

Science and Technology Committee

Oral evidence: [Satellites and space](#), HC 804

Tuesday 15 March 2016

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Written evidence from witnesses:

- [UK Space Agency](#)
- [Ordnance Survey](#)

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Members present: Nicola Blackwood (Chair); Jim Dowd; Chris Green; Carol Monaghan; Derek Thomas

Questions 159-219

Witnesses: **Joseph Johnson MP**, Minister for Universities and Science, Department for Business, Innovation and Skills, and **Dr David Parker**, Chief Executive, UK Space Agency, gave evidence.

Q159 Chair: I open our third and final session on space and satellites, with particular focus on growth and innovation. First, I apologise for keeping you waiting. I am afraid I was coming from the debate on the Investigatory Powers Bill, on which we published a report. That is also why we are depleted. Some of our members are speaking in that debate, but that by no means indicates a lack of interest in this fascinating subject. We are very excited about our world-leading position in the space sector.

Can I open by asking a little about the funding issues that have been raised with us by some of those who have given us written and oral evidence? Minister, as I understand it, UK Government funding for space R and D falls within the remit of several different research councils, the UK Space Agency and Innovate UK. We have had evidence that the STFC, EPSRC and NERC are all involved, and that this may cause specific problems when trying to fund engineering or individual projects. That is the evidence we have received. Could you explain how, when you go forward to establishing Research UK as an overarching body, you can work to avoid some of those funding gaps?

Joseph Johnson: It is good to be before your Committee again, Madam Chairman, and I am glad to be able to try to help with your inquiry into satellites and space. Let me put space and our funding for it in the broader context of our science commitment, with which you are very familiar. It is obviously a function of our broader commitment to supporting science, which we are demonstrating with our real-terms protection until the end of the spending review period. We have been able to protect the cash spend on space within that,

and that demonstrates the importance we attach to space as an important aspect of our science research base and as a driver of growth and innovation in the economy as a whole.

On your question about the co-ordination of different groups that have an interest in the science of space and the innovations that can come from it, clearly the creation of the UK Space Agency was a big step forward for Britain in terms of having a dedicated agency that could co-ordinate activity across Government. Within the research councils there are areas of activity that relate directly to space. You mentioned the STFC. There is also some funding for physics doctorates and so on, for example, in the EPSRC, but the creation of the space agency as our lead agency has been the significant step forward in terms of co-ordinating Government policy on space.

Q160 Chair: The issue we are highlighting is that there are certain gaps. The evidence we received from the Satellite Applications Catapult is that, in early stage satellite-specific engineering and ICT communications development, funding applications fall through a gap because the EPSRC does not support the space sector, the STFC funds only space science and the UKSA cannot fill the gap as it is not a research council. These are the sorts of questions for which we seek resolution when you are looking at reforms of these issues anyway with Nurse.

Joseph Johnson: I would be pleased to understand exactly where the gap is, because the purpose of the innovation work that takes place through the Satellite Applications Catapult and ESA's innovation work is precisely to make possible those sorts of applications and ensure that those innovations come forward.

Dr Parker: One of the questions is specifically about early stage R and D in space engineering. That is a topic where the space agency maintains a dialogue with EPSRC as the relevant research council. They are always willing to receive open-call R and D; indeed, for EPSRC bottom-up responsive mode R and D is fundamentally part of what they are there to do. We in the space agency have co-funded R and D activities with them in the past, and the two chief executives remain in contact and talk about how we can work together. As I think I have said before, we are very open to co-fund activities where they span the remit of the two organisations. Just as we work very closely with STFC, NERC and Innovate UK, there are no barriers to working with EPSRC at all.

Q161 Chair: You do not think that gap should exist; it is more that for some reason it is not working quite as it should.

Dr Parker: There will always be a challenge in any responsive mode R and D system in relation to the quality of the proposals received. It is always a question of whether there is enough money to cover the excellent proposals. Now that there is clarity on science allocations in general and we know that the agency's national space technology programme will continue, it provides a mechanism to co-ordinate across research councils, as we have always co-ordinated with Innovate UK, for example, to have joint calls. The tools are there.

