IOP Institute of Physics

Satellites and space

Institute of Physics response to a House of Commons Science and Technology Select Committee inquiry

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Response to the House of Commons Science and Technology Select Committee inquiry into satellites and space

1. The Institute of Physics (IOP) is a leading scientific society. We are a charitable organisation with a worldwide membership of more than 50,000, working together to advance physics education, research and application. We engage with policymakers and the general public to develop awareness and understanding of the value of physics and, through IOP Publishing, we are world leaders in professional scientific communications.

2. The IOP welcomes the opportunity to respond to the Committee's inquiry into satellites and space. The UK space sector is an important and growing sector, world-leading in some areas, and provides many good examples of university-business collaboration.

3. The main points we make in response to the inquiry are that:

- All stages of the technology process and all stakeholders must be taken into account when decisions are made regarding priority investment areas.
- There are many potential areas of growth in the space sector, and a full market survey of the sector would be a good place to identify those that are most promising.
- SMEs will be a big part of any potential future growth, and further financial incentives would help stimulate new SME development.
- Research councils, whose work is vital to the emergence of new technologies and the future growth of the sector, are under significant financial pressure.
- The future supply of a STEM-skilled workforce is essential and existing Government programmes aimed at increasing the uptake of STEM subjects and the progression of students in STEM subjects in schools must be enhanced.

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

4. Decisions made on which areas of research and which technologies to invest in need to take account, as far as is possible, of the full technological process – from initial idea and basic research through to the final product - and the full ecosystem of any

technology's possible end uses. Developing investment policy in ignorance of any of these factors or possible stakeholders could serve to undermine its success. The Government should ensure that all investment decisions of which research areas and satellite technologies to support are made in close consultation with those working in research and in industry, and with all other relevant stakeholders.

5. The products that the space sector produces, particularly in satellite-based technologies, are of national importance to UK technology and to Government policy priorities. A range of advancing technologies are needed to support the work of most Government departments, including defence, security and border issues, humanitarian assistance and climate change monitoring, the provision of high speed internet and surveying for the Rural Payments Agency.

6. Many of the Government's policy objectives, for example, require the support of earth observing services programmes. The Natural Environment Research Council (NERC) performs important work in providing data to solve contemporary environmental challenges including climate change and water quality management through the National Centre for Earth Observation (NCEO)[1] and through its data centres (in collaboration with STFC), including in solar and space physics.[2]

7. The domestic space sector is also of importance to the UK economy, contributing £4.8bn in GVA to the UK economy and supports over 100,000 jobs.[3] Products and technologies developed within the space sector are used in industries beyond the sector itself in everything from healthcare, such as MRI scanners, to energy, including solar panels. It is vital to recognise the role of underpinning research at lower Technology Readiness Levels[4] (TRL 1-3) in supporting such space and satellite technologies, particularly for 'future-proofing' our nation. Without adequate long term investment in research universities, many of the instruments at TRL 5 and higher being supported by the UK Space Agency and developed by satellite

[1] National Centre for Earth Observation: http://www.nceo.ac.uk/
[2] Natural Environment Research Council - *Data Centres*: http://www.nerc.ac.uk/research/sites/data/#f1
[3] UK Space Agency - *The Size & Health of the UK Space Industry* (2014): https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/363904/SandH2014final2.pdf
[4] Technology Readiness Levels (TRL) are a means of estimating the level of technology maturity of a program during the acquisition process. They also enable consistency in comparisons of technical maturity across different types of technology. The TRL scale runs from 1 to 9 with 9 being the most mature technology.

companies would not have been achieved. It is essential therefore that a longer term vision is maintained by investing adequately at the low TRL level so that future new technologies may be developed in the UK, maintaining the income to the UK and employment in this sector.

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)?

8. In the UK, broadcasting and telecommunications currently account for 80% of the space sector.[5] Globally, satellite services (predominantly broadcasting and telecommunications) account for 38% of the space industry.[6] Telecommunications and broadcasting have provided a significant contribution to the UK economy, dominated by a few larger players. The UK Space Agency acknowledges that the target set in the Innovation and Growth Strategy in 2010[7] of the UK accounting for £40bn of global revenue from the space sector by 2030 (from 6.5% to 10% as a share of global revenue) "is unlikely to be achieved by the current space industry members alone as broadcasting is unlikely to be able to deliver the growth needed".[8][9] As such, there are large opportunities for growth in other areas of the sector, which will be needed to ensure the sector itself can grow. The Government should conduct a full market survey of current satellite capabilities, providers and users, and across all spectral bands to determine which areas present the best opportunities to stimulate further sector growth in the next five years.

