THE UNIVERSITY OF OXFORD

The University of Oxford has a wide range of satellite and space-related activities including research, education, knowledge exchange and commercialisation. The Atmospheric, Oceanic and Planetary Physics sub-department has been building space instrumentation since 1970; Oxford-built instrumentation has been launched on at least 15 spacecraft, in Earth orbit and beyond to the Moon, Mars and Saturn. The Astrophysics sub-department has played major roles in definition and exploitation of space-based observatories, and in developing technologies for future ones; they are also pioneering “big data” and citizen science approaches of relevance to space applications. The Department of Engineering Science has been investigating satellite drag and hypersonic entry vehicles since the 1970s; Oxford IP is in rocket engines and Oxford-built coolers are in orbit around the Earth. In the Department of Earth Sciences, researchers are world-leading experts in satellite study of tectonic and volcanic activity; also, through geochemistry they are investigating topics as fundamental as the formation and evolution of the solar system. Geography researchers use a wealth of earth observation system mapping for remote sensing of land use; they also use space data in the assessment of climate change and are pioneering use of space data for societal change, e.g. weather apps for farmers in sub-Saharan Africa. The University has recently invested in a Space Research Network to coordinate activity in space research, which it sees as an important area for growth both in research and training, both across the University and in collaboration with the Harwell Campus.

EXECUTIVE SUMMARY

0.1 The University of Oxford is supportive of ongoing Government funding and enabling of all core satellite technologies (earth observation, communications and positioning systems), and their applications.

0.2 The widespread application of earth observation, underpinning importance of space science as well as enabling investments in satellite navigation systems and other satellite technologies are of particular importance.

0.3 Sustained funding for basic research into space technologies can be difficult to secure in the UK, as it falls between the remit of EPSRC, NERC, STFC, and UKSA. Increased clarity in this area would produce not only gains in scientific knowledge and commercial applications, but would also help to secure EU and ESA funding for technology development.

0.4 Our view is that increased funding of national UK programmes is essential in order to support leadership in European/International endeavour; establishment of a programme of regular launches whether at the cubesat level (e.g. UKube-1) or microsat level (TechDemoSat-1) would greatly enhance the UK’s ability to compete at an international level.
Insurance and regulatory issues still present major barriers for new space players, in particular for Cubesat and small satellite projects. Action by UKSA to simplify this process would increase participation by universities and SMEs, leading to more innovation.

SUBMISSION

Q1: What satellite-based capabilities should the Government particularly support — telecommunications, navigation, earth observation, space science, or others — and how?

1.1 Researchers at the University of Oxford conduct a wide range of programmes of research focussed on both the upstream technologies which form the components of satellites and those that make use of the downstream data which is generated or transmitted by satellites, whether this be data about the earth or the universe around us. The University is therefore supportive of Government funding and activity in these areas.

1.2 Earth Observation (EO) is a key growth area. It enables a wide range of scientific studies from tectonics and volcanology, through climate change, hydrology and forestry to archaeology and transport systems. It is also essential to understanding the global challenges of climate change and its impacts, man-made developments such as urbanisation and transport systems and even our history and culture. ESA’s Copernicus programme will provide an array of EO products in near-real-time, opening up many opportunities for commercial exploitation and economic growth.

1.3 Space science, which enables our understanding of the universe from its origins to its future, including the variety of stars, planets and other bodies and the processes, is both a key area for development of new space technologies but also vitally important for inspiring a new generation to get involved in science, technology engineering and maths (STEM) subjects. There is great potential for UK leadership in this area: indeed, a disproportionate number of proposals to ESA’s space science programme are led by British researchers. However, the UK’s potential is being held back by a lack of funding in this area, at all levels from basic technology development, to proposal preparation support, to commitment for large projects. Further specific comments are made below in answer to question 4.

1.4 The application of positioning systems is a crucial component for the emerging research and application of autonomous vehicles operating across a range of modes (e.g. land-based, airborne, space-based) and environments (e.g. in vacuo or in dangerous contexts) as well as enabling the monitoring of, for example, fishing vessels in studying biodiversity impacts of fishing, migratory birds to understand their behaviours or tracking consumer behaviour through mobile phone positioning analysis.

1.5 Given the significant UK strengths in satellite technology, scientific research and the growth of commercial exploitation of downstream services, an integrated approach to supporting
development is important. It is therefore important that funding be provided through European and national programmes for both research and innovation. The National Space Technology Programme does not provide a mechanism for sustained research into fundamental space technologies. The NSTP Core Programme funds only at 50% of cost, which is insufficient to support fundamental research programmes from which future technologies will emerge. The UK community is very competitive but without crucial funding we certainly lag behind our European colleagues.

1.6 Additional support for the space and satellite sector through the transfer of technology from different sectors and application areas to facilitate greater innovation and enable the UK to stay at the forefront of satellite technology.

Q2: What steps should the Government be taking to build markets for both new satellites and the ‘space services’ that they provide (such as space-based internet services or high resolution imaging)?

