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Long-term sustainability of outer space activities

Long-term sustainability of outer space activities: implementation experiences, opportunities for capacity-building and challenges

Working paper by the Chair of the Working Group on the Long-term Sustainability of Outer Space Activities

1. At its sixty-second session, in 2019, the Committee on the Peaceful Uses of Outer Space adopted the Guidelines for the Long-term Sustainability of Outer Space Activities (A/74/20, para. 163 and annex II). At the same session, the Committee decided to establish, under a five-year workplan, a working group under the agenda item on the long-term sustainability of outer space activities of the Scientific and Technical Subcommittee (A/74/20, para. 165). The current Working Group on the Long-term Sustainability of Outer Space Activities undertakes its work in accordance with its terms of reference, methods of work and workplan (A/AC.105/1258, annex II, appendix).

2. At its sixty-sixth session, in 2023, the Committee on the Peaceful Uses of Outer Space noted that the Working Group had requested that the Chair of the Working Group draw on the inputs received since the start of the work of the Working Group to compile concise summaries of Member States' implementation experiences, opportunities for capacity-building for implementation of the Guidelines, and overarching themes on challenges to the long-term sustainability of outer space activities. Those summaries were to be made available in the six official languages of the United Nations for consideration at the sixty-first session of the Scientific and Technical Subcommittee, in 2024 (A/78/20, para. 141).

3. The summaries below draw on input included in parliamentary documents A/AC.105/C.1/L.409, A/AC.105/C.1/L.409/Add.1, A/AC.105/C.1/L.409/Add.2, A/AC.105/C.1/L.409/Add.3, A/AC.105/C.1/L.409/Add.4 and A/AC.105/C.1/L.409/Add.5, conference room papers A/AC.105/2023/CRP.15/Rev.1, A/AC.105/C.1/2023/CRP.4, A/AC.105/C.1/2023/CRP.6, A/AC.105/C.1/2023/CRP.7, A/AC.105/C.1/2023/CRP.8, A/AC.105/C.1/2023/CRP.9, A/AC.105/C.1/2023/CRP.10, A/AC.105/C.1/2023/CRP.11, A/AC.105/C.1/2023/CRP.12, A/AC.105/C.1/2023/CRP.13,

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A/AC.105/C.1/2023/CRP.15, A/AC.105/C.1/2023/CRP.19, A/AC.105/C.1/2023/CRP.21, A/AC.105/C.1/2023/CRP.22, A/AC.105/C.1/2023/CRP.26, A/AC.105/C.1/2023/CRP.27, A/AC.105/C.1/2023/CRP.28, A/AC.105/C.1/2023/CRP.31/Rev.2, A/AC.105/C.1/2022/CRP.22, A/AC.105/C.1/2022/CRP.20, as well as verbal interventions made during Working Group discussions. The summaries in sections I to III attempt to draw out insights and main themes, compiling them in one place to support ongoing discussions and further work. The summaries do not represent consensus by the Working Group on content or language formulations. To the extent practicable, the language of the original submitter was retained in the working paper.

4. While the summaries below take the form of individual points given in the briefest form possible, the larger ideas represented are often complex and nuanced. Many inputs interconnect with others and are relevant across the three categories. An experience in implementation may, for instance, include or reveal a challenge or a related opportunity for capacity-building.[1]

I. Member States' experiences implementing the Guidelines for the Long-term Sustainability of Outer Space Activities

Methods of work and cross-cutting aspects

5. To evaluate the implementation of the Guidelines for the Long-term Sustainability of Outer Space Activities at the national level, some States engaged in dedicated national mapping exercises.

6. Some States reported that implementation of the Guidelines, and therefore the gathering of information on implementation, involved multiple entities, including multiple ministries, or a full or near all-of-government approach.