9. Meeting the 2030 target will require stimulating the growth of a more diverse market, including encouraging and incentivising the growth of new SMEs into the space sector. The Government should look to build upon the recommendations in the Space Innovation and Growth Strategy 2014-2030 aimed at reducing complexity in regulations for SMEs and supporting them with access to finance. The Government should create a separate area of funding to provide financial support for new SMEs

[5] UK Space Agency (2014)
[6] Satellite Industry Association - *State of the Satellite Industry Report* (2015): http://www.sia.org/wp-content/uploads/2015/06/Mktg15-SSIR-2015-FINAL-Compressed.pdf
[7] Space IGS - *A UK Space Innovation and Growth Strategy 2010 to 2030*: https://www.nottingham.ac.uk/grace/documents/resources/marketreports/spaceigsexecsumandrec.pdf
[8] UK Space Agency (2014)
[9] Revenue from the UK space sector in 2012/2013 was £10.6bn (at 2010/2011 prices). Growth in the sector was 7.3% from 2013 – 2015 and sectoral growth would need to be at least 8.1% each year to meet the 2030 target.

to enter the sector. This budget should be administered as part of and alongside the existing work to support SMEs collectively performed by the Satellite Applications Catapult, UK Space Agency, UK Trade and Investment, Innovate UK, the Knowledge Transfer Network (KTN) and UK Export Finance.

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?

10. The UK space sector is perhaps better placed than other markets by virtue of the fact that there are strategies in place with targets of growth in the market. The UK Space Agency has published a space growth action plan which aims to reach a target of the UK constituting 10% of the global space economy by 2030.[10] The Space Innovation and Growth Strategy 2014-30 also sets out a number of actions that should be taken to achieve growth in the sector. These actions, when implemented - including simplifying the regulatory environment and finance for SMEs in the sector, analysing the existing contribution the space sector makes to the economy and establishing a National Space Growth Programme which prioritises opportunities for bi-lateral cooperation - will certainly help to improve the current regulatory environment.

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

11. A strong and secure research base is of vital importance to the future sustainability and growth of the UK space and satellites sector. In last year's Spending Review the Government announced real terms protection of the science budget until 2020.[11]

12. However, due to the science budget falling in real terms during the last Parliament there are many areas of research, including those relevant to the space sector, which are under significant financial pressure. Research councils already report that they are not able to run capital projects at full capacity and there is a risk that vital work to underpin and translate developments to support the space sector will go unfunded. In addition, with further budgets pulled inside the ring fence, spending on basic research, crucial for underpinning technological innovation in the space sector, has

[10] Space IGS - *Space Innovation and Growth Strategy 2014-2030*: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/298362/igs-action-plan.pdf
[11] HM Government - *Spending Review and Autumn Statement 2015*: https://www.gov.uk/government/topical-events/autumn-statement-and-spending-review-2015

seen reduced spending. The inclusion in the science budget of the £500m "Global Challenges Fund" may also put pressure on existing work. However there are opportunities here as well, and the Space Innovation and Growth Strategy 2014-2030 includes the action to "promote the use of space to achieve overseas aid and other UK policy objectives".

13. The Government should commit to provide the necessary funding required to the research councils in order for them to meet all expected costs during the next parliament, including resource and subscriptions, and so that they are able to continue to support a full programme of excellent research.

14. The Government makes commitments in its National Space Policy to continue in its "efforts to increase the supply of a skilled workforce on which the space sector depends".[12] This must be a priority. Businesses in all sectors report shortages in STEM-skilled employees; the Social Mobility Foundation calculates that there is an existing shortage of 40,000 STEM graduates required to meet demand.[13] To meet this demand will require a long-term investment in skills in students from school through to university, and also throughout people's careers through adult retraining and learning. The Government should maintain support for programmes to increase the uptake of STEM subjects and the progression of students in STEM subjects in schools and colleges. It should ensure that **all** UK secondary schools have trained physics teachers in place by 2020.