Q162 Chair: We also received evidence from an outstanding company, Reaction Engines, in which I declare an interest; it is just outside my constituency and I have visited it. It is developing the SABRE rocket. In 2013, the Government announced £60 million of investment in that rocket engine, which is clearly a very exciting project. The company gave evidence to us a few weeks ago. They were very grateful for the investment and it meant a lot to them as a company, but they told us last month that those funds had yet to reach them. This was announced in 2013 and, given how competitive the market is, you can understand that there is some frustration. Do you think a three-year delay is reasonable?

Dr Parker: In the case of that particular programme, which is one I have personally championed for a long time, the announcement of grant funding was simultaneously with the words “subject to a business case”; in other words, it is potentially a very large investment in what we would call a novel and contentious type of investment. It is a small company in the early phase of a very novel technology, so Government investment in it would transform that company from being a small one with some good ideas, but not a great deal of capital, into a company with considerable potential. Our end goal was to secure this technology for the UK, not see it go abroad as has happened sometimes in the past. There was a process of helping the company understand the need to produce, first, a very coherent programme in steps. We were not simply going to write a cheque for £60 million and walk away; we needed to protect the taxpayer’s investment and work with the company to ensure that the right kind of terms and conditions went into the grant offer letter, which has gone out. The project management board is meeting literally this week, so the project is now up and running.

Q163 Chair: All the risks you speak of are genuine and real, and there is a need for a viable business case to make sure it is a good investment for the taxpayer. All those things are perfectly valid, but surely they are the same considerations you would have for venture capital or any other investment, and those would not normally take three years, would they?

Dr Parker: In this case, it is an R and D project under the Science and Technology Act. We had to ensure that what we were doing remained compatible with the terms of the Act, so aspects of that had to be taken into account. In addition, because it was a national project, we had to ensure that it met EU state aid rules. The project had to be sufficiently well defined to go through that process alongside, but I accept that there was a learning process on both sides. I think the company would also recognise that, as an organisation that had not worked with Government before, it took a while for them to understand what was required.

Q164 Carol Monaghan: Minister, just before Christmas 2015 the Government published their first national space policy, which set out four high-level objectives: first, it “recognises that space is of strategic importance;” secondly, “it commits to preserving and promoting the safety and security of the unique space operating environment;” thirdly, “it supports the growth of a robust and competitive commercial space sector;” and, fourthly, “it commits to cooperating internationally,” and so on. Those four pillars of the policy are, on the face of it, certainly laudable. Innovate UK tells us that the most successful countries in terms of space and space exploration are those with clear and focused strategies that look at the hardware

and what is available. Why do you think that level of detail and vision was missing from the UK Government's first ever national space policy?

Joseph Johnson: The national space policy, which we published in December, was the first attempt to put in one place the totality of our Government's policy towards space. In that respect it is a significant step forward in trying to consolidate, unify and reconcile different documents that have come up over time, all of which had a bearing on Government policy towards space. For example, it put together the 2010 innovation and growth strategy, which had in it a lot on space. That was updated in 2014. It brought in the space security policy and the civil space strategy from 2010, which we are now in the process of updating. It brought them all together in one place and tried to address the concern that had been expressed about fragmentation of policy, with too many policy documents flying around, and get everything into a coherent whole that represented the totality of Government policy towards civil space activity.

Q165 Carol Monaghan: I understand that it is a kind of overarching plan, but the vision is about the detail and how we get specific objectives and targets that allow the UK space industry to flourish. It is that level of detail that seems to be missing. Is there a plan to go further with that?

Dr Parker: If you look at the annual corporate plan of the space agency, you will see very specific individual actions, so there is a logical flow-down. There has been a civil space strategy every five years for many years. The national space policy is a capping document, as the Minister suggested, which sits on top of the civil space strategy, the innovation and growth strategy and space security. Underneath that is what each organisation is going to do, the space agency being one of them. You will see all our 50 performance indicators and five KPIs every year. Innovate UK is doing activities in space and it defines those, as do the research councils and so on. There is a natural flow-down from the top into the actions of each individual organisation, as you would expect.

Q166 Carol Monaghan: You are talking about a natural flow-down, but you are painting for me quite a complex picture of agencies, organisations and different stakeholders within that.

Dr Parker: That is natural, because the most important stakeholders are industry. Most of the actions are being taken by industry. Government cannot tell individual companies what their day-by-day actions are. The coherence is provided by the framework. Each individual organisation is working together, and it is all brought together through the Space Leadership Council, as it has been over the past few years.

Q167 Carol Monaghan: I am not sure whether something that "commits to preserving and promoting the safety and security of the unique space operating environment, free from interference" is really a strategic direction.