7. Some States emphasized the importance of multi-stakeholder approaches to the implementation of the Guidelines.

8. Some States surveyed or released public solicitations requesting information from not only governmental sources, but also industry and the private sector, academic institutions and/or non-governmental organizations on how they were voluntarily implementing the Guidelines.[2]

9. Some States used specific templates to help in the consistent reporting of national implementation practices.

10. The Working Group agreed that an easily accessible and searchable open-source repository of information and views on the elements included in the Working Group's terms of reference would be useful and could serve as a tool for building transparency, confidence and capacity. The Working Group also requested the Office for Outer Space Affairs to develop and host such an information repository on a website of the Office (A/AC.105/1279, annex II, paras. 17 and 18). The intention is that the Office will develop such an information repository.

11. Ongoing implementation of the existing Guidelines and capacity-building efforts could reveal common challenges in areas not previously considered by the Working Group. Examples could include areas where adopted Guidelines exist but there are issues, questions or differing views regarding their application (e.g. the registration of space objects), and new areas, issues or themes that are not adequately addressed within the existing Guidelines.

[1] In general, input was listed under the same category as it was reported by Working Group members.

[2] As some States provided information on non-governmental efforts to implement the Guidelines in their input to the Working Group, main themes from that content are included in the lists, although those points may not necessarily reflect the view of a Government.

Policy and regulatory matters

12. When designing a national space regulatory framework, it is important to build in flexibility. This ensures the regulatory regime continues to keep pace with the rapid development of space technology and operational practice, allowing for novel space activities to be adequately regulated.

13. A non-prescriptive, outcome-based authorization regime provides flexibility by design. This flexibility, alongside proactive engagement with the space industry and the broader community will be key to ensuring that the rapid pace of change in technology and operational practice can be adequately taken into account.

14. In cases where various government departments with different mandates are responsible for legislation and the regulation of specific space activities, engagement and collaboration across government departments and agencies is required.

15. The conduct of an in-depth operational review of a national space law is a valuable exercise for identifying areas of the regulatory regime that need revising or amending.

16. Regulatory frameworks developed by early players in space activities in "fit-for-purpose" mode (appropriate at the time they were developed) often do not cover activities involving emerging technologies. A holistic evaluation of all current and future space activities will help future-proof a modern regulatory framework.

17. It is a challenge to review the provisions of related national laws and regulations as necessary to ensure that they are sufficient for new forms of space objects.

18. When developing, revising or amending national regulatory frameworks, it is a challenge to follow up on the many relevant factors and reflect them in the domestic regulatory system in a timely manner.

19. A review of existing space legislation is aimed at ensuring that space regulations are appropriate for addressing technological advancements and does not unnecessarily inhibit innovation in space capabilities. Any relevant update to the framework supports the growth of the space industry by removing unnecessary barriers to participation and encouraging entrepreneurship, as well as ensuring the safety of the activities.

20. The review of existing regulations could help to identify opportunities for modernization and to streamline regulatory processes in order to encourage space exploration and commercial investment.

21. Concerted efforts have been made across government to streamline regulations and to promote safety, responsibility and effectiveness across the full range of government and non-government space activities.

22. The review of regulatory and policy frameworks could present opportunities to improve the oversight of national space activities, as well as to enhance transparency and provide guidance.

23. Efforts were made to update an existing law on the use of drop zones for separating parts of space rockets to take into account practical realities, in order to close gaps in legislation in this sphere of activity and to ensure public safety and environmental protection in such zones.

24. The establishment of a system that facilitates an appropriate level of supervision is a challenge in view of the increasing number of satellites in operation.

25. It can be challenging to figure out how to conduct appropriate and valid examinations to license the activities of private sector entities where a precedent may not exist.

26. A dedicated industry engagement mechanism to guide stakeholders through the application and regulatory process, including through the provision of publicly

available guidance documents, can help assist industry in navigating the regulatory process and reduce possible delays and costs.

27. An important issue in the space industry is the need to conduct conformity assessments of space equipment through consistent regulation by the institutes of accreditation in the field of space equipment.

28. A number of policy and legal issues arise when considering active debris removal and on-orbit servicing missions involving multiple States.

29. The supervision of space activities of non-governmental legal entities can be implemented during licensing control through scheduled and unscheduled inspections in the form of desk reviews and site visits.

30. Some commercial industry representatives have created processes for more efficient spectrum use that provides reliable communication globally while reducing spectrum consumption.

