COUNCIL FOR SCIENCE AND TECHNOLOGY

Science Landscape Seminar Reports: Space, Satellites and Astronomy

Background to the meeting

This seminar is one of a series convened by the Council for Science and Technology (CST), which is working to provide a map of the UK Knowledge Landscape as a whole. This mapping includes all areas of research carried out by academia, industry, charities and others.

The seminar series has brought together diverse sets of experts to discuss eight parts of the research landscape in depth; these areas are roughly aligned with the UK government's eight great technologies.

The aim of this work is to provide decision makers with a clearer picture of the whole landscape and enable better strategic decisions to be made. We would also like the reports to prompt communities to think more about what they can do to ensure their areas continue to make the best economic case for themselves and operate in a coherent way. The seminar series is limited in scope, but has revealed the importance of a clear articulation of the strengths and requirements of different parts of the UK research landscape. Specific research communities may wish to hold further sessions of their own.

The discussion took place under the Chatham House rule. This document represents the views of this group and is published alongside an infrastructure document (see below) which reflects the seminar's view of the RAS landscape.

This meeting addressed space, satellites and astronomy research and development, and was asked to consider:

- Strengths and weaknesses of space, satellites and astronomy research in the UK;
- How the UK compares internationally; and
- What future concerns exist for the discipline.

1. Infrastructure list

To seed discussion, attendees were provided with a draft list of infrastructure relevant to Space, Satellites and Astronomy. The list is not exhaustive but does provide a summary of some of the key facilities for Space, Satellites and Astronomy research in the UK. It was updated in the light of discussion at the seminar to include, for instance, the addition of a section on astronautics, a number of research facilities and SMEs. The infrastructure list is available at: www.gov.uk/government/publications/science-landscape-seminar-space-satellites-and-astronomy.

2. Scene setting

Seminar participants, while discussing the infrastructure document, also touched on some key issues surrounding the current status of available space infrastructure. They were:

- The discipline spans ‘traditional’ astronomy and mission launches as well as fields of research that depend on the use of similar knowledge infrastructure, including meteorology, earth observation and aerospace.
- The essential infrastructure includes elements which are used to collect and analyse data, and others used to manufacture the key components that these depend on.
- There needs to be a clear momentum vector for space research. The sector is good at bringing together academia, government and industry to do excellent work, particularly in projects where there are clear plans and a shared vision. Further effectiveness could be achieved if leadership and collaboration could be extended to more areas of space science research and a clear strategic long-term vision developed.

3. Strengths and weaknesses in UK space, satellites and astronomy

Seminar participants identified the following areas of strength:

- The quality of instrumentation such as telescopes, satellites and technology. The UK has consistently produced instruments that are world-class, and have been used in many telescopes around the world as well as in space.
- Earth observation and particularly the collation of observations. Our strengths here span fundamental research and engineering. As a result, the UK has a well-rounded overview of Earth observation that underpins our work in other disciplines such as climate science, meteorology and oceanography.
- The core infrastructure for meteorology, such as satellite capability, data collection and analysis, and modelling are robust and will remain reliable for the next two decades.

Despite these strengths, attendees felt that there were still some key weaknesses which need to be overcome. The gaps identified included:

- Risks associated with instrumentation. While instrumentation is an area of strength, much of the infrastructure available today was built several decades ago, and there has been an over-reliance on it since then. Reductions in funding (both real and effective) over that time have led to a situation where it may become difficult to compete internationally; most of the UK’s contribution to international space research has recently focused on theory rather than the provision of new instruments.
- Difficulties in obtaining funding at an early stage of developing infrastructure may lead to future weaknesses. There is sometimes a funding gap at the boundary between the conceptual and development stages of a project.
- Funding bodies and the processes they follow need to be as flexible as possible and able to respond to rapid scientific and technological innovations.

Smaller funding platforms that can quickly react to fast changes may be a more effective option to have as an addition to larger funding bodies.

- There is a need to think carefully about how funding is allocated to space, satellites and astronomy research and how available funds might be spent to best effect. Funders should work more collaboratively and take into account that some projects take longer to deliver results.
- The UK needs to make improvements to its current launch capabilities, as well as exploring how it can develop a national launch capability to keep up with the growing numbers of satellites.

4. Skills

Some key observations were made in relation to the state of skills in the UK for space, satellite and astronomy research:

- While the number of STEM graduates in the UK is going up, they are sometimes viewed as weaker than their European counterparts. The UK is a world leader in terms of academic research, but British students may be at a disadvantage in comparison with European graduates; the latter are often perceived as more experienced and therefore more employable. This may be due to a greater tendency by European graduates to seek study and work experience in multiple countries.

- A rigorous background in physical and mathematical sciences and engineering is vital to the space industry. Employers need to articulate and clarify the space-related job opportunities available to graduates in these fields more effectively.
- There are courses and modules which are essential if a graduate is to be effective in the space industry. For example, it is necessary to have a critical mass of people who have been taught and trained in instrumentation usage. The ideal curriculum is a firm basis in rigorous general courses followed by more specific and tailored modules which include sufficient practical experience as well as theory. Masters' courses may fill a valuable role in providing the latter.

5. International comparisons

Seminar participants compared the strength of the UK space infrastructure to that in other countries. They noted that:

- The UK is a world leading in academic research, and has made strong contributions to, and helped shape the agenda in, key European projects as well as the European Space Agency (ESA).
- The UK needs a vibrant SME community, as these firms can move quickly and respond to rapid change more readily.
- The regulatory environment may be hindering efforts to attract companies to the UK. The US seems to be less burdened by licencing and insurance restrictions, producing an environment more conducive to research and development and commercial rollout.

- In comparison to other countries, the UK contributes well to the development of smaller projects. This may come at the expense of larger projects, which are sometimes perceived to have lower profits and be higher risk, as well as providing fewer opportunities for repeat business.

Seminar participants offered suggestions to improve the UK’s international standing in space, satellites and astronomy:

- The UK should attempt one mission launch per year at US$20,000 per kilogram launched. Launches by the UK would help improve its reputation as a key player in space research.
- Consideration should be given to developing satellites that can be deployed from space stations which are a cost-effective alternative to ground-launched satellites. Launching regular payloads of cargo containing equipment (“buses”) for structures in orbit would also help to decrease costs as well as increase overall UK space activity.

6. Future developments, issues and appropriate regulation

Seminar participants discussed future scenarios in areas related to space infrastructure and high-altitude aeronautics. They agreed that:

- The UK may be behind in terms of research and development for unmanned aerial vehicles (UAVs), where development is currently driven largely by military rather than civilian needs. While Britain seems to excel in niche areas related to high-altitude long-endurance flight, expansion to civilian usage remains underdeveloped. Effective usage of civilian UAVs can and should complement satellite-based technology to maximise the number of observations and data we collect. There are current efforts to develop civilian UAV technology, but future legislation is needed to ensure appropriate regulation of this developing area.
- Any future developments in orbiting infrastructure should take into account the prospect of overcrowding and space debris. There is a growing challenge that greater regulation will be needed to ensure that new satellites can be safely launched and maintained in orbit without risk of collision. This will have to be addressed through the regulatory system rather than simply through improved technology.
- Development of technology opens the prospect of information technology from space. This includes concepts such as a global internet and more extensive cloud computing. However, the risk of cybercrime will continue to be an issue.
- The use of space robotics should be looked at as a way to harness the potential for manufacture and industry in space. Concepts such as mining in space may become a possibility in the future.
- With a growing range of both government space agencies and commercial groups, there is a growing need to co-ordinate and standardise activities in space.

This publication available from www.gov.uk/cst

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