Dr Parker: It is a fundamental and enduring principle of the UK approach to space. This is the first time we have set out for our international partners those enduring principles of how we work together in space. The policy is a policy; it is not a set of actions. Those are

in the growth action plan. The nature of the document tells you what is inside the box, as it were.

Q168 Carol Monaghan: Minister, you quote the Space Leadership Council. It appears to be a rather opaque organisation. Few details of it are in the public domain; no minutes are published and very little information comes out from the Space Leadership Council. What does the council actually do, and why does it operate in such a closed-door manner?

Joseph Johnson: Like many of the industrial councils that exist across Government, its purpose is to ensure that Government policy is informed by the needs of business and of the community that is going to take responsibility for enabling us to deliver on our goals for the sector as a whole. I would not say it is opaque. It is a valuable organisation that enables policy to be well informed by the priorities of the business community. At the moment it consists of myself; the Minister of State for defence procurement, Philip Dunne; the president of UK Space, Andy Green; and David Parker, chief executive of the UK Space Agency. As needed, we call in experts from industry or academia to help us understand issues of the day.

Q169 Carol Monaghan: Would it be problematic to publish minutes of those meetings?

Joseph Johnson: I am not sure what the practice has been in the past.

Dr Parker: The decision has been taken under the terms of reference of the SLC, which the Minister reformed recently, that summary minutes will be published. I was reviewing the summary minutes earlier today and they will be on the website shortly.

Q170 Carol Monaghan: That is good to know. Minister, how do the Government prioritise investment in space innovation, such as in Reaction Engines, which the Chair has already mentioned?

Joseph Johnson: Broadly speaking, we split the £400 million budget in a number of dimensions. We allocate a significant portion of that budget to the ESA, and we retain 20% or so for the national programme. We also think of the split of activity in terms of how much we are spending on science and how much on the innovation that will come from it. Broadly speaking, there the split is 70:30, so those are two ways in which we look at how we allocate funds.

Q171 Derek Thomas: You just mentioned the money that goes across to the ESA. Our figures show that about three quarters of the cash we set aside goes to the ESA. Have the Government done any work to study the pros and cons of having our own national space programme?

Joseph Johnson: That is an important bit of analysis. The evidence is very strong that we get a very high return from our spend through the ESA. Roughly, £1 of investment generates a return of £10, according to research that has been done for us. We see access to ESA programmes multiplying the UK's bang per buck. We could not afford to lay on

the missions and create the facilities we have access to through the ESA on our own; it would simply be unaffordable.

Q172 Derek Thomas: One of the barriers SMEs find when trying to progress their space innovation is that they have to demonstrate that their innovation works before they can access any cash. If we are not to have a national space programme, which probably would help with that, what can we do to help SMEs a little earlier, before they perhaps struggle to find the investment to get the innovation up and running?

Joseph Johnson: The innovation ecosystem that is developing in places such as Harwell with ECSAT—the European Centre for Space Applications and Telecommunications—with the UK’s Satellite Applications Catapult and the Rutherford Appleton Laboratory, where a lot of space work is going on, and the many businesses and industrial players active in that area, provide opportunities for small businesses to get involved in the exciting opportunities that space presents. There is more to do, and we want to see more small businesses recognise the opportunities that are out there.

Q173 Derek Thomas: The UK is a major contributor to the ESA, but we do not have a UK national at director level or above, as far as I am aware. Greg Clark told our predecessor Committee in the last Parliament that he intended to remedy that situation. Do you know whether much progress has been made with that?

Joseph Johnson: It is a priority for us to be better represented in international organisations. I am sad that we are losing David Parker from his position as chief executive of the space agency, but pleased that he is taking up a big role in the ESA. That is not a trade secret.

Dr Parker: No.

Joseph Johnson: He is to be one of the key players in their human space flight programme; I believe he is to be director of human space flight.

Dr Parker: Yes.

Joseph Johnson: That is an incredibly important bit of ESA’s programme. We are delighted to be represented at that level.

Q174 Chair: To follow on from your answers to Derek Thomas, some of the evidence we received was about frustration with the conservatism—small c—of the space industry and the need to demonstrate flight heritage before getting investment. Dr Parker, I know this is something you have spoken about before. There was a lot of support for Innovate UK’s in-orbit demonstration programme as a way to overcome this particular barrier, particularly for start-ups and smaller companies, which is something that the UK wants to promote. Are there any plans to expand that programme to make sure that more companies are able to access it or are aware of it?

