PREPARATORY DOCUMENT

1st SPHERE Space Policy Forum

The New Space Age:
Multidisciplinary Governance for the Future of Public Policy

Note for speakers and moderators

This preparatory document is being distributed in advance to speakers and moderators, and will be made available to the public during the Forum, via download from the Research Centre for International and Strategic Studies (CISS) website, to provide the conceptual framework for the 1st SPHERE Space Policy Forum. The document serve as the executive summary of the final report, which will be distributed after the event as a thought-provoking resourceand a basis for future developments.

The context of the initiative

The contemporary space sector is undergoing a phase of transformation that is unprecedented in its history. After six decades of activity dominated by large state agencies and characterised by technocratic decisions made by a small elite of engineers and scientists, a profoundly different ecosystem is now emerging: pluralistic in its actors, pervasive in its terrestrial repercussions, and complex in its ethical and regulatory implications. The proliferation of stakeholders – from New Space start-ups to emerging powers, from commercial satellite constellations to permanent return programmes to the Moon – is producing dynamics that can no longer be governed with the conceptual tools of the past.

This systemic complexity requires an epistemological leap in the way we formulate space policies. Technical and scientific expertise, while remaining fundamental, is no longer sufficient on its own to answer the questions that the new space age poses to contemporary societies. These questions concern not only the technical feasibility of missions, but also their social desirability, their regulatory legitimacy and their long-term sustainability. Who decides whether to establish settlements on Mars or which resources to exploit from asteroids? How can we ensure that the benefits of space technologies – from satellite connectivity to *Earth Observation* data – are distributed equitably and do not exacerbate existing inequalities? With what ethical mandate can we alter extraterrestrial environments that are still largely unexplored?

The 1st SPHERE Space Policy Forum stems from the recognition that these questions cannot be answered solely through technical means. They require the systematic contribution of the social sciences and humanities: international law to build appropriate regulatory frameworks, economics to assess social costs and benefits, ethical philosophy to question our moral obligations, geography to

understand territorial dynamics beyond the atmosphere, politics, sociology and anthropology to anticipate how humanity will organise itself in extraterrestrial habitats. This preparatory document aims to provide participants – speakers, moderators, audience – with a conceptual map of this necessary disciplinary convergence, positioning the Forum as the first step in a multi-year journey that the SPHERE (*Space Policies, Humanities and Exogeographical Research Ecosystem*) Unit of the CISS (*Centre for International and Strategic Studies*) intends to build.

Objectives of the Forum and this preparatory document

The event on 7 November marks the beginning of an annual cycle of forums dedicated to the multidisciplinary analysis of space policies. This first edition has a dual purpose, both operational and strategic. On **an operational level,** this preparatory document offers moderators and speakers a shared analytical framework to guide the debates of the three panels. It identifies key issues that deserve particular attention, suggests thematic links between interventions from different disciplines, and proposes stimulating questions to facilitate interdisciplinary dialogue. The aim is to transform what could be a simple juxtaposition of sectoral expertise into a truly integrated discussion, where engineers and lawyers, astrophysicists and philosophers, planetary scientists and geographers, doctors and anthropologists, computer scientists and political scientists, biologists and sociologists, exogeologists and economists, data scientists and historians, astrobiologists and theologians, telecommunications specialists and media studies experts speak a common language centred on policy making.

On **a strategic level**, this document is also aimed at a wider audience, anticipating the contents of the full report that will be distributed after the Forum. It aims to document how the SPHERE Unit conceives its role as a bridge between STEM and social sciences, what skills it considers necessary for future policy makers, and what vision of space exploration and utilisation it believes should guide Italian and European strategic choices. In this sense, the document is not neutral: it proposes a thesis – the need to move beyond an exclusively technocratic approach – and argues for it, aware that it is contributing to a broader debate on the type of governance that the new space age requires.

The central thesis: multidisciplinary governance as a necessity

The thesis that runs through this preparatory document (and subsequently the Report) can be clearly formulated: the traditional technocratic approach to space governance, although it produced extraordinary successes in the first era of exploration, today shows structural limitations that make it necessary to move beyond it. These limitations do not stem from the inadequacy of STEM skills – which remain essential – but from the intrinsic inability of any single disciplinary perspective to grasp the multidimensional complexity of contemporary challenges.

