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Space Industry Workshop Report: Industry Perspectives on Addressing Space Security Challenges

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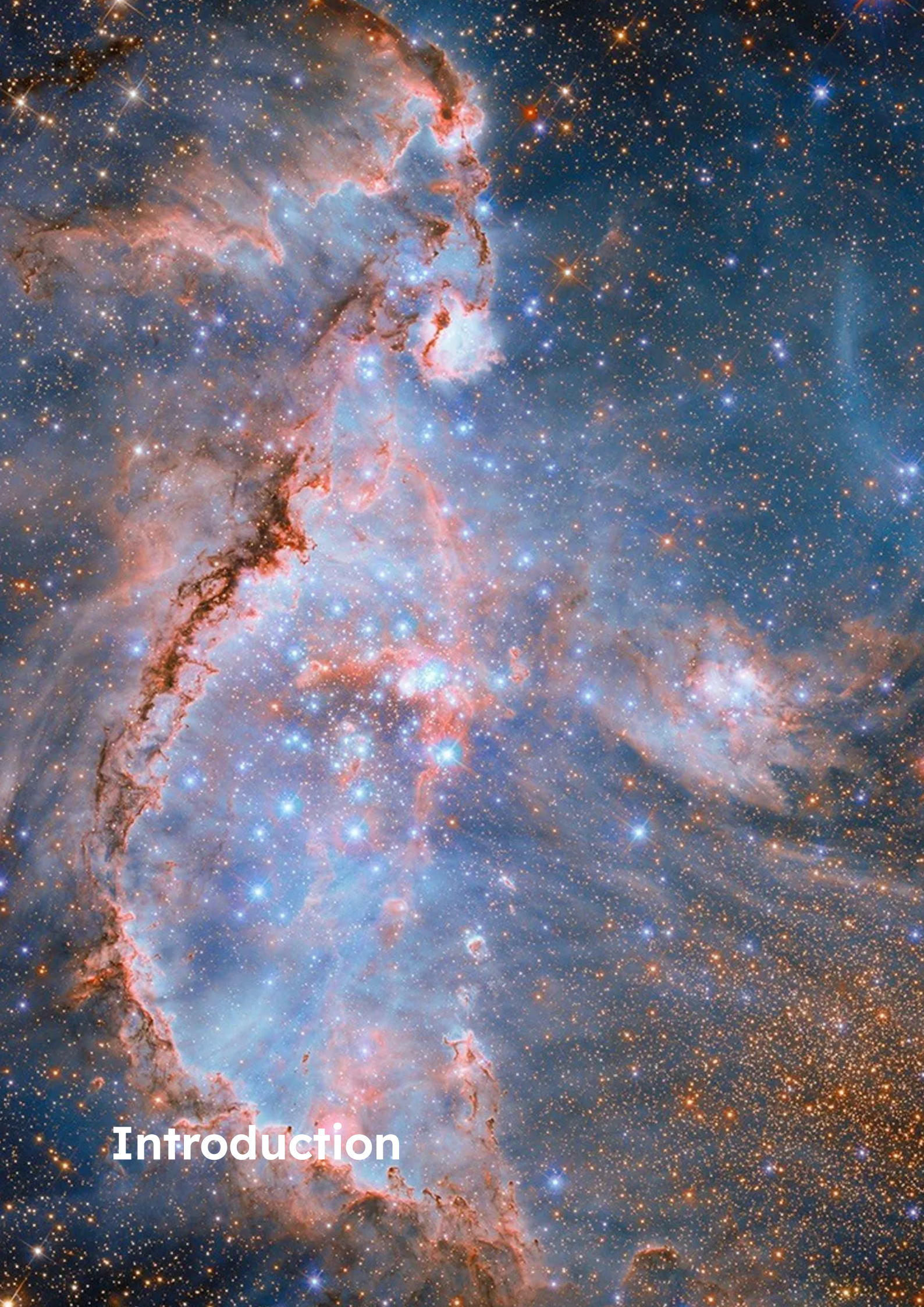
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Abbreviations and Acronyms