Dr Parker: Innovate UK has been evaluating the possibility of a further technology demonstration satellite. I will happily send you a note on the exact status of its present

thinking on that. On the UK Space Agency side, we have been able to offer technology demonstrations using cubesats, which are one size smaller in spacecraft. We have a joint cubesat with Algeria, with SME technology aboard, launching later this year. There are always more opportunities one would like to see, but they do exist.

Q175 Chair: How good are we about letting our home-grown SME industry know about those opportunities so that they do not miss the boat?

Dr Parker: We always try to put out calls through all our networks, whether it is on the website or the advisory committee structure. In particular, the knowledge transfer network has a space element. That is Innovate UK activity, which is particularly effective at connecting to the SME world.

Q176 Jim Dowd: One matter we raised with Dr Parker when he was with us not long ago related to licensing, more particularly third-party liability requirements. The UK is not alone, but is certainly in the minority of countries, in demanding full liability for the whole operation, not just the launch. Are there any plans for us to behave more like most other people in the field?

Joseph Johnson: I do not think we are unique in operating the kind of regime that we do in regulating the space sector. France has a very similar model to ours. If you look at the results we are getting from our regulatory regime, we are doing well, broadly speaking. The chief executive of the space agency may have given you some of these figures during his previous appearance before you. We are currently licensing between a fifth and a sixth of all spacecraft licences every year, and that number has risen from an average of four to six a year in the period 2009 to 2012 to between 11 and 21 a year in the period 2012 to 2015. Our regulation regime is surviving the test of the marketplace, in the sense that we are gaining share of this important and growing sector. It is very important to bear that in mind when we are looking at how much risk we want taxpayers to retain in allowing these licences to go forward, with the UK taxpayer bearing all the tail risk.

Q177 Jim Dowd: We heard previously that the agency is working on a traffic light system for grading risk, depending on the nature of the event and the satellite and so on. What public consultation has been conducted on that, if any?

Joseph Johnson: We are establishing whether we can put in place a traffic light system whereby small satellites meeting certain launch, orbit and technical criteria can be fast-tracked to licensing. We are reviewing how in-orbit operations insurance can be waived completely for any such fast-tracked small satellites; how insurance requirements can be aggregated for constellations of satellites to support these new and emerging trends within the sector; and aspects of how we charge for licensing.

Q178 Jim Dowd: Obviously, you will be well aware that when the cost of insurance comes to more than the cost of the rest of the project it becomes a prohibitive barrier.

Joseph Johnson: As you know, we have legislated to waive insurance premium tax, which would be a help to any operator.

Q179 Jim Dowd: Certainly up until tomorrow. We will find out whether that enviable position persists beyond all the stories around IPT at the moment, but that is for tomorrow. Can I put a technical point to Dr Parker? What is the difference between a cubesat and a nanosat?

Dr Parker: It is a different name for the same thing. A nanosat is probably generically a very small spacecraft; a cubesat was a particular standard established a few years ago—a standard 10 by 10 by 10 centimetre cube, and multiples thereof, all of which could be launched in the same way.

Jim Dowd: You say cube and I say nano.

Dr Parker: If you wish.

Q180 Jim Dowd: Minister, you mentioned the work that has been done on the traffic light system. Will the Government adopt that?

Joseph Johnson: We are in the process of establishing it at the moment.

Q181 Carol Monaghan: Minister, the Government's aim is to have a spaceport up and running by 2018. Mixed evidence has been given to the Committee regarding the need for a spaceport, with Airbus saying that because they had access to launch sites around the world they did not feel they had the same need as some of the smaller companies that were very keen on having a UK spaceport. What is the role of Government in this? Is it to fund the development of a spaceport or simply to facilitate it?

Joseph Johnson: I think it is much more the latter. We have always made it clear that this is primarily a commercial enterprise. Government's role is to make sure that there is an enabling regulatory environment and that we work through all the complex regulatory and technical issues that having a space flight capability involves. That work continues. We are in discussions, on a non-prejudicial basis, with a number of potential operators to continue to work through these very complex technical and regulatory issues.

Q182 Carol Monaghan: Are the Government planning to publish their technical requirements for a UK spaceport?