31. Whole-of-government collaboration and timely engagement with relevant external stakeholders are important for the timely and accurate registration of space objects.

32. Registration practices work well with long-established space operators, but more outreach and education efforts are required with newer actors, who may be unaware of or unfamiliar with registration requirements or may forget.

33. When a launch service provider launches a satellite or other object that is within another country's jurisdiction and/or under its control, the challenge is to coordinate appropriately and to ensure that the object is registered by the second country.

34. There is a need for updated registration guidance that takes into account the increasing complexities of space activities, such as how to jointly determine who should register an object in the case of multiple launching States.

35. There is a need to address ongoing complexities related to the status of launching States, in particular in the context of the rapid expansion of new spaceport projects worldwide.

36. Points of contact for the registration of space objects and for spacecraft operations could be merged.

37. Points of contact for the registration of space objects often focus on policy matters, whereas points of contact for space operations are technical, and therefore any related lists should remain separate.

38. Representatives of some non-governmental organizations have advocated for spacecraft owners, operators and stakeholders to engage with Governments to ascertain the appropriate State of registration.

Safety of space operations

39. Timely and actionable space situational awareness data and space traffic coordination services are essential for ongoing space activities.

40. A whole-of-government approach is found to improve space situational awareness information-sharing efforts. That approach includes making readily available national contact information, information on on-orbit spacecraft operations, conjunction assessments and the monitoring of objects and events in outer space.

41. Space situational awareness data and basic space traffic coordination services are being provided free of direct user fees. The current landscape includes commercial operators that provide space situational awareness services to both spacecraft operators and national entities.

42. As part of ongoing improvements in data-sharing – including the exchange of relevant information on space objects and events in near-Earth space with different

sources and the effective accumulation of, and provision of access to, information on objects and events in outer space – space situational awareness information-sharing responsibilities in one State are transitioning to a civil agency. These efforts should improve data-sharing, transparency and consistency in the understanding and use of such information, as well as facilitate effective responses to orbital collisions, orbital break-ups and other events that might increase the probability of accidental collisions or pose a risk to human life, property and/or the environment, in the case of uncontrolled re-entry of space objects.

43. There is a need to improve the exchange of space situational awareness points of contact between Member States, including private operators.

44. Operator-to-operator communication regarding close approaches is critical to prevent both operators from simultaneously manoeuvring into each other and causing a collision. In order to ensure flight safety and prevent manoeuvre-on-manoeuvre collisions, planned manoeuvres are screened before they are executed. This screening ensures that a representation of the planned trajectory is available to all other space operators.

45. Some non-governmental organizations have developed a crowdsourcing data lake model to bring disparate data together in order to create a comprehensive space situational awareness and flight safety tool. This crowdsourcing includes the sharing of contact information between spacecraft operators.

46. Some commercial industry representatives provide space situational awareness data to Governments for conjunction assessment services and have created internal processes for the automatic upload of predicted manoeuvres.

47. States that participate in regional initiatives exchange space situational awareness data in standardized formats (e.g. collision data messages). This enables the validation and merging of data from multiple sources and the generation of products from them, such as autonomous regional collision warnings.

48. Projects have been undertaken to set up observational facilities (radar and optical telescopes) for the dedicated tracking and monitoring of space objects. The projects are aimed at enhancing space object monitoring capabilities and at bringing all space situational awareness efforts under a common umbrella for more efficient management and coordination.

49. A space agency releases and regularly updates orbital debris modelling and mission compliance assessment tools based on debris monitoring data, which are used by hundreds of satellite operators, academia and research groups around the world.

50. States make use of data-sharing agreements and receive collision warnings from partners.

51. The challenge remains to establish international rules for pre-launch conjunction assessment and collision avoidance.

52. The challenge remains to create an international database for space object trajectories and their errors.

53. The challenge remains to establish an international scheme for sharing launch and re-entry schedules and trajectories.

54. Contact point databases, for satellite and launch operators, at both the governmental and non-State operator levels, should be improved. This could involve the creation of new databases and/or better coordination, on an international basis, of existing national and regional databases.

