Future Uses of Space (FUS): Narrative Evidence for Science & Technology Advantage through linking Research and Policy

SPACE POLICY: AN OVERVIEW OF POLICY QUESTIONS AND SUPPORTING EVIDENCE

This report is designed to provide context for those preparing synthesis papers for the FUS project, and for participants at the workshop. It will also form part of the project's published material. The report conveys perspectives from practitioners and academics with backgrounds in space policy and research (listed at Annex B). The report is structured around the following questions:

1. What are the biggest decisions concerning space policy, in the next ten years?
2. What are the areas of greatest need for evidence, models, and anticipations of the future?
3. What stories are most influential to key existing and emergent collective identities in the relevant fields?

1. What are the biggest decisions concerning space policy, in the next ten years?

Space policy is affected by a range of geopolitical, economic and technological trends and developments. These create a wide range of choices and decisions for policy-makers, and require judgements about framing, risk and uncertainty in the face of multiple potential futures.

1.1 Sovereignty, defence and security

Each nation and major player has to consider **whether and how to ally or partner** in developing strategic capabilities. For example, the war in Ukraine brought this question to the fore in the EU, because the EU was using a Russian launcher based in French Guiana. The UK faces decisions about its own multilateral and global arrangements, for instance deciding whether to seek increased alignment with North America, or to become more independent and risk isolation within a geopolitical arrangement dominated by large blocs.

Policy-makers need also to contend with the **interdependencies created by national or local reliance on globally operating** space-based systems.

There are policy choices about setting **limitations on military uses of space**: Article IV of the UN's Outer Space Treaty restricts military use of space and this remains widely supported: "States Parties to the Treaty undertake not to place in orbit around the earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install such weapons on celestial bodies, or station such weapons in outer space in any other manner. The moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes." But these boundaries can be tested at the margins: WMDs cannot be placed in space, but other weapons might be; while nuclear weapons might be flown through space, without being stationed on a celestial body.

Dual military and civilian uses pose further choices. These might include the extent to which it is practicable or desirable to use the same capabilities for observation in military and civilian - especially perhaps humanitarian - contexts. The dependence of Ukrainian defence on the commercial Starlink communication satellite service gives a different illustration of controversial and apparently unintended dual use.

Policy-makers must consider how to respond to risks to the space sector *and to the sectors and infrastructure that depend upon it* from **cyber attacks**. For example, before it invaded Ukraine, Russia launched an attack on American company Viasat, a commercial satellite communications company on which the Ukrainian military relied for command and control of the country's armed forces. The attack not only resulted in immediate significant loss of communication for the Ukrainian military at the start of the war, but also had wide and perhaps unintended impact on Viasat's capabilities more generally, such as affecting the operation of thousands of wind turbines in Europe.

Space-based **geo-engineering** technologies such as mirrors, umbrellas or atmospheric particulates and aimed at increasing national or global security in the face of climate change, raise further major policy questions about multinational and global governance, responsibility for unintended effects, dual use potential and the balance of risk and benefit.

Every country faces continual decisions about the right levels and types of public sector **investment** in scientific research, technological support, space-based or space-oriented infrastructure and defence.

1.2 Exploration, ownership and governance

Exploration brings new decisions, especially concerning **access, ownership, rights and responsibilities.** Commercial, public, and military objectives may collide. Issues to consider include whether and how to develop frameworks that enable exploitation for resources, or for human access in the future. Some have suggested that deliberation should be informed by notions of colonialism drawing on the experiences of historic exploration and exploitation on Earth.

The idea of outer space as a largely **ungoverned commons** underlies the Outer Space Treaty (1967), which can be considered, on its own terms, to have been a successful attempt to anticipate future governance needs. Decision-makers today need to be able to consider how it needs to evolve and what, if anything, can be applied today from the way it was created 60 years ago. The UN Moon Treaty (1979) establishes a framework of laws belonging to the moon and other celestial bodies, including (in Article 7.1) the requirement that lunar exploration does not disrupt the existing environmental balance, and that the environment of earth is not disrupted through the introduction of extraterrestrial matter. However, in contrast to the Outer Space Treaty, fewer than 20 nations have signed up to the Treaty, and even fewer to the US-initiated The Artemis Accords. This in turn raises fundamental questions about the **future design of effective negotiation and governance structures** at regional bloc and global scales.