Joseph Johnson: We have been consulting on this quite closely, and we recently put out a call for information as to what kind of technical specifications would be needed.

Dr Parker: The technical requirements were published by the DFT back in December 2015, following a technical briefing they had with potential operators in November 2015, so that is out there.

Q183 Carol Monaghan: Can I check that vertical launch capability is not currently included in UK spaceport plans? Is that correct?

Dr Parker: The primary thrust up to now has been on horizontal launch-based planes. Many of the aspects are similar for vertical launch, but there are other aspects that would be different. Hitherto, most of the interest has been coming from those wanting to operate space planes, but an emerging interest has appeared in vertical launch too, and, ultimately, as long as the satellite gets into orbit, that is a step forward.

Q184 Carol Monaghan: Some of the evidence the Committee received talked about possible economic issues—that it could harm commercial viability if vertical launch was not included in a UK spaceport. I suppose there is concern that, if we are going to do it, we should be doing it properly. Do you share those concerns?

Dr Parker: It is implicit in what I said that the goal of satellite launch could be achieved in several ways, so, if we are to legislate for this, we should try to do it once and be as inclusive as possible. To understand that requirement is part of why the Minister has been able to put out a call for technology R and D in the area of space access.

Q185 Carol Monaghan: You anticipate that the requirements will be broadened to include vertical launch.

Dr Parker: It is an iterative process to understand the differences between vertical and horizontal launch and, therefore, what feeds back into that.

Carol Monaghan: One is up and one is sideways.

Dr Parker: Yes, but, in terms of the regulatory aspect, what are the implications of going up or going horizontally?

Q186 Chris Green: The Government are a natural customer for satellite-derived services, such as emergency communications and environmental management. How many Government Departments use space-based services at the moment?

Joseph Johnson: I think about 13 are involved in the national space strategy.

Dr Parker: You can deduce it by looking at the national space policy, where it spells out the role of each Government Department and how it is either a provider of technology or particularly a user. I will not attempt to rattle all of them off from memory; the NSP refers. One such as DEFRA really leans forward in putting the use of space data at the centre of its work. For the MOD, it goes without saying that it is very important to all aspects of its activities, and increasingly Departments like DFID are using space data in disasters, so there is a range of opportunities.

Q187 Chris Green: There is no doubt quite a range of different applications, depending on which Department you are looking at. Is there much scope to improve the cost-effectiveness of our use of space-based services by sharing procurement across different Departments, or is

it too distinct from Department to Department as to how they are using the technology or services?

Dr Parker: I am not sure there is a single answer to that question. The requirements that the MOD might have for military purposes would be wildly different from DFID's for disaster management, but there are areas of commonality, particularly in the domain of Earth observation. That is why the DECC permanent secretary, Stephen Lovegrove, was asked to chair a panel to look at Earth observations across Government, not just satellite but all sorts of terrestrial sources of data as well. There is ongoing work, therefore, to see what could be done to aggregate demand better and to be more efficient in the use of available data. As I think I said at the previous hearing, it is important to recognise that through the European Union's Copernicus satellite system data are being provided free. The challenge is not generating the data. The biggest challenges probably lie in effectively transforming the data into information.

Q188 Chris Green: Given the applications being developed over time and the way Departments use that information, with sufficient development in a number of different areas, now is the time to start seeing how you can improve the procurement of those services.

Dr Parker: Yes.

Q189 Chris Green: The Space for Smarter Government programme was established in 2014 following a recommendation from our predecessor Committee. Phase 1 ran from 2014 to 2015 and had a budget of £700,000. How have you measured the effectiveness of the programme?

Dr Parker: The effectiveness of the programme is the massive over-demand for potential projects to use it. We went from a budget of £700,000 in the first year to £1.5 million in the current financial year, which is just coming to an end, and our plan is to increase it again in the coming year. That is being driven by individual Departments coming with their demands and requirements and linking them to the Satellite Applications Catapult with its technical expertise to help them with their problems. Inevitably, it will be a while before pilot projects turn into full operational services, but, as with all these issues, a business case is always required, and it will be evidence-based.

Q190 Chris Green: The demand is driving the budget to a certain extent. It has slightly more than doubled, and there is more demand in future.

Dr Parker: We feel so.