55. The lack of coordination between different information-sharing platforms hinders operational efficiency and effectiveness.

56. The dual nature – civilian and military – of technologies for monitoring debris in space or for actively removing debris is an important factor to be noted.

57. There is a benefit to collaboration between civilian and military stakeholders on conjunction analysis and space situational awareness. In addition, the ability to analyse space situational awareness data from multiple sources, independently verify those data and collaborate with international partners, is important.

58. The multiplication of private initiatives in orbit makes it necessary to develop standards in order to standardize good practice and reduce the risks of debris creation or collision. The definition and dissemination of technical standards must be in line with the reference principles defined by the Committee on the Peaceful Uses of Outer Space.

59. As cost is a consideration for deorbiting satellites, it is worth considering innovations in small satellite deorbiting techniques.

60. A national administration consistently provides free and unrestricted access to operational space weather data, disseminates space weather forecasts, and engages in extensive international cooperation to coordinate approaches and meet critical needs for space weather information and/or data.

61. Space weather services are freely available from the national actors working in the area in one jurisdiction. The sharing of space weather forecasts is more limited, as there is not presently a 24/7 national space weather service. National actors are, however, meeting regularly to plan for such a service.

62. Limited awareness of the importance of space weather to the operation of crucial space-based services (i.e. satellite communications) and the impact of a space weather event on these services among end users (e.g. the general population) is a challenge.

63. It can be a challenge to increase awareness of space weather in the space industry and in industries that rely on space data or space-based services.

64. The challenge remains to establish a unified format for sharing space weather observational data.

65. Regarding space weather disasters, the challenge is to establish a practical information-sharing scheme.

66. It is necessary to protect frequencies used for space weather sensors without imposing any additional restrictions on existing services.

67. It can be difficult for less established operators, who may use satellites in a form factor smaller than 10 cm, to demonstrate how trackable their space objects are.

68. Regulations are necessary to promote design approaches that increase the trackability of space objects; regulators must also communicate with government entities providing tracking and conjunction information.

69. Some commercial industry representatives have designed their spacecraft in such a manner that if a failure occurs, the space object’s battery and propellant tanks are designed to leak rather than explode.

70. Some commercial industry representatives minimize debris generation by designing spacecraft to not release any planned debris during normal operations and to retain all separation and deployment mechanisms.

71. Some commercial industry representatives design launcher stages that go into orbit for satellite deployment in a manner that allows purposeful deorbiting.

72. Some non-governmental organizations advocate for government support for the development of both government and commercial active debris remediation technologies.

73. Some non-governmental organizations promote the creation of bilateral or multilateral dialogue with international partners on the rationale, costs and benefits of active debris removal.

74. Mission developers are encouraged to seek design-for-demise trade options to reduce re-entry risk.

75. The challenge remains to consider the need for controlled re-entry, especially in rocket vehicles, while taking economic factors into account. A challenge is that launch providers tend to avoid controlled re-entry involving launch capacity loss. An international standard for, or consensus on, controlled re-entry is felt to be necessary.

76. A re-entry service, offered free of charge, currently serves more than 125 registered users. Each uncontrolled re-entry is closely followed. Another entity releases information to the public via press releases and website updates prior to high-risk re-entries. Debris assessment software, including a re-entry risk assessment module, has been developed and released to the international community to assess risks associated with uncontrolled re-entries.

77. Some commercial industry representatives develop and share information on improved end-of-life disposal technologies and practices. Furthermore, some commercial industry representatives have created industry associations that develop industry-led standards and best practices for outer space activities, including for in-space servicing, assembly and manufacturing.

78. Prior to the use of lasers that generate beams passing through near-Earth outer space, relevant government departments and agencies follow safety analyses and deconfliction procedures to reduce the risks of accidental illumination and of malfunctioning, damage and break-up due to illumination. They also, as necessary, observe appropriate precautionary measures. Regulators disclose licensees' laser-related information to appropriate intergovernmental entities such as the International Telecommunication Union (ITU) on behalf of those licensees, if provided.