ASAT	Anti-satellite
CONFERS	Consortium for Execution of Rendezvous and Servicing Operations
EIA	Environmental Impact Assessment
ISAM	In-space servicing, assembly, and manufacturing
LEO	Low Earth Orbit
RPO	Rendezvous and proximity operations
SDA	Space Data Association
SIA	Space Industry Association
SME	Small and Medium Enterprises
SSA	Space Situational Awareness
SSC	Space Safety Coalition





Introduction

Introduction

The global space economy was valued at USD 596 billion in 2024 and is forecasted to grow to USD 944 billion by 2033.¹ This growth trajectory will shape the future of outer space as the space environment becomes more saturated with advanced space technologies, commercial activities, and diverse actors seeking to engage in space operations.

The proliferation of space activities and infrastructures will engender new and persisting challenges, including the risk of collisions and further space debris accumulation. Such challenges can also be exacerbated by the lack of information-sharing among actors as space becomes a more congested environment. Concurrently, some States are seeking new ways to integrate commercial space technologies into national security-related activities. These challenges are further compounded by the development and use of counterspace capabilities that could threaten space assets. These developments highlight the critical importance of space security, which all stakeholders must take into account.

The space industry can play an active role in ensuring that space remains a peaceful and secure environment. Specifically, the technical and practical experience of commercial actors derived from performing everyday operations can greatly assist States in shaping effective policies and governance measures for space activities.

To facilitate such engagement, UNIDIR organized a two-day workshop with industry representatives. The dialogue took place virtually on 17–18 March 2025. The workshop was organized over two days to accommodate different time zones, ensuring that representatives from various regions could participate. The workshop convened 38 participants, providing diversity in both geographic background and areas of expertise.

Industry representatives spanned a wide range of sectors, and this broad participation brought together technical and operational perspectives from across the global space industry.

Participants addressed key questions such as:

- ▶ What are the primary security challenges threatening industry operations and assets today?
- ▶ What best practices can industry actors follow to minimize the challenges in outer space?
- ▶ In what ways does the space industry currently collaborate with governments and other stakeholders to address shared space security challenges?
- ▶ What role can industry play in supporting the effective implementation of existing legal and normative frameworks to address the challenges in outer space?

To encourage open discussion, the meeting was held under the Chatham House Rule, allowing information to be shared without revealing the identity or affiliation of participants.

1 Novaspace, The Space Economy to Reach \$944 Billion by 2033: Insights (9 January, 2025), <https://nova.space/press-release/the-space-economy-to-reach-944-billion-by-2033-novaspace-unveils-key-insights> [<https://perma.cc/S8KZ-8NKL>]





Understanding Current Space Security Challenges

Understanding Current Space Security Challenges

The goal of the first session was to gain insight into what industry actors consider to be the primary threats to space systems and services. Participants acknowledged that space threats result from intentional actions whether through interference, disruption, or other forms of hostile behaviour, and emphasized the importance of defining and distinguishing between kinetic and non-kinetic threats. Recognizing this distinction is important, since different categories of threats have unique technical, regulatory, and strategic implications that require targeted approaches. During the discussions, the following key challenges to commercial space operations were identified.

Space Debris

Several participants expressed concern over the growing accumulation and density of debris in low Earth orbit (LEO). Such debris heightens the risk of collision and endangers operational satellites and could accelerate the onset of the ‘Kessler syndrome’, in which collisions among accumulated debris result in a cascade of yet further debris creation. While the uncontrolled reentry of space debris is not common, participants also highlighted this as a challenge because of the risk it can pose to lives and infrastructure on Earth.

Additionally, participants noted that destructive anti-satellite (ASAT) testing remains a significant concern as repeated kinetic ASAT testing can significantly increase the proliferation of debris in outer space. While space debris was identified as a primary threat to space operations, participants underscored the lack of consensus on how to address the issue. Some participants suggested that improving space situational awareness (SSA) through close cooperation among space actors can improve tracking objects in orbit, which can help with space debris management and reducing incidents of collision.