Q191 Chair: Dr Parker, you just commented that the transformation of data into information is where the biggest challenge lies. Many of our witnesses commented on the digital skills crisis. We have had the same evidence in parallel inquiries we have done into big data and digital skills. Andy Green told us that digital skills are a real crisis for the country; other witnesses said the same. When we have asked whether we will meet our innovation and growth strategy targets for increasing our share of the global space sector to get to 100,000

jobs and so on, most people have told us that, despite the fact that they are bullish about our achieving that goal, the real risk is the skills crisis. How are we to overcome that with a focus on delivering the skills specifically needed for the space sector?

Joseph Johnson: We recognise as a Government that it is essential that we train sufficient skilled engineers and ICT specialists to meet the rapid growth we are targeting for the sector and to make the most of the opportunities that data can provide. We are taking action at a number of levels to ensure that we are developing those skills. For example, the agency has recently appointed a national skills point of contact, who is working closely with NERC as the body responsible for the key researchers in this field, to support and investigate where we can do more on training and capacity-building for workers in the space sector using big datasets. In the longer term, however, clearly this is something we have to drive across the entire age range. That means a schools programme encouraging skills such as coding, most notably through endeavours such as the Astro Pi project. I am not sure whether you have come across it, but it is a programme using the Raspberry Pi. That was in 330 schools in 2015, and over 1,000 schools may be involved in this Raspberry Pi, or space-based pi, project by the end of the period.

There are many benefits to the recent inspirational space exploration missions. I think we can all agree that the Principia education projects have been particularly successful; 24 million people watched Tim Peake launch in December. There have been lots of schemes related to the Tim Peake mission, such as the rocket science project, which involved 8,500 schools, and the EO detective project with gap students analysing imagery from space. All these are the kinds of programmes that we need in Britain to have an effect similar to the Apollo effect that the US managed in the 1960s, 1970s and 1980s. We want to see a real uptick in the numbers of people taking physics, maths and other subjects at higher levels that enable them to move into these careers. There are a lot of other schemes I could run through, but the Government are absolutely focused on making sure that we have a pipeline of skilled people able to contribute to the development of our space sector.

Q192 Chair: That is encouraging. What about upskilling the existing workforce? We have heard a lot of evidence about the need to raise awareness of the value of the space industry, perhaps within unexpected industries and in the Government. DEFRA has produced a road map for the use of Earth observation data across the Department. Is any work under way to produce a broader road map across the Government, because that might assist in the triggering of similar data skills?

Joseph Johnson: Yes. The Government are funding innovative pilot conversion courses to provide a new supply of computer graduates with data analysis skills, and that will start from the summer of 2017. We are also investing £40 million in centres for doctoral training in different areas of data. In November 2015, the Chancellor announced plans for a £20 million competition to open a new institute for coding that will train the next generation in high-level digital and computer science skills. We also have the Alan Turing Institute coming onstream, hubbed at the British Library but with spokes elsewhere. One of that institute's roles will be to help data scientists through their doctoral training programmes.

Q193 Carol Monaghan: Mr Parker, I want to ask you about a specific issue, which you may or may not be able to answer just now. I was at Glasgow University a couple of weeks ago and visited Space Glasgow, which is an umbrella group for space activities taking place at the university. It includes the team involved in the LISA Pathfinder, gravitational waves, and all the celebrations around that. They talked about some of the difficulty they had in securing funding, not necessarily for blue-sky research or for technical innovation. They found that, if they put in an application to EPSRC, they would be told it would be better to go to the UK Space Agency; if they put in the application to the space agency, they were bounced back again. Who should be taking an overall view of a situation like that, where cutting-edge technology is being developed but nobody seems to want to be the person who funds it?

Dr Parker: Thank you for the question. I do not know the specifics, but if it is related to the gravitational wave detection technology—I am speculating here—

Q194 Carol Monaghan: It is concerned with lots of different areas of space.

Dr Parker: Fine. To clarify a point raised earlier, we have a national programme. We have a national space technology programme that, through the allocations, we will be able to continue. That operates at multiple levels of funding, by which I mean from quite big flagship projects of the order of a million or two all the way down to small-scale funding of the order of 10K for novel ideas when you do not know where something will go. We deliberately have this kind of staircase of funding opportunities, but they are always competitive and always driven by evaluations of what the potential is to go forward to the market, or to scientific application or whatever. If there are specific cases, the space agency is always ready to sit down and if there is a danger of something falling through the funder pores—the gap between organisations—we will look at it.

