The House of Commons Science and Technology Committee Call for evidence:

UK Space Strategy and UK Satellite Infrastructure[1]

UK Computing Research Committee (UKCRC)

The UK CRC is an Expert Panel of all three UK Professional Bodies in Computing: the British Computer Society (BCS), the Institution of Engineering and Technology (IET), and the Council of Professors and Heads of Computing (CPHC). It was formed in November 2000 as a policy committee for computing research in the UK. Members of UKCRC are leading researchers who each have an established international reputation in computing. Our response thus covers UK research in computing, which is internationally strong and vigorous, and a major national asset. This response has been prepared after a widespread consultation amongst the membership of UKCRC and, as such, is an independent response on behalf of UKCRC and does not necessarily reflect the official opinion or position of the BCS or the IET.

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Responses:

Question 1: What are the prospects for the UK's global position as a space nation, individually and through international partnerships.

[1.1] There is huge potential to build on existing strengths across the UK space industry – however, post Brexit there is a need to refocus and reinforce the innovative work that is taking place across research and industry.

[1.2] Many of the most exciting prospects, across sensing and in-orbit infrastructure delivery, stem from University spinouts which often struggle to find the investment needed to bring those innovations to market.

[1.3] The UK has, in the past hosted core technologies, that provide the foundations for many European projects. However, key staff and operations have been relocated outside of the UK as a side effect of Brexit.

[1.4] The UK Space Agency has been rejuvenated in recent years and has responded to these challenges – for instance, working with InnovateUK and the Catapult network.

[1.5] However, there is a need to rejuvenate the 2015 National Space Policy[2] in a manner that avoids the needless duplication of research and innovation where cooperation may

[1] https://committees.parliament.uk/call-for-evidence/459/uk-space-strategy-and-uk-satellite-infrastructure/

[2] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/484865/NSP_-_Final.pdf

enable us to tackle larger scale problems – for example within the framework of ARIA and recognising the growth in UK MoD Space capability.

[1.6] Such a review should also outline the national space strategy within the context of the integrated review of Security, Defence, Development and Foreign Policy[3].

[1.7] It should explain our approach to leveraging UK innovation in the wider context of strategic international partnerships post-Brexit; recognising the growing range of opportunities to work with more and more countries that are investing in space capability.

Question 2: What are the strengths and weaknesses of the current UK space sector and research and innovation base.

[2.1] The UK has strong expertise across many application areas. The UK Space Weather community provides a specific example covered in more detail by the UK Space Weather Community's recent submission to the House of Lords Risk Assessment and Risk Planning Committee.

[2.2] Innovation is, typically, driven by SMEs, typically, spun out from UK research groups.

[2.3] These companies often focus in particular areas – such as quantum optics, benefitting from the wider UK R&D landscape, in this instance working with teams in NPL.

[2.4] Innovation tends to be focussed on the lower levels of technology readiness – up to In-Orbit-Demonstrations (IoD).

[2.5] These innovations are built using world-leading development techniques. The UK has a reputation for maximising results with extremely low budgets against challenging timescales; often built upon CubeSat infrastructures.

[2.6] Our achievements have been recognised by world leaders – including SpaceX, NASA and the USAF who frequently recruit talent from UK Universities; especially within the software development programmes associated with space missions.

[2.7] The fact that so many UK engineers have chosen to move abroad, from the 1970s to the present day, illustrates systemic weaknesses that stem from a lack of sustained funding and a lack of commitment to the national space strategy.

Question 3: What lessons can be learned from the successes and failures of previous space strategies for the UK and the space strategies of other countries.

[3] https://www.gov.uk/government/publications/global-britain-in-a-competitive-age-the-integrated-review-of-security-defence-development-and-foreign-policy

[3.1] As mentioned in the answer to Question 2, the UK "punches well above its weight" at lower TRLs.