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

15. There is not necessarily a conflict between national and international endeavour. For example, the European Space Agency does not preclude the Government acting unilaterally or creating bilateral agreements.

16. Working with the ESA often complements UK-based capacity. The UK Government spends around £400m a year through the UK Space Agency (with around £300m of this on work with ESA, £60-70m committed nationally in complementary projects and

[12] HM Government – *National Space Policy* (2015): https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/484865/NSP_-_Final.pdf

[13] Social Mobility Foundation – *In the balance: The STEM human capital crunch* (2013): http://www.smf.co.uk/wp-content/uploads/2013/03/Publication-In-The-Balance-The-STEM-human-capital-crunch.pdf

£30m to EUMETSAT through the Met Office). ESA projects bring about a favourable return on investment, of up to £10 for every £1 invested. The principle of *juste retour* guarantees each participating nation, at a minimum, a share of ESA contracts in proportion to the financial input the nation makes, allowing them to support domestic research and innovation. In 2013 the "return coefficient" for the UK was 0.99.[14] The UK also hosts a major ESA facility, the European Centre for Space Applications and Telecommunications (ECSAT) at Harwell, which opened in 2009.[15]

17. The Government invests in excellent research in the space sector through the UK research councils. This investment has seen a return in world-leading and internationally excellent research in areas from climate science to optics, much of which has brought about a significant return to the economy in terms of GVA and jobs.[16] There is room to build on this success and for the Government to diversify its investment in space research. Funding for the UK Space Agency, including ESA, sits within the science budget and subscription costs to ESA are likely to grow in the coming parliament as it increases its schedule of activity (the total ESA budget rose from €4433m in 2015 to €5250m in 2016), placing increased pressure on other budget areas. Whilst the Government should maintain its investment in international collaborations including ESA, this should not come at the expense of investment in UK-based research. UK-based research supports growth of the UK space sector and space programme. Existing national areas of research excellence in turn allow the UK to gain full benefits from ESA collaborations.

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?

18. Among the key challenges for the Government and industry in developing and implementing new space capabilities and services are:

- A lack of government investment in underpinning or basic research compared to competitor countries. A lack of investment at this stage in the technology development process means that the UK potentially misses out on numerous

[14] European Space Agency – *ESA Annual Report 2013*: http://www.esa.int/About_Us/ESA_Publications/ESA_Publications_Annual_Report/ESA_Annual_Report_2013
[15] European Centre for Space Applications and Telecommunications: http://www.esa.int/About_Us/Welcome_to_ESA/ECSAT
[16] Institute of Physics – *Inspirational Physics for a Modern Economy* (2015): http://www.iop.org/publications/iop/2015/file_65903.pdf

opportunities to build intellectual capital that can be exploited later on and turned into all manner of future services and products.

- Lower levels of investment in total R&D. The UK spends only 1.7% of GDP on research and development, with public R&D investment at only 0.5%. In contrast, the OECD average is 2.4% and the G7 average is 2.3%. The UK already performs very efficiently despite its underinvestment in R&D - from 0.9% of the world's population the UK contributes 15.9% of the world's most highly-cited papers. But there is little scope for further efficiencies. To grow sectors including the space sector, more investment in R&D will be required, from both public and private sources. Recently, the Science and Technology Committee and the Business, Innovation and Skills Committee both called for the Government to aim towards increasing levels of total R&D spend in the UK to 3.0%[17][18], meeting an EU target set for 2020.
- A shortage in available STEM-skilled employees. In order for businesses to expand and diversify, and for the space sector to grow, it will need new talent and new ideas, as well as a steady flow of skilled employees to meet current demand and to replace those that leave the industry. The predicted 40,000 or so graduates needed to meet demand is challenge in two ways – the Government needs to do more to attract UK students into STEM degrees and STEM career pathways, but it also needs to do more to retain those in the industry, and attract talented STEM-skilled graduates in a high competitive international employment market.

[17] House of Commons Science and Technology Committee - *The science budget* (2015): http://www.publications.parliament.uk/pa/cm201516/cmselect/cmsctech/340/340.pdf
[18] House of Commons Business, Innovation and Skills Committee - *The Government's Productivity Plan* (2015): http://www.publications.parliament.uk/pa/cm201516/cmselect/cmbis/466/466.pdf