Consider the paradigmatic case of mega-satellite constellations. Aerospace engineering demonstrates the technical feasibility of deploying thousands of satellites in low orbit to provide global connectivity. But does this technical feasibility exhaust the decision-making framework? Astronomers report increasing interference with the observation of the night sky, which is both a scientific and cultural h l heritage of humanity. Development economists question business models: if access is commercial, do

we risk replicating the terrestrial *digital divide* in space? International lawyers identify regulatory gaps in the regulation of orbital traffic. Technological philosophers raise questions of principle about the privatisation of what the 1967 Treaty defined as 'the province of all mankind'. Exogeographers analyse how low Earth orbit is becoming a contested territory, applying classic geographical categories – territorial control, access to resources, spatial externalities – to a domain that escapes traditional notions of terrestrial sovereignty.

None of these perspectives alone can claim to provide the definitive answer. What is needed is a synthesis – not a mechanical summation of disciplinary opinions, but a true integration that recognises how each dimension (technical, social, regulatory, ethical, environmental) constrains and informs the others. An effective policy maker is not one who favours one dimension over others, but one who knows how to build a thoughtful balance between technical feasibility, social desirability, legal legitimacy and systemic sustainability. This balance cannot emerge spontaneously: it must be built through structured deliberative processes, where representatives of different disciplines learn to translate their specialist languages into a shared vocabulary centred on policies.

Cross-cutting issues: a common thread for the Forum

The **three panels** of the Forum address distinct thematic areas – international space governance, the space economy and innovation, and the future of humanity beyond Earth. However, **five cross-cutting issues** run through all the debates, forming the common thread of the entire day. Identifying them explicitly helps participants recognise recurring patterns and build conceptual bridges between the different sessions.

The **first issue** concerns the balance between national sovereignty and international cooperation. Space is by its very nature a domain that transcends terrestrial boundaries, yet the ability to access it remains asymmetrically distributed among nations. How can the legitimate interests of states – which invest public resources and claim strategic returns – be reconciled with the need to address common challenges that require multilateral coordination? Space debris management, *planetary defence* against potentially dangerous asteroids, the allocation of orbits and radio frequencies: these are problems that no state can solve unilaterally. What institutional architecture can ensure effective cooperation without sacrificing legitimate technological competition and diversity of approaches?

The **second issue** concerns equitable access to the benefits of space. The growing commercialisation of the sector promises efficiency and innovation, but raises questions of distribution. Will *Earth Observation* data, essential for monitoring climate change and managing natural disasters, be accessible to all countries or only to those who can afford it? Will satellite connectivity really reach rural regions in the global South or remain the privilege of solvent markets? Will future asteroid resources benefit humanity as a whole or enrich a few private actors? These questions do not admit simplistic answers. They require rigorous economic analysis of market failures, philosophical reflection and on on the principles of distributive justice, and legal design of redistribution mechanisms that do not stifle innovation.

The **third issue**, of an environmental nature, operates on two levels. On the one hand, space activities have an impact on the Earth's environment: emissions from launches, the production of orbital debris that risks rendering some orbits unusable for generations, and light pollution that compromises astronomical observation. On the other hand, a new dimension of environmental ethics applied to extraterrestrial environments is emerging. Do we have moral obligations towards the Moon or Mars? Does *planetary protection* – the set of protocols to prevent biological contamination – respond to purely scientific reasons (preserving the possibility of studying possible biosignatures) or also to deeper ethical principles of respect for uncontaminated environments? And what responsibilities do we have towards future generations, who will inherit space in the condition in which we leave it?

The **fourth question** concerns decision-making processes and their democratic legitimacy. Who decides the major strategic choices that will define humanity's space future? Today, these decisions are made by a small technocratic and industrial elite, with little public involvement. This model appears increasingly unsustainable as space activities produce consequences that affect society as a whole. How can we build forms of democratic participation that are both technically informed and socially representative? How can we ensure that decisions on billion-pound public investments, shared risks and contested values are not taken out of the public debate and locked away in technical rooms?