[3.2] Significant concerns remain about how best to translate IoDs into sustained commercial offerings, including those needed to support emerging national critical infrastructures or those to which we may be denied access after Brexit.

[3.3] If this translation is not addressed then it seems likely that our best engineering practices and our application innovations will continue to leak abroad with the young engineers who developed them.

Question 4: What should be the aims and focus of a new UK Space Strategy, including considerations of:

- **technology.**
- **skills and diversity.**
- **research funding, investment and economic growth.**
- **industry.**
- **civil and defence applications.**
- **international considerations and partnerships.**
- **place.**
- **current regulatory and legislative frameworks and impact on UK launch potential.**
- **impacts of low Earth orbit satellites on research activities.**

[4.1] The UK suffered for a long time under a legislative framework that created significant potential liabilities for space operations [4].

[4.2] The development of the UK industry was further complicated by the difficulty in interpreting how existing legislation related to space operations, ranging from airworthiness requirements through to range control.

[4.3] Many of these concerns have been addressed through the Space Industry Act, 2018 although much remains to be done to realise the ambitions that motivated its passage[5].

[4.4] More needs to be done to clarify regulatory responsibilities, especially in regard to safety and security, as well as the consequent relationships between regulators and those bodies responsible for the promotion of space enterprise (including but not limited to the UK Space Agency, BEIS and DfT).

[4.5] One significant strength of the Space industries is that core underlying technologies are distributed across the UK. Although there are clear hubs, such as Surrey, they are supported by other centres of innovation – including the work in Cardiff and Belfast on materials and innovative manufacturing, with operational facilities in development at several sites in England and Scotland. Hence, the promotion of UK space industries is

[4] http://www.dcs.gla.ac.uk/~johnson/papers/Space/SpaceAccidents2.pdf

[5] https://www.gov.uk/government/publications/launch-uk-space-industry-act-legislation-and-regulation-industry-plenary-session-june-2019

an ideal means of realising the 'place agenda' as well as achieving the aims in the integrated review towards 'Global Britain'.

[4.6] Space technology is by definition "dual use". There are very few civilian technologies that could not be turned to military uses and vice versa. It is, therefore, essential that the Space Agency supports the work of CPNI and UKRI in developing and promoting "responsible innovation" and trusted research[6]. There is strong evidence of interest in UK space technologies from countries that do not share the values espoused in the integrated review.

Question 5: What needs to be done to ensure the UK has appropriate, resilient and future-proofed space and satellite infrastructure for applications including:

- **navigation systems.**
- **weather forecasting.**
- **earth observation including climate change; and**
- **communication (including broadband).**

[5.1] Resilience engineering is one of the areas in which the UK is a recognised world leader, especially as it relates to software development. UK engineers and scientists occupy leading positions across Europe and North America.

[5.2] However, as noted above, the difficulty of progressing from IoDs to more sustained commercial services means that the majority of University researchers working on the reliability of space infrastructures do not remain in the UK.

[5.3] Specifically for navigation systems, the growing range of physical threats, including but not limited to debris, and the cyber concerns means that the UK should develop a diverse range of alternatives to existing forms of space-based location and timing systems.

[5.4] Existing space-based navigation and timing systems remain a very significant concern as a common point of failure across many diverse infrastructures[7].

[5.5] Satellite Based Augmentation Systems mean that we are more reliant on these infrastructures than ever before, and we encourage government to act now to address the potential impact of any compromise affecting these technologies in both civil and military domains – following the approach recommended in the integrated review.

[5.6] Not only are satellite infrastructures critical for the sensing capability that enhanced our understanding of the impact of climate change – there is also a concern that climate change will undermine many of the applications that rely on satellite infrastructures. For example, machine learning algorithms that use meteorological satellite data will need to be re-trained if they are to predict evolving patterns of weather.

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[6] https://www.cpni.gov.uk/trusted-research-guidance-academia

[7] https://www.raeng.org.uk/publications/reports/global-navigation-space-systems