International cooperation, capacity-building and awareness

79. It is important for a broad cross-section of stakeholders to be engaged in long-term sustainability activities. This includes public, commercial and academic representatives, in addition to national and foreign Governments.

80. Relevant international and regional cooperation is supported through a number of organizations, initiatives and forums, including the following: World Meteorological Organization (WMO), ITU, International Civil Aviation Organization (ICAO), Inter-Agency Space Debris Coordination Committee (IADC), International Committee on Global Navigation Satellite Systems (ICG), International Space Exploration Coordination Group (ISECG), Committee on Earth Observation Satellites (CEOS), Group of Earth Observation (GEO), International Astronautical Federation (IAF), International Organization for Standardization, Committee on Space Research (COSPAR), Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters (International Charter on Space and Major Disasters), International Space Weather Initiative (ISWI), European Space Agency (ESA), European Union, European Organization for the Exploitation of Meteorological Satellites (EUMETSAT), European Cooperation for Space Standardization, Asia-Pacific Regional Space Agency Forum (APRSAF) and its National Space Law Initiative, Asia-Pacific Space Cooperation Organization (APSCO), Association of Southeast Asian Nations (ASEAN) Subcommittee on Space Technology and Applications (SCOSA), African Space Agency, and the regional centres affiliated to the United Nations.

81. Capacity-building and awareness-raising activities may take many forms, including the following: training courses, fellowships, webinars, workshops, international conferences, forums at the ministerial level, industry events, the provision of technical assistance, academic articles, digital outreach programmes, social media efforts, podcasts and monthly question and answer opportunities with subject matter experts from the space sector.

82. International cooperation efforts should be as inclusive as possible, with particular efforts made to include developing countries.

83. A regional approach to space traffic management is in and of itself international cooperation, with multilateral engagement foreseen in the context of the United Nations, and bilateral engagement foreseen with international partners, in view of interoperability and data-sharing towards international standards and rules for space traffic management, building on regional approaches.

84. Exchanges on the topic of sustainability are held with non-State actors in the context of the provision of contracts and grants.

85. There are efforts to develop a simplified version of the adopted Guidelines for use in a national context – one that retains the Guidelines' key ideas but uses more accessible language, making the content easier to understand and apply.

86. There are ongoing efforts to improve diversity and inclusion in the space sector and to increase the representation of women and include the voices of Indigenous Peoples and young generations.

87. Some commercial industry representatives hold dialogues with commercial operators and international actors regarding best practices to promote the long-term sustainability of outer space and actively advocate for multi-stakeholder engagement on long-term sustainability issues.

88. Some non-governmental organizations advocate for the development of incentive-based frameworks to promote space sustainability.

89. Some non-governmental organizations raise awareness of the particular needs of the global South for remote sensing data to address the effects of climate change and extreme weather events.

90. Some commercial industry representatives share experiences of operating anomalies, similar to practices in the aviation industry, to reinforce the adoption of safe practices for space operations. This can take the form of developing and sharing best practices for the anomaly attribution process within the servicing community, participating in the development of anomaly resolution standards and sharing frameworks, and, where possible, sharing information within the satellite servicing community on specific examples of anomaly resolution and attribution that could affect the community as a whole.

91. Some commercial industry representatives engage in outreach activities with schools and universities, employ seasonal and project-specific undergraduate- and graduate-level interns from diverse backgrounds, and speak at public and industry events.

Scientific and technical research and development

92. A space agency funds efforts to reduce future debris, with the technological development of debris-sensing instruments and advancement of satellite drag models and models on the effects of space weather to improve debris tracking.

93. Laser optical technologies are being studied that enable precise orbit determination of space objects as small as 10 cm in size.

94. Work is ongoing to develop a space robotic system that is able to capture large space debris objects in intensively used orbits.

95. Commercial industry representatives use onboard telemetry systems to improve tracking of space objects.

96. Efforts are under way to develop new methods of collision avoidance manoeuvres and automate collision avoidance.

97. Commercial industry representatives design and employ reusable launch vehicles.

98. Space robotics, automation and artificial intelligence, combined with standardization, modularization and digitalization, have been identified as strategic elements for improving aspects such as flexibility, cost efficiency and protection of the space environment in, for instance, on-orbit satellite services.