Ambiguity Of Intent Behind Close Proximity Operations

The demand for in-space servicing, assembly, and manufacturing (ISAM) activities was identified as a key driver behind growth in the number of rendezvous and proximity operations (RPOs). Participants stated that the ambiguity of intentions when conducting RPOs can create distrust, and that this obscurity of intent may be further exacerbated by ongoing competition among spacefaring States.

During the discussions, it was highlighted that certain ISAM-related activities such as satellite inspection, debris cleanup, or refuelling could be misconstrued as hostile acts among space actors if conducted without transparency, advanced notice, or cooperation. For example, one



participant noted that debris removal activities could be perceived as a cover for testing ASAT capabilities. In essence, a lack of transparency when conducting such activities raises concerns about intentions. Commercial actors may be viewed as supporting military activities, which can undermine trust in commercial activities and leave commercial actors vulnerable to targeting. In connection with this point, participants emphasized the need to build transparency and common expectations around RPO activities.

Geopolitical Tensions

Some participants voiced concerns over intensifying geopolitical tensions and the implications for commercial actors. One participant pointed out that geopolitical tensions and the proliferation of ASAT testing go hand in hand as escalating geopolitical tensions may trigger a security dilemma when testing conducted by one State to bolster its capabilities may be perceived as threatening to others. Geopolitical tensions and the threat of ASAT testing pose significant challenges not only for States but also for commercial actors. Participants stated that commercial actors need to remain aware of geopolitical tensions between spacefaring States as it can impact business strategies and operations.

Commercial actors now find themselves operating in a more contested and unpredictable environment where heightened tensions can lead to their operations being disrupted, particularly if those operations are interpreted as advancing the objectives of geopolitical rivals.

Although outer space law establishes some obligations in relation to military activities in outer space—specifically that such activities should be non-aggressive and comply with the principle of peaceful purposes, and more specifically that it is prohibited to place weapons of mass destruction (WMD) in orbit—participants stated that international measures for space governance remain limited in addressing the full range of emerging security challenges. In this sense, several participants agreed that the absence of an authoritative body to regulate space operations, particularly as competition among States intensifies, creates a ‘grey zone’ where actions taken by various actors can increase the potential for miscalculation and conflict.

Integration Of Commercial Space With Military Efforts

Participants expressed concern over the integration of commercial space services with military efforts. They explained that the dual-use nature of space systems could blur the line between commercial and military operations, potentially making commercial actors military targets. One participant specifically raised the issue of whether providing services to governments, such as space situational awareness, might cause commercial entities to be perceived as legitimate military targets by adversarial States.

Concern was also raised over whether offensive or counterspace capabilities might be (mis) identified as originating from commercial systems. This lack of clarity on distinguishing between civilian and military involvement in outer space creates ambiguities in the absence of defined parameters to guide conduct. Participants questioned where the line should be drawn between legitimate military targets and non-targetable civilian objects and expressed further concerns over liability and compensation if space companies are targeted during military operations.

Participants also stressed the importance of defining shared protocols to guide actions during space operations and suggested that multilateral initiatives could help define 'red lines' and create common standards. For instance, such efforts could involve developing clearer frameworks for information-sharing and regulatory oversight to manage challenges that can emerge from integrating commercial space services with military applications.

Cybersecurity Threats

Many participants expressed concerns over the vulnerability of space assets to cyberattacks. Participants pointed out that the dual-use nature of many space systems could make them prime targets for cyberattacks as this duality increases their potential exposure to cyber threats. To mitigate these risks, participants stressed the necessity of a strong cybersecurity layer that covers all segments of space systems, from payloads to terrestrial networks. Participants stated that space actors need to be aware of cyber threats, which includes identifying areas of weakness.