2.1 The government has a key role to play in the procurement and use of satellite services. This can include a range of applications from emergency response to environmental management. There is an opportunity to work with researchers and businesses to develop solutions that will draw upon the latest science and stimulate commercial market development.

2.2 Within this context, it will be important for Government to remain open to new, disruptive technologies as well as incumbent solutions. This requires close working with innovation agencies such as Innovate UK and the Catapults, who can all advise on emerging possibilities, along with academic research groups which may be developing new solutions.

Q3: What is the impact of the current UK regulatory environment on growth in the satellites and space sector? Is it conducive to new players, such as SMEs and start-ups, entering the market? Has the regulatory environment kept pace with innovations in satellite/space technologies?

3.1 We understand that the regulatory environment for the satellite sector has improved in recent years with the limiting of insurance and indemnity requirements and that continued simplification and acceleration of processes both for commercial and research projects is important. This is particularly the case for small satellites where there is significant potential for innovation.

Q4: What mechanisms are needed to encourage investment in UK space and satellite technology, and improve access to finance?

4.1 The early stage funding of space and satellite technology to take research ideas into the development of prototype and demonstration systems is difficult to pull together as it fits between EPSRC which may fund underpinning technology research, STFC and NERC which funds space and environmental science, and the UKSA. This is also the case for small scale missions where it unclear for researchers as to how to gain the necessary funding. An overarching
approach from Research Councils, Innovate UK and in collaboration with ESA, which looked to develop an effective ecosystem of funding would therefore be beneficial.

4.2 Access to seed funding, venture capital, inward investment mechanisms and the appropriate use of brokerage and incubation facilities are also vital to securing effective financing for satellite technology.

4.3 A successful model of funding is provided by the Centre for Earth Observation Instrumentation’s Space Technology (CEOI-ST) funding programme. This is run by a consortium of industry, government and academia (Airbus Space, RALSpace and the University of Leicester) and issues research contracts for space technology development. Advantages of this funding model are that it has frequent funding calls, has a rapid response time, and makes industry/academia partnerships simpler than would be the case for research council grants. Expanding this funding model to more areas of space technology development, including space science, would be beneficial.

4.4 While the CEOI-ST funding model offers quick, responsive funding for projects of up to 12 months in duration, funding with longer time-scales is needed to establish long-term research on underpinning technologies. It is difficult to build up a lab and/or hire research assistants and doctoral students on grants of 12 months or less. Support can be sought from existing Research Council funding lines, but they can be reluctant to fund technology development if they feel it is under the remit of UKSA. Increased co-ordination between UKSA and the research councils in the implementation of the NSTP is needed to resolve these points.

Q5: Is the Government striking the right balance between national and European/international endeavour?

5.1 The UK Space Agency is currently focussed on access to space through the European Space Agency. We support this strategy: it gives access to world-leading, high-profile projects. This is an appropriate way to be involved in flagship projects, the response time is long and ignores the growth potential of small satellite projects and applications.

5.2 The UK Space Agency does not currently have a mechanism for participation in bilateral projects with other space agencies, whether with NASA or with emerging space nations such as India or China, meaning that the UK is missing many valuable opportunities.

5.3 Opportunities for UK leadership in international programmes (such as ESA programmes) are being held back by a lack of opportunities to demonstrate new technologies. A national programme of small-sat / cubesat launches such as the recent TechDemoSat-1 / UKube-1 satellites would be highly beneficial to obtain in-space demonstration capabilities. A regular programme of launches would provide a mechanism for maturing and validating UK technology developments, which would be vital for increasing UK-led participation in future European and international programmes. This would also provide invaluable opportunities for University students and young professionals, vital for providing training new entrants to the space sector.
5.4 UK researchers and industry are in general highly successful at securing space funding from ESA and the EU. This provides valuable funding for maturing projects at medium TRL (Technology Readiness Levels), however, it does not in general fund underpinning research for technologies at low TRL. A modest increase in UK funding of underpinning space technologies would help to secure an increased return in the form of ESA and EU funding.

Q6: What are the key challenges facing the Government and industry in developing and implementing new space capabilities and services? What are the technical barriers to further growth in the sector, including the lack of a UK launch capacity?

6.1 From a research perspective, an important challenge faced by government and industry is the need to rapidly take up new technologies and solutions, working with researchers. This requires understanding and accommodation of different timescales and approaches to technology and solution development and therefore a very collaborative environment is needed.

6.2 UK Space Agency assistance in securing launch slots for small satellites, whether as auxiliary payloads or in constellation launches, would enable growth in this sector. We would support the development of a sovereign UK launch capability once this is shown to be economically viable.

6.3 Insurance and regulatory issues still present major barriers for new space players, in particular for Cubesat and small satellite projects. Action by UKSA to simplify this process would increase participation by universities and SMEs, leading to more innovation.

6.4 Increased training in the satellite sector is vital for continued development of skilled workers in the sector. Establishment of multidisciplinary Doctoral Training Centres in the fields of Satellite Technology and Satellite Applications would spur growth in this area.