99. A regional research and innovation programme supports research into the sustainable exploration and use of outer space through research grants. Examples include extensive research in the field of space surveillance and tracking; innovative instrumentation and technologies enabling space science and exploration missions; robotic servicing and exploration technologies; technologies for in situ space resource utilization; and technologies for the sustainable use of Earth orbit and resources (e.g. raw materials and rare-earth metals), including modularity, standard interfaces, orbital replacement units, serviceability including refuelling, self-removal and decommissioning.

100. The development has begun of environmentally friendlier technologies for space, such as the use of green propellants for launch vehicle and satellite propulsion. Ammonium dinitramide- and hydroxylammonium nitrate-based monopropellants and hydrogen peroxide- and kerosene-based bi-propellants are being actively studied and have been ground tested at subscale engine level.

101. The importance of information technology and cyber and data security in relation to space sustainability is growing. Attacks on the integrity of data systems necessary for the operation of satellite systems can have catastrophic effects. Therefore, space cyber security is considered as part of the product assurance, safety and sustainability requirements for space projects.

102. Representatives of some academic institutions have developed a means of incentivizing industry to design missions compatible with sustainable and responsible operations and operate missions taking into account potential harm to the orbital environment and impact on other operators, in addition to mission objectives and service quality.

103. A model for sustainable space missions could include a mission index to estimate the mission's marginal contribution to overall orbital risk; collision avoidance capabilities; the ability and willingness of the operator to share data on the mission; the mission's detectability, identification and tracking; the operator's compliance with standards and regulations; and the commitment to use or demonstration of the use of on-orbit servicing and external services.

II. Opportunities for capacity-building for implementation of the Guidelines for the Long-term Sustainability of Outer Space Activities

104. Many practical legal questions arise in respect of licensing and licensing procedures. Therefore, it would be helpful to have practical guidance on, among other things:

- Risk assessment for possible damage
- Calculations of the minimum insurance sum required for missions using satellites of different sizes
- An overview of the insurance companies that insure satellites

105. Further clarification is needed on the jurisdiction and control of a State registering a space object.

106. It would be helpful to have the opportunity to discuss other States' experiences in and approaches to licensing active debris removal and on-orbit servicing activity in a safe and transparent manner.

107. Work on space law within regional forums enables the continuous exchange of information and mutual learning, including among experts.

108. Support provided by the Office for Outer Space Affairs allows States to, upon request, receive assistance in developing their national space legislation and/or national space policies in line with international space law.

109. There is an identified need for further capacity-building in the area of space situational awareness, including conjunction assessment tools and space situational awareness on the trackability of very small satellites.

110. Models for determining the trackability of satellites smaller than 10 cm prior to launch would be useful for less established operators.

111. It is important for there to be a focus on developing resilient systems and processes that support the delivery of products and services.

112. Timely and accurate space weather information, nowcasts and forecasts are possible only if sufficient observation data are made continuously available through multi-instrument capability.

113. Potential users of space data are often unaware of their benefits. Therefore, there is a need for active exchanges between the space sector and sectors striving for sustainable development and green solutions.

114. The relationship between traditional Indigenous knowledge and space technology can be further leveraged to accelerate the realization of the Sustainable Development Goals.

115. The role of education and technology, including the specific contributions of higher education institutions to capacity-building, can be developed further.

116. The value of, and methods for, transferring technology are to be considered further.

117. There is a need to support the commercial space sector, including the competitiveness of companies employing sustainable methods or developing sustainable technologies.

118. The Access to Space For All initiative of the Office for Outer Space Affairs provides scientific and technical capacity-building opportunities at the international level.

119. Active participation in the Committee on the Peaceful Uses of Outer Space and its subsidiary bodies helps to improve transparency and accountability and builds capacity.

120. Participation in various other international and regional organizations and forums, such as those listed in section I, frequently offers capacity-building opportunities.