Finally, the **fifth question** is educational in nature and directly concerns the role of universities. If multidisciplinary governance is necessary, what skills do we need to develop? What professional profile should a space policy maker in 2030 have? Are universities training experts with the ability to translate between the disciplinary languages required by the sector? Or do we continue to produce vertical specialists incapable of communicating beyond the boundaries of their own disciplines? The Forum will devote **specific attention to this dimension,** recognising the educational role of universities as a strategic lever for shaping the future of space governance.

The skills map: a conceptual architecture

This preparatory document introduces a systematic mapping of the disciplinary skills needed for multidisciplinary space governance. This mapping does not claim to be encyclopaedic in its comprehensiveness, but aims to outline a conceptual architecture that will help policy makers, universities and students navigate the complexity of the disciplinary landscape. The distinction between three categories – traditional evolving STEM competences, established social disciplines applied to space, and emerging socio-humanistic disciplines – is not rigid but heuristic, useful for highlighting how the contribution of each disciplinary area must adapt to the specificities of the space context. The full report, which will be distributed after the Forum, will systematically develop this conceptual architecture with detailed analyses of each skill, case studies of interdisciplinary synergies, and specific training recommendations. STEM skills, while remaining fundamental, are evolving to meet the challenges of New Space. Aerospace engineering increasingly integrates sustainability considerations into system design (*reusability, decommissioning, debris mitigation*). Computer science and artificial intelligence raise new ethical questions when applied to autonomous systems in space. Biotechnology for extraterrestrial environments raises bioethical questions about possible modifications to the human

genome to adapt to radiation or microgravity. These developments show that even the most 'hard' disciplines can no longer ignore the social and ethical implications of their work.

Established social disciplines – international law, economics, political science, international relations, human geography – are developing increasingly sophisticated space applications. Space law addresses regulatory gaps inherited from the treaties of the 1960s. Space economics analyses business models, market failures and environmental externalities. Astropolitics studies strategic rivalries and the dynamics of multilateral cooperation.

Emerging socio-humanistic disciplines represent perhaps the most promising and least explored frontier. Exogeography – a bridging discipline promoted by SPHERE – applies classic geographical categories (territory, border, resources, scale) to extraterrestrial spaces, naturally integrating physical, economic, political, and cultural dimensions. *Space Ethics* questions our moral obligations towards extraterrestrial environments and future generations. Environmental philosophy applied to space rethinks concepts such as planetary *stewardship* and intergenerational justice. Astrosociology studies how micro-societies will organise themselves in isolated habitats. Astroanthropology analyses intercultural dynamics in multinational teams and cultural adaptation processes. Space psychology addresses mental health challenges in long-duration missions. *Space architecture* designs habitats that support well-being as well as survival. *Cultural studies* analyse how media and narratives shape collective imaginaries that influence political consensus and youth vocations.

In addition to these three categories, there are cross-cutting enabling skills that do not belong to individual disciplines but are essential for integrating different contributions: futures studies and scenario planning to anticipate developments, data science for *evidence-based policy making*, *risk assessment* to evaluate systemic vulnerabilities, *science diplomacy* to facilitate multilateral negotiations, *project management* and *systems thinking* to coordinate complex programmes. These methodological skills form the connective tissue that allows translation between specialist languages.

Exogeography as a bridging discipline: an epistemological model for spatial governance

Among the skills mapped in the previous section, exogeography deserves specific attention for the paradigmatic role it can play in the construction of multidisciplinary spatial governance. This emerging discipline, promoted by the SPHERE Unit, is not simply one of many relevant perspectives, but represents an epistemological model particularly suited to embodying the convergence between hard sciences and social sciences and humanities that constitutes the central thesis of this Report.

