for STM;
- active debris removal and in-orbit servicing.

In both active and passive engagement, the need to expand and solidify global consensus in the legal, political, as well as technical mechanisms was highlighted as a prerequisite for keeping outer space safe and sustainable. Incentives might work differently based on the type of activities and engagements to create such a consensus.

A further distinction reflected across the interviews was between large and small space companies and their roles in affecting space sustainability. It was raised that start-ups and SMEs play an important role in ensuring space sustainability, however, there is a considerable lack of funding and mechanisms to encourage start-ups. Some argued that there should be financial incentives or/and less strict sustainability regulations – similar to affirmative actions – to be able to operate and thrive in the space business, while still following the sustainability measures. Nevertheless, as it was touched upon under question 3/III, we must pay close attention to the new market trend towards miniaturization and cost-efficient small and microsatellite production and launch, which does not seem to support the inclusion of the "space sustainability element".

When it comes to *large companies*, several participants stressed that we should keep in mind that, although private actors tend to be domestically founded, the space sector lends itself, thus far, to exciting high levels of interdependence between public and private stakeholders. General acknowledgement in the interviews to the fact that large private space industry is leading the competition of LEO constellations, led to open speculation on whether it is these companies that could be expected to show the path and set an example through the creation of new best practices of space sustainability.

"The private sector needs the sense that they are part of the creation of the solution and it is not imposed on them."
Dr Beyza Unal (Chatham House)

When asked about incentives, most respondents, including those from the commercial space sector, shared the view that a fair and predictable legal structure is crucial to

providing a clear and balanced economic competition. By extension, the concept of forum shopping came up in a section of interviews, with the need to avoid a 'race to the bottom' in terms of the policy response to space sustainability challenges. What can also be asserted from the interviews in terms of private sector incentivization regarding space sustainability practices, there is a lack of deep research on the issue. Conceptual works, including bringing ideas from other sectors, i.e. behavioural economics, sociology, etc. and so on were identified by many as a large gap in the public policymaking process. Many called for more comparative studies to explore how things have shaped up in other domains and what lessons they have that we could extrapolate to the space domain.

As it was previously touched upon in Question Three, time and again interviewees underlined the need for national legislation with a common global baseline. When it comes to the possible relations between the State and space companies, two main ideas came to the forefront of the answers received. On the one hand, it was articulated by a private operator that space companies might be able to regulate themselves in the short-term to carry out sustainable practices, which might also increase their reputation. On the other hand, a space policy professional advised that we cannot, and should not separate, the private sector from the State because sustainability is not possible without buy-in and action from both private and public operators. Even though it is the companies that are in an ideal position to understand the problem and come up with a solution, still, an all-encompassing and consistent solution is needed through public policy. At the same time, it was emphasized that the State, as well as the international space community, have to involve the industry in the discussions.

"The fundamental idea is being responsible and accountable and not repeating the mistakes of other industries in terms of sustainability."
Vishal Latha Balakumar (Dhruva Space)

The notion of this shared experience between the private space companies and national governments was unpacked extensively, in that such companies often depend heavily on their national space agency's involvement in global space governance and international discussions. Besides, information sharing between space agencies is crucial in the companies' point of view as well, so that information can flow to them. From the views we received from space companies residing in emerging space nations, often it was expressed that companies were actively leading the practical investigation for space sustainability. It is the industry in the emerging space nations that tends to map the commercial activities and can provide guidelines

and advice for their governments and space agencies regarding space sustainability priorities and capabilities as they have the necessary knowledge and research that the governmental agencies might lack. Such companies, therefore, can bring about changes in national space sustainability legal measures and practices. Furthermore, the industry can give direction to investment and R&D opportunities to the State.

Even cooperation (besides competition) between private entities can help to find new, greener technologies, and share technology, so with a coordinated, international effort, they can find ways to address the space sustainability problem effectively. It was commented that often, national space agencies play a key role also in capacity-building practices. As it was pointed out, creating incentives for university and any start-up experimental missions may be necessary to include deorbiting capabilities to such missions, for example.

Question Five: Looking ahead to the next 15 years, what element (s) does the international space community have to get right to ensure space sustainability is delivered over the medium term?

In this final question of the interview, respondents were encouraged to look ahead to the medium-term and speculate on what should be at the top of our collective 'to-do list' in terms of securing space sustainability.

Interviewee responses to this question can be broadly categorised into three areas, the insights shared under each area are subsequently broken down in this section:

a) **Technology** development - as part of the cause of the problem, as well as the potential resolution;
b) **Governance and Political Leadership** - in other words, the motivation and political will of the players
c) **Capital** - involving business ventures and capital mindset.