It was also highlighted that a more complex and globally distributed supply chain opens layers of exposure and vulnerability to cyberthreats. Cyberattacks can target any link in the supply chain from manufacturing to software development. Participants suggested that stakeholders conduct vulnerability assessments which could be either self-diagnosed or externally supported to help identify weak points susceptible to cyberattacks.

In response to these concerns, participants talked of the need for industry-wide cybersecurity standards. They suggested that strengthening cybersecurity measures during the licensing process, with a focus on protecting space assets, could help to reduce vulnerabilities.





Collaboration and Governance for Space Security

Collaboration and Governance for Space Security

Discussions also focused on how industry can contribute to strengthening space security through collaboration with governments and other stakeholders to address shared space security challenges. Participants reflected on current efforts, identified barriers to more effective cooperation and discussed the role of industry in supporting the implementation of existing legal and normative frameworks. In line with these considerations, the following themes emerged.

Industry Associations

Participants widely acknowledged the critical role played by industry associations in facilitating collaboration between governments and the private sector. Organizations such as the Consortium for Execution of Rendezvous and Servicing Operations (CONFERS), the Space Data Association (SDA), the Space Industry Association (SIA) and the Space Safety Coalition (SSC) were cited as key examples, with guidelines such as CONFERS' on-orbit servicing and mission diagrams noted as particularly relevant.

However, some participants expressed concern about the growing number of associations and the resulting overlap in standards and guidelines. Participants further emphasized the importance of lowering entry barriers and promoting inclusivity to facilitate broader consensus on those standards. Specifically, participants noted that the fragmentation of guidelines can lead to confusion among actors, as it can be unclear which frameworks to follow. Using space debris as an example, they observed that while numerous initiatives exist, industry actors often face uncertainty about which standards to follow. One participant also voiced scepticism that governments may be shifting responsibility to industry actors by not offering adequate regulatory guidance.

Additionally, the high financial cost of participating in multiple industry associations was noted as a barrier, particularly for small and medium-sized enterprises (SMEs). In this context, it was suggested that instead of creating new associations, efforts should focus on bringing existing actors together to coordinate actions and reduce overlaps and divergences.

Harmonization of Regulations

Given the global and diverse nature of supply chains, some participants called for better alignment and harmonization of existing initiatives and national regulations. One participant cited the example of a national law that governs commercial space activities and obligates commercial actors to operate in a manner consistent with national security interests. Another participant advocated the development of national legislation with punitive measures to

regulate industry, arguing that the absence of clear regulation has enabled some satellite operators to act primarily in pursuit of profit at times to the detriment of safe, secure, and sustainable space practices.

Information-sharing

Participants recognized that information-sharing is essential in addressing the challenges of space security, as it builds trust and reduces misunderstandings. One participant noted that sharing details about actual system capabilities can help to demystify technology and reduce the risk of misinterpretation. Drawing parallels with the maritime and air domains, the participant added that operational rules and regulations in those areas have contributed to long-term strategic certainty, which would be similarly beneficial for space actors.

Some participants noted that while information-sharing should ideally be reciprocal, even unilateral sharing is preferable to none. They acknowledged that some degree of mistrust is likely to persist between adversaries but emphasized that sharing information remains beneficial overall. Another participant highlighted the value of historical observational data in identifying behavioural patterns and detecting potential deviations. Such data, the participant observed, can also support collaborative endeavours and scientific cooperation, contributing to a more informed approach to space activities.

At the same time, some participants acknowledged the cultural and economic barriers to sharing information. While some actors may be willing to share data, others remain cautious due to confidentiality concerns or competitive pressures. One participant noted that relevant information is often published across numerous company websites, making it difficult to access—whether due to language barriers or decentralization. In this sense, another participant referred to the Registration Convention and General Assembly resolution 62/101,² which aims to enhance information-sharing related to the registration of space objects, and advocated for more detailed and consistent submissions to improve transparency in space activities.