As space transitions from being accessible only to a small number of wealthy nation states to something accessible to most nation states and an increasing number of private companies, the notion of it as an ungoverned commons may become less sustainable. Different choices about the basic approach may apply to different elements of space, such as Earth orbits as opposed to outer space.

In earth orbital space increasing levels of use bring the inevitable challenges of potential harm due to collisions or other aspects of operation; and choices about responsibilities with respect to debris and end of life operations. These in turn raise questions about **future regulation that might form, in effect, rules of the road** and which would require policy agreements and regulatory infrastructure. The European Space Agency has adopted a unilateral target of Zero Debris by 2030, but such an approach, and any regulation, inevitably increases the cost of operations and shifts costs between current and future users and between sectors.

2. What are the areas of greatest need for evidence, models, and anticipations of the future?

2.1 General challenges to the provision of evidence and the quality of debate

It is likely that public reasoning about space suffers from a number of challenges that are common to other areas of policy, but that come together sharply with respect to space. Some of the reasoning is about matters that are extremely long term and **highly speculative**, such as terraforming, and human colonisation on other planets, making it harder to establish evidential standards, and harder to sustain public and political interest. **Dual use** technologies and operations complicate access to evidence and to decision-makers as leading edge operations may be militarily sensitive or commercially confidential. The **path dependency of different use**s of space results in different approaches that may then converge in unexpected ways. For example, Innovate UK has an earth imaging strand and a space strand, which can appear disconnected. As is often the case with public reasoning in policy areas associated with new technologies, debate and decision-making may **focus on the (popularly exciting) nature of the technologies,** rather than their social, systemic and political consequences.

More than many such areas of emergent technology, however, space policy suffers from **inconsistent terminology** and lack of standardised definitions, which hamper reasoned debate.

It may also be helpful to note that the evolution of governance with respect to space means there are relatively **few arrangements for public engagemen**t with decision-making, despite the popularity of space as an academic subject and site of public speculation.

2.2 Governance

A set of key questions concerns the development of plausible and well-founded potential models for future governance at national, multinational and global scale and across multiple types of use. Developing these models requires anticipations about geopolitics, power and conflict, technological development, and climate change. In the face of such complexity and competing potential uses, one view is that in recent years **lack of clarity about the purpose and objectives** of different approaches to space has hindered the creation of effective governance frameworks.

One potential source of evidence for reasoning about previously ungoverned spaces, and about access to major commons, would be to draw on **historical analogies**. For example, the signatories to the Antarctic Treaty (1959) committed to leaving Antarctica as a pristine environment for scientific exploration, but this may change as the cost of access lowers. Other potential analogies are the evolution of the laws of the sea and access to the deep oceans, the evolution of governance with respect to cyberspace, and even land-based exploration such as the colonisation of the USA, including the West Coast Gold Rush. Space poses a risk of unregulated and potentially confrontational conflict, where analogies can be made with WWI and its causes involving competition over possessions and colonial expansion. To what extent can historical evidence from the management of these events, and learning about their social and economic consequences, inform space decision making.

2.3 Anticipating technologies and their uptake

Many of the policy questions require the best available evidence on current and potential future technologies and on the likely nature and scale of their uses over time. It is notoriously difficult to anticipate the business models of the future. As the future uses of space are likely, at least in economic terms, to benefit the sectors which depend on them, rather than creating net value on their own terms, such deliberation rapidly becomes particularly difficult to quantify.

For example, satellite-based communications and earth observation capabilities have been transformative and underpin commercial activity and public services (such as those relating to weather and climate) that are essential to society. However, much space exploration is not currently economically justified or justifiable, and judgments about how much to invest depend on other objectives such as research, defence, or long term national positioning.

3. What stories are most influential to key existing and emergent collective identities in the relevant fields?

Sections 1 and 2 describe a very wide range of sectors, and therefore of particularly relevant collective identities. It would be helpful to public reasoning to learn in more detail about the characteristics of reasonably well defined groups such as particular national military players, influential business people and researchers, and the communities closely associated with the evolution and implementation of global and

multinational space law and policy. For example, there may be different narratives and narrative networks associated with the military in different nations and groupings. The entrepreneurs of Surrey Satellites will almost certainly have different collective identities to those expressed in Silicon Valley. Across the public sector, regulators (such as Ofcom) may have different narratives from space agencies (such as the ESA), which may themselves have regulatory functions.