Along with the above three focus points, we gathered generic as well as specific ideas, throughout the interviews, where the international community, and most particularly UNOOSA, the United Nations' dedicated entity to outer space affairs, can help to get ahead of the impending near-Earth environmental damage curve. By extension, it was also agreed by nearly all participants that we should be guided by scientists and professionals on the environmental challenges and learn from our past mistakes concerning climate change on Earth, to be able to extend our focus to the spatial element of our environment and our irreversible dependence on it.

> ***"There is a need for lifecycle planning and monitoring, and establishing a clear direction of what should be done to the objects that are still in orbit."***
> *Alexei Skorupsky (SCANEX)*

A) **Technology**

- Many participants were convinced that in-depth research on specific metrics and datasets is needed, to be able to identify, quantify and inform evidence-

based policymaking processes on space sustainability. Some respondents thought these lines of research could focus on meeting frequent questions that were being posed, such as what is the carrying capacity of LEO? What will be the impact of mega-constellations on collision avoidance manoeuvres?

- Working towards addressing such research interest in a global, inclusive, and scientific manner would represent, in the opinion of many respondents, a huge step forward. The benefits of such an injection of certainty into the discussion will have considerable benefits, not least an increased solidification of the policy dialogue to signal to developers where to focus their attention on modern technology that can support space sustainable practices. Indeed, many interviewees conveyed that when we can agree on the specific questions put them in a mathematical language, then we can start searching for potential ways of addressing the topics and trying to find a consensus on the most basic level of common understandings. This way, it was proposed, both implementation of existing guidelines and also the development of new ones can work from more established and accepted evidence-bases to find the safe level of space debris and, for example, better manage the ratio of the new debris created, with the ones that are removed.
- Beyond finding technological solutions and mitigation techniques, several respondents underscored the need to concentrate on preventive measures when dealing with space sustainability.
- For that, a mindset shift is needed by all the space actors, decision-makers, and the public. It was noted that we would do well to stop thinking of space sustainability as an extra cost but incorporate it from the outset of the operation.
- Another aspect of this category was open speculation on the value of a global space tracking system. Indeed, the development of a technological and policy ecosystem that can provide trusted, timely and accessible information to the international space community was deemed, by many, as a prerequisite for space sustainability in the medium-term.

Interviewees recognized that such developments would require a notable step forward in the existing normative framework, building on existing services already rendered through, for example, the Registration Convention.

B) **Leadership**

- Perspectives were clear that we need to set up the prioritisation of space sustainability as a policy challenge of global importance. As was suggested by many professionals, LEO and MEO and large satellite constellations are the most pressing issues, both in terms of their impact on the potential of a space debris disaster and their interference with space observation from the Earth. We need to concentrate on national regulation at present to ensure, as mega-constellations continue to enter the space environment, their entry and setup are as professionally managed as possible.

- One option proposed by several respondents was the idea to establish space sustainability 'champions' from the private, public sector, civil society and academia. Such champions and leaders may be given a decisive role in encouraging the space community to invest in space sustainability and to work on the associated issues. Creating awareness and pride in thinking long-term with multi-stakeholder background is also key. Such sentiments capture the need for solidifying concepts of social and corporate responsibility in how space activities are conducted.

- When it comes to the political aspects of delivering space sustainability, there appears to be merit in sub-dividing the policy challenge into parts. Commentators noted that with a growing plurality in political actors on space affairs, subject-specific champions could emerge. For example, rather than simply pushing space sustainability in general terms, certain States may choose to contribute their attention to enhanced registration of space objects, establishing in-orbit servicing or inter-governmental standards for public SSA services.

"First, we need to make the space actors understand, why we need to act collectively. We can break the soft barriers in terms of embracing a common set of values and to understand what is driving such commonality."
Dr Valanathan Munsami (South African Space Agency)

- Clear, concentrated, small, technical agreements (or rules of the orbit) were also recommended to apply, specifically looking at one set of challenges at a time. Legal TCBMs can help us to build confidence and trust on the road. Besides, creating a parallel development between tech and regulation was considered extremely important, as technology is very quick and legislation should not be left behind.

- The direct need for educational, and cultural programmes within the space sustainability initiative framework was claimed to be necessary for established and emerging space countries. Such activities, it was presented, was a key missing component to further maturing the policymaking landscape around space sustainability.

- From a communication perspective, as already stated, several participants noted the value of the UN finding a direct, inclusive, positive, and cognitively appealing message. One core aspect of such public engagement could be emphasising the huge dependency both our societies and economies have already developed on space infrastructure. Around such a message should be built of the opportunity for the future that tackling this issue promises.