Participants also proposed developing clear standards for the types of information to be shared—ranging from technical specifications and operational plans to manoeuvre data— noting that such transparency could help to categorize potential threats, for example, by distinguishing between physical interactions and non-kinetic threats such as jamming, spoofing or cyberattack. One participant called for a top-down approach to formulating guidelines on data formatting and interpretation that could improve standardization and facilitate coordination among stakeholders. Overall, participants agreed that any framework for information-sharing should be structured, accessible and inclusive.

2 G.A. Res. 62/101 on Recommendations on enhancing the practices of States and international intergovernmental organizations in registering space objects (10 January 2008), <https://docs.un.org/A/RES/62/101>.



Best Practices And Strategies For Long-Term Space Security



Best Practices And Strategies For Long-Term Space Security

The third part of the discussion focused on identifying best practices adopted by industry to address long-term challenges in outer space. Participants underscored the importance of practical and forward-looking approaches to ensure that space remains a secure and sustainable environment. In this regard, the following key points were highlighted.

Licensing, Incentivization And Subsidies

Participants discussed the economic barriers that limit the adoption of best practices in space sustainability. To address this, some proposed that governments provide financial support, including subsidies or grants, to incentivize compliance which can help to embed best practices as industry norms. One participant noted that mandatory insurance requirements under national space regulations is a positive measure; however, insurance premiums could be adjusted based on a company's adherence to sustainability standards.

Some participants also emphasized the role of licensing, suggesting that licensing frameworks should incorporate cybersecurity measures and sustainability benchmarks. However, concerns were raised over the challenges of licensing space assets in certain jurisdictions, as varying compliance levels across countries create inconsistencies, with companies opting for jurisdictions that offer easier processes and weaker compliance standards. Many participants agreed that harmonized, incentive-based licensing models could promote a culture of compliance while reducing financial burdens, particularly for smaller actors.

Environmental And Lifecycle Assessments

One participant cited environmental impact assessments (EIAs) and life cycle assessments of satellites as emerging best practices that help to identify long-term sustainability risks and ensure accountability throughout mission planning and operations. Another participant highlighted the Space Sustainability Rating as a valuable tool in motivating industry actors to develop practices in support of the sustainable use of space, though they noted that obtaining such ratings can be costly, with companies having to spend significant resources merely to receive them.

Holistic And Multi-Stakeholder Approaches

Participants stressed the importance of inclusivity in space governance, emphasizing that developing countries and smaller actors should have a meaningful voice in decision-making. Several participants discussed the importance of cross-sector collaboration in addressing

shared challenges like cybersecurity. Participants called for more inclusive frameworks involving both public and private stakeholders, standardized data-sharing protocols, and governance models that address commercial interests as well as security and sustainability concerns. One participant noted that the space stakeholders now include not only States and technical companies but also private equity firms, consultancy firms and legal advisors. As such, the participant indicated that effective governance must consider financial, legal and technological perspectives to reflect the evolving nature of space activities.





Way Forward

Way Forward

The workshop discussions underscored the important role that industry actors can play in supporting space security. Industry actors can provide pragmatic solutions because of their technical expertise and operational experience. During the discussions, participants shared concerns over the increasing number of industry associations; however, they emphasized the important role that associations can play in promoting collaboration and developing shared standards. In addition, representatives highlighted several best practices to promote sustainable space operations, such as information-sharing, environmental and life cycle assessments, harmonizing regulations and incentivization mechanisms.

New and persisting challenges such as space debris accumulation, cybersecurity threats, geopolitical tensions and the integration of commercial space services with military functions will continue to pose threats and risks to the security and sustainability of outer space. These challenges will require States to coordinate closely with all stakeholders, including industry actors that can provide innovative solutions.

Looking ahead, involving industry expertise in space security policymaking can contribute to ensuring that space remains peaceful. The workshop shed light on the importance of industry participation in multilateral forums and processes. Industry participation can ensure that operational realities and commercial innovations help to guide the development of balanced space governance frameworks.