Academic geography, from which exogeography draws its methodological inspiration, is historically recognised as a bridging discipline between the natural sciences and the humanities. This is not a characteristic exclusive to geography – other disciplines show similar elements of hybridisation – but it can be said that geography is the 'bridging' discipline par excellence in international academic systems and in the Italian university system. It is, in fact, the only subject that has **a dual and distinct formal position** both among the 'hard' sciences (physical geography and its sub-disciplines, included among the Earth or natural sciences) and among the social sciences and humanities (human geography and

its sub-disciplines, in the social sciences), with separate and declared codifications, disciplinary sectors, degree courses and institutions. This dual institutionalisation is not a mere historical accident, but reflects the structural recognition of the intrinsically hybrid nature of the discipline of geography. Physical geography studies terrestrial geomorphological, climatic and hydrological processes using quantitative methods borrowed from Earth sciences. Human geography analyses settlements, migratory flows, territorial organisation and spatial identities using qualitative approaches specific to the social sciences. However, the true heuristic strength of geography lies not in the simple coexistence of these two fields, but in their systematic integration: the territory – the object of geographical study par excellence – is always simultaneously a physical substrate and a social construct, an environmental constraint and a cultural product.

This two-sided epistemological structure makes geography naturally suited to mediating between disciplinary languages that would otherwise find it difficult to communicate. A rigorously trained geographer can read a geological map and interpret it in the light of demographic dynamics. They know how to analyse satellite data on land use and contextualise it in relation to agricultural policies. They know how to model river basins, considering both the physical processes of runoff and social conflicts over the allocation of water resources. This capacity for bidirectional translation – from the language of the natural sciences to that of the social sciences and vice versa – is precisely the skill that the spatial policy makers of the future will need to possess.

Exogeography applies this epistemological model to extraterrestrial spaces, taking the geographical approach beyond the Earth's atmosphere. While planetology and planetary geology – STEM disciplines distinct from geography – study the composition, structure and physical processes of celestial bodies, exogeography analyses them as possible territories for human expansion, with all the implications that the concept of territory entails: symbolic appropriation, demarcation of boundaries, exploitation of resources, construction of identity, exercise of sovereignty. A lunar crater is not only a topographical depression to be studied in terms of its physical genesis (physical geography), but simultaneously a potential site for permanent installations whose location raises questions of accessibility, logistics, commercial value (economic geography) and competitive territorial claims and strategic significance (political geography). The Martian polar caps are analysed by exogeography simultaneously as physical formations in their material composition and as strategic reserves whose control could determine the balance of power between future settlements.

This integrated approach allows exogeography to serve as a natural interface between the STEM skills needed to understand extraterrestrial environments and the socio-humanistic skills needed to govern their use. An exogeographer collaborates with planetary scientists and geologists to map mineral resources, but also consults with economists to assess their extractive l viability and with lawyers to establish their ownership regime. They work with aerospace engineers to identify optimal sites for lunar bases, but consult with sociologists to anticipate social cohesion dynamics in isolated communities and anthropologists to design culturally sensitive housing layouts. They use remote sensing data

interpreted by STEM scientists, but contextualise it in relation to policy objectives formulated by social scientists and politicians.

The exogeographical model demonstrates that effective interdisciplinary dialogue does not necessarily require the creation of new disciplines from scratch, but can emerge from the extension of already established epistemological traditions that inherently possess the dual structure necessary to mediate between otherwise separate fields of knowledge. Earth geography has taken centuries to develop languages, methods and conceptual frameworks capable of integrating physical and human dimensions. Exogeography inherits this methodological heritage and applies it to spatial contexts, thus accelerating the construction of multidisciplinary governance that other monodisciplinary perspectives would find more difficult to achieve.

It is for this reason that SPHERE places exogeography at the centre of its scientific identity: not out of disciplinary parochialism, but because it recognises in this perspective an epistemological laboratory that demonstrates the validity of the geographical model applied to spatial contexts. If exogeography succeeds in systematically integrating the physical and human dimensions into the study of extraterrestrial spaces – as geography has done for centuries on Earth – this approach can become a replicable paradigm for other forms of disciplinary convergence necessary for the multidisciplinary governance of space.

The strategic positioning of LUISS and SPHERE

The Forum inaugurates an ambitious path for LUISS: to position itself as the first Italian university, and among the first in Europe, to have systematised the integration of STEM and social sciences for space policy making. This ambition does not come out of nowhere. The university already has a well-developed educational ecosystem that includes the pioneering teaching of 'Exogeography, Astropolitics and Space Economy', the Master's in Space Economy at the Business School, the Master's in Space Law and Geopolitics at the School of Law and the School of Government, and the Training Course in Space Journalism at the School of Journalism. The SPHERE Unit of the CISS represents the connective tissue that links these disciplinary excellences, creating a platform for dialogue between departments, between generations of scholars, between the academic world and institutional and industrial stakeholders.