"The space community needs to continue to work towards demonstrating 'ISS-type collaborations' that showcase international partnership and space for common good."
Dr Minoo Rathnasabapathy (MIT Media Lab)

- It was also noted by some interviewees that the UN should concentrate on transparency, data-sharing and trust, as well as confidence-building measures. UN could support, as appropriate, a regulatory framework that makes post-mission disposal a central element of their authorization and ongoing supervision of space activities.
- Finally, respondents argued that organising a major international event could provide a catalytic moment to engineer the turning point required to make tangible progress.

C) **Capital**

- Several respondents remarked on the value of socializing the concept of **responsible investment** in space to emphasise the fact that space, especially LEO, MEO and GEO, is a finite resource. In this context, there appeared to be a lack of tools that would allow investors to make better-informed decisions based on sustainable practices. On the same note, bringing together responsible investors and space operators is also important, and was identified as a role where UNOOSA could contribute with its convening power.

"Aligning everyone's incentives and disincentives is crucial to hold the private sector accountable."
Blaine Curcio (Euroconsult)

- Monetizing altruism and incentivization were reoccurring themes in the responses to this question. Again, further research was identified as a potential next step to finding the missing metrics or indicators to better understand the problem and the impact of the potential solutions. Such an evidence base would be key to allowing policymakers to shape the incentives that can unlock capital in a way that can reinforce sustainable space practices.

Conclusions

This process was a valuable opportunity for UNOOSA to engage with the wider space community in an informal and wide-ranging manner on the subject of space sustainability. This report has outlined the key insights and perspectives shared by participants across the five standard questions used for each interview to unpack the concept of space sustainability.

This elevated focus on the issue is presented in this report as being symptomatic of the maturing global space sector; an increasingly complex ecosystem of actors and interests that are already rapidly redefining how we access and use the space environment.

As noted, the study was structured to address the research question 'where can the UN add the most value to ongoing space sustainability activities'? Respondents pointed to environmental, economic, political, and social perspectives on how to first understand - and then - address the challenge of space sustainability. Through the process, responses waxed and waned from comprehensive reflections on a huge and nebulous policy challenge to nuanced observations on technical or legal hurdles that must be overcome to make progress. This challenge of combining views and interests at the international and local, private, and public, state, and individual level, plus a temporal aspect that calls for a reconciliation between the need for both near and long-term political and economic returns on investment, only add an extra level of complexity.

Sentiments shared by interviewees were often compounded by an underlying sense of urgency. There was a recognition that, like in other policy fields, space public policymaking can experience a lag-time when it comes to keeping up with operational realities.

In terms of concrete areas where the UN, through the leadership of UNOOSA, could add value to ongoing activities in this field, the key takeaways from this study are:

- Space Sustainability requires a holistic response. Solutions to enhance space sustainability can be found in legal, technical, financial, political, and social spheres.

    - *We should quickly move beyond generalities. We need to support the maturation of the policy debate on space sustainability. This can be done by breaking down the concept into core components and domains. Common interpretations and linguistics labels will help discussion on the subject both at the cross-sectional and international level, especially when considering defining the concept of space sustainability.*

- Space Sustainability is pervasive. Be it environmental, economic, or social getting this issue right has huge ramifications for socio-economic growth. Much of society remains unaware of their irreversible reliance on access to the global space infrastructure for their daily lives.

    - *Communication about the global challenge of space sustainability is key. There is a massive awareness gap to be overcome, even in the space community, but more especially among political decision-makers and the general public. The communication tools exist to fill this gap in the service of space sustainability according to the importance that it deserves.*

- Further research required. While academic scrutiny of the space sustainability concept already exists, respondents pointed to clear gaps in research towards enhancing the data infrastructure on space sustainability issues. Such research will improve our ability to both discuss and evaluate space sustainability activities, creating a crucial evidence-based approach to support future policymaking on the subject.

    - *The establishment and expansion of commonly accepted quantitative metrics to measure space sustainability practices could add value to the policymaking process at all levels, including the UN.*

- The Space Economy is key. The commercial space sector has a pivotal role to play across the issue of space sustainability.

    - *It is important to incentivise sustainable action across the sector. Private space actors must remain part of the solution to the long-term sustainable development of the space environment. Continued engagement with such stakeholders, at the UN level, is therefore crucial.*

The views captured in this study demonstrate clearly that space sustainability will have a significant impact on our future relationship with space. This is true for public space operators, commercial space actors, academics, scientists and the public.

What is also clear is that space sustainability matters more today than ever before.

In summary, space sustainability will not happen by itself. Concerted, collective and committed action is required, including at the UN level. The clock is already ticking; the decisions we make in the next few years will define how successful we are in achieving sustainable space operations for generations to come.

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