Starting from the narratives rather than the apparent collective identities, it might amongst many others - be helpful to explore narratives around the future of the UN, about the meaning of Mars, about environmental sustainability in Earth orbit, about colonisation and exploitation, about potential future governance, business and social models dependent on future uses of and in space, or about any of the subjects listed in the earlier sections.

Space is an area of public reasoning that takes place against a longstanding tradition of widespread forms of popular fiction, popular non-fictional interest in stories about major new developments from Moon landings to rocket launches, and continued amateur participation in some forms of astronomical observation and/or speculation. Evidence might be usefully gathered about such the nature and influence - changing perhaps over time - of such stories, including science fictional speculations' influence on individual entrepreneurs, on technological development, and on informing public (mis)perception of space (e.g. by making it seem easier to escape Earth's atmosphere than it actually is).

ANNEX A

The Royal Society are currently running a ‘Perspective on Space’ that will look at the current and future applications of science and technology in the context of space, humanity’s role in it, and possible implications on society. The future time frame is longer than FUS: the ‘Perspective’ is looking ahead to 2075, to outline plausible future scenarios based on current trends in space science and technology. It will explore the impact these developments could have on society and what governance systems could be put in place today to prepare for future scenarios.

FUS complements the larger Royal Society exercise, by gathering in particular narrative evidence (from the Humanities and Social Sciences) to inform debate and decision making, and by focusing on policy concerns within the more immediate next ten years. It starts from these immediate policy issues, rather than from longer-term anticipations of the development of the science and technology. Nevertheless, the Royal Society has identified the following areas of focus for their working groups which might usefully provide further context to FUS:

1. Space Robotics
    - Exploring different facilities in space and their uses.
    - Robotic built infrastructure for scientific observations and experiments.
    - Encouraging international collaboration on grand projects.

2. Astrobiology, Synthetic Biology, and the Discovery of Life
- Philosophical and policy considerations around the discovery of life.• What implications would the discovery of life have on the field of biology?
- Will further regulations around interacting with bodies knownto have lifeforms be needed?

3. Space Medicine and Human Life in Space
    - How could we keep people healthy in space; and how to ensurespace medicine research improves life on Earth?
    - How could we cater for a larger and more diverse group of peoplegoing into space?
    - Mechanisms to improve international astronaut medical data sharingto advance the field.

4. Long-term Science Goals and Challenges
    - Whilst space scientific goals up to 2050 are already laid out bymajor space agencies (ESA, NASA), what scientific missions could be on the horizon for 2075?
    - With upcoming Moon missions this decade, what scientific missionscould be done from the Moon, e.g., largescale telescopes built in lunar craters?
    - What big scientific questions can we try to answer bydeveloping new technologies?

5. Commercial Space and Enabling Technologies
    - How to manage and increasingly commercialised sector with agrowing number of private actors.
    - How to ensure growing commercial activity and investment inspace benefits humanity.
    - Exploring the impact of taking traditionally terrestrial industriesoff-planet.
    - What technologies and infrastructure are necessary to enablebroader space activities? • How might these developments be enabled?
    - What policy and innovation environment could developthese technologies?

6. Space Exploration and Utilisation – Policy and Legal
    - This subgroup will primarily focus on contributing their expertiseand perspective on the legal aspect of areas highlighted by other subgroups.
    - The subgroup will take ownership of the topic of lunar governance.

ANNEX B

The policy concerns report is based on a meeting with the project steering group, whose members have backgrounds in space policy, qualitative evidence and academic space research. The meeting addressed the three key questions outlined above, and was held online on 2nd February 2023. The details of participants are as follows:

Name: Professor Duncan Bell
Roles held: Professor of Political Thought and International Relations at the University of Cambridge; British Academy Fellow

Name: Dr Claire Craig
Roles held: Provost of The Queen's College, University of Oxford; former Director of the UK Government Office for Science; co-author of *Storylistening*

Name: Professor Sarah Dillon.
Roles held: Professor of Literature and the Public Humanities, University of Cambridge; co-author of *Storylistening*

Name: Professor Sa'id Mosteshar
Roles held: Director of the London Institute of Space Policy and Law

Name: Dr Alex Tasker
Roles held: Lecturer in Human Ecology, UCL; ESRC Policy Fellow in International Relations and National Security

Name: Dr Graham Turnock
Roles held: Special Advisor at the European Space Agency

Name: Dr Tom Wells
Roles held: Deputy Director at the Government Office for Science