This Forum – and this preparatory document, which forms its conceptual framework – aims to signal to the national and European systems LUISS's willingness to play a leading role in training the next generation of space policy makers. It is not a question of claiming academic primacy, but of making a concrete contribution to **bridging an educational gap that risks becoming critical**. As the space sector expands and becomes more complex, there is a growing demand for professionals who are able to navigate between disciplines, translate technical expertise into policy recommendations, balance economic efficiency and social impact, and build consensus on controversial choices. These hybrid figures do not arise spontaneously: they must be trained with intentionally interdisciplinary curricula and h , with teaching methods that emphasise cross-disciplinary teamwork, and with internships that expose students to contexts where STEM and social sciences collaborate.

The model proposed by SPHERE is replicable and scalable. Other Italian and European universities could develop similar initiatives, creating a network of centres specialising in multidisciplinary space governance. This network could become a privileged interlocutor for European (Commission, ESA, Parliament) and national institutions in the formulation of long-term space strategies. The aim is not to monopolise the debate, but to sow seeds of expertise and stimulate virtuous emulation.

This Executive Summary and the full report

This Executive Summary provides the essential conceptual framework for participating profitably in the Forum on 7 November. It presents the central thesis on the need for multidisciplinary governance, identifies the cross-cutting issues that run through the three panels, offers a mapping of relevant disciplinary expertise, and strategically positions the role of LUISS and SPHERE in this emerging field.

The full preparatory report, which will be distributed to participants after the Forum, will explore these issues in greater analytical detail. It will be divided into three complementary parts: Part I ("Context") will analyse the ongoing paradigm shift; Part II ("The Three Pillars of the Forum") will devote a chapter to each panel with the state of the art, key challenges, and stimulating questions to guide future debates; Part III ("Skills and Training") will explore the emerging professional figure of the space governance expert. The Appendices will include a glossary, essential bibliography, and online resources.

A call for collective action

This preparatory document and the subsequent Report are not a point of arrival but a starting point. The analyses and questions they contain are deliberately open-ended, designed to stimulate discussion rather than close it with definitive answers. Multidisciplinary governance is a work in progress, not a codified model to be applied mechanically. It requires experimentation, constructive errors, and iterative learning. The Forum on 7 November represents **a moment in this broader process:** an opportunity to test the effectiveness of interdisciplinary dialogue, to identify communication barriers between disciplines, and to discover unexpected synergies.

We invite moderators to use the cross-cutting issues and disciplinary perspectives outlined here as a flexible repertoire to be adapted to the flow of the discussion. The full post-Forum report will offer further stimulating questions for future exploration. During the Forum, we invite speakers to consider their presentations not as displays of sectoral expertise but as **contributions to a broader dialogue,** actively seeking points of contact with the other disciplines represented. We will invite the audience to actively participate in the interactive Q&A, bringing perspectives and questions that can enrich the discussion. We will invite all stakeholders – institutional, industrial, and academic – t te this Forum as an opportunity to initiate concrete partnerships, identify skills gaps to be filled, and imagine future collaborative projects.

The decisions we make in the coming years regarding space – which missions to fund, which technologies to develop, which standards to adopt, which resources to exploit, which environments to preserve – will determine not only our technological future but the type of civilisation we will become. Will we be able to extend into space the values of cooperation, equity and sustainability that we

proclaim on Earth? Or will we replicate beyond the atmosphere the logic of unbridled competition, predatory exploitation and concentration of power that too often characterise earthly affairs? Multidisciplinary governance does not guarantee virtuous answers, but it creates the conditions for the right questions to be asked, for different perspectives to be heard, and for choices to be as informed as possible about their multiple implications.

The 1st SPHERE Space Policy Forum is a first step – small but deliberate – in this direction. A step that LUISS is taking with the ambition of charting a path that others can follow, in Italy and in Europe. The challenge is complex and will require sustained commitment. But the opportunity is extraordinary: to help shape the future of humanity beyond Earth with the wisdom that only **the integration of all our intellectual traditions** – scientific, humanistic, social – can produce.