121. The information repository requested by the Working Group (A/AC.105/1279, annex II, para. 18) could represent a good capacity-building resource, providing information on, among other things, lessons learned.

III. Overarching themes on challenges to the long-term sustainability of outer space activities

122. Overarching themes on challenges to the long-term sustainability of outer space activities, as drawn from input by members of the Working Group to date, are as follows:

Registration of space objects

- The timely registration of space objects
- Mechanisms for improving registration practices for large constellations
- How to address ongoing complexities related to the status of launching States
- Special responsibilities of launching States related to uncontrolled re-entries

Space situational awareness and collision avoidance

- The increased need for timely and accurate space situational awareness information and related data to be made available in a common/interoperable format
- Improvements to space situational awareness and connected information-sharing, for conjunction-free launches and the safety of human spaceflight missions
- Improved mechanisms to locate the appropriate points of contact for operational communications
- An improved mode of inter-operator coordination
- The trackability and manoeuvrability of CubeSats and nanosats
- The contact information of small satellite operators for coordination and data exchange to mitigate collision risk
- The exchange of operational ephemeris
- Air traffic coordination during the passage of space objects in airspace
- The prevention of on-orbit failures of space systems, especially those that are mass-produced using commercial off-the-shelf components
- A standardized method of risk assessment and a common protocol for collision avoidance
- The safety of human spaceflights and space stations

Safety and security of space operations

- The supervision and safe conduct of close-proximity rendezvous operations
- The prevention of dangerous alterations of space environment parameters resulting from intentional modifications
- The implementation of operational and technological measures of self-restraint on States' space activities in order to prevent adverse developments in outer space
- The implementation of policy aimed at precluding interference with the operation of foreign space objects through unauthorized access to their on-board hardware and software
- The preclusion of activities that could damage foreign ground and information infrastructure related to space activities
- Cyber threats, including those posed by private actors

- The observance of spacecraft manoeuvring rules to avoid collisions (e.g. between human-rated spacecraft, robotic spacecraft and constellations)
- Operational transparency (e.g. notifications of manoeuvres that may result in safety issues to other operators)
- Requirements related to spacecraft manoeuvrability in various orbits
- A lack of required data, information, knowledge, technology and infrastructure to implement the Guidelines
- The failure to reach an international agreement on mechanisms and standards required for the implementation of some Guidelines that require data-sharing or consultation
- The predominance of a competitive environment motivated by commercial and political views, which will prevent the formation of an interactive and cooperative approach among Member States
- The deployment of thousands of satellites in near-Earth space in the form of large or mega constellations, which can cause orbital congestion and limit the free and equal access of other Member States to the peaceful exploration and use of outer space, which is recognized as the common interest of all humanity

Awareness-raising and international cooperation

- Mechanisms and standards needed to implement the Guidelines that require data-sharing or consultation
- Mechanisms to ensure that emerging spacefaring nations enjoy inclusive participation in space activities
- Mechanisms to ensure equitable access to low-Earth orbit
- Mechanisms to address the lack of required data, information, knowledge, technology and infrastructure to implement the Guidelines
- The promotion of interactive and cooperative approaches among members to avoid a competitive space environment

Debris mitigation and active debris removal

- The development and implementation of criteria and procedures for the preparation and conduct of space activities aimed at the active removal of space objects from orbit
- The assignment of ownership to space debris
- Appropriate solutions for the active removal and destruction of non-registered space objects
- The safe conduct of operations for the destruction of in-orbit space objects
- Good practices for active debris removal
- Cyber safety, including in relation to space debris mitigation
- Transparency and safety assurance to encourage private sector actors to implement space debris removal activities

Technical developments, space exploration and sustainability

- Long-term contributions and challenges of large-scale commercial space launches
- The effect of multiplication of spaceports
- Approaches to the design and operation of small-size space objects
- Protection of the dark and quiet skies, including for astronomical observations

- The sustainability of on-orbit operations and on-orbit manufacturing
- The sustainability of deep space missions
- The need for the cooperation of all Member States and the full support of developed countries in the implementation of research and the sustainability of space exploration