Q195 Chair: There is one final question I would like to put to you—you have been very helpful. The innovation and growth strategy has the target of increasing the UK's share of the global space market to 10%. Given the growth rate we have achieved so far, which was about 9% a year between 2010 and 2014, how confident are you that we will reach that target? Where do you think the risks lie, other than skills we have already discussed, which we will need to overcome to achieve it?

Joseph Johnson: This is a very positive story within the UK economy overall. UK space industry growth at about 8.5% is almost twice the average global growth rates for the space sector. We are gaining market share at the moment and we want that to continue. As you know, we are targeting a 10% share by 2030, equating to what we estimate will be about £40 billion-worth of economic activity. It will play a big part in contributing to our export growth as a country, and by and large we think we are on track.

We are not complacent, and we are looking closely all the time at factors that will influence our ability to continue to stay on track—the quality of regulation, whether we have a competitive regulatory architecture and whether the industry is accessing spectrum in the right quantities. We are paying very close attention to those sorts of business environment-type issues. Most of all, we are continuing to ensure that we have stability in our research funding. We achieved stability through the spending review settlement for science as a whole. Within that, space has cash stability. Those are the key elements in

Government playing our part to make sure that industry can rise to the challenge we are setting it.

Q196 Chair: The phrase that has come up again and again from our witnesses, written and oral, is that the greatest challenge now for the space industry is to become more outward looking; that it needs to reach out to other sectors in the UK and the global economy that can benefit from space applications, data and services but perhaps do not realise it yet, because that is how we are going to grow that market share. What is your vision for reaching out to increase awareness in those sectors?

Joseph Johnson: The last few months have been tremendous in raising public awareness of space. The inspirational aspects of the programmes the Government fund have done incredibly well. We saw it yesterday with the launch of the first phase of the ExoMars project. That was on the “Today” programme and in every major newspaper. It is getting the kind of attention that space has not had for a long time, and it is building on the terrific success we have already mentioned generated by Tim Peake’s ongoing mission to the ISS as Britain’s first ESA astronaut. The inspirational programmes are important in raising public awareness, but there is also growing awareness of the importance of space in the everyday applications we all use, from navigation to health and to maritime monitoring, which perhaps we are not so aware of. There are lots of everyday applications: satellite TV and how GPS works on our phones. There is much broader awareness and it will continue to develop. One of the challenges is to continue to communicate to small businesses in particular the benefits they can get from understanding how space can transform their business models.

Chair: Minister and Dr Parker, thank you. Dr Parker, could I join the Minister in congratulating you on your new position at ESA? We will all miss you from the UK Space Agency. We think you have done an excellent job, but we are proud that you will be representing us at ESA, and we wish you well there.

Examination of Witnesses

Witnesses: **Professor Ian Boyd**, Chief Scientific Adviser, Department for Environment, Food and Rural Affairs, **Philip Marnick**, Group Director (Spectrum), Ofcom, and **Neil Ackroyd**, Chief Operating Officer, Ordnance Survey, gave evidence.

Q197 Chair: I welcome all of you to our final session on space and satellites. As you may or may not have heard, we have a particular focus on innovation and growth. We are very proud of the role that the space sector is playing in the UK economy. We think it is largely a positive story, but there are always ways in which we can improve. If you were here at the end of our session with the Minister, you will have heard me quoting the phrase, which has come up a lot in our inquiry, that the greatest challenge now for the space industry is to become more outward looking; it needs to reach out to other sectors in the UK and the global economy so that they can benefit from space applications, data and services. It is clear to us that this lack of awareness limits the achievement of some of our goals under the IGS. Can you give us an idea of why you think it has been a bit of an uphill struggle to get public sector

and businesses interested in using satellite data and other space services? Perhaps you would like to start, Professor Boyd.

Professor Boyd: The quickest answer is that it is a complex area. Very large amounts of data are available from satellites of a variety of different types. For the public sector in particular, to increase its capability to receive those data and turn them into useful information, which can then be used within public policy, needs a whole system change in how we do things. It means that we have to have a data-oriented system of management. The real challenges in that sit within the skills in the public sector, for example, but also in the systems and processes. The large volumes of data are a challenge in their own right, but the number of people who have the skills to be able to process those data and the private sector involvement to provide the tools those people need to process the data is taking a while to get going. We have been very good at putting hardware in the skies and designing it in such a way as to throw a lot of data at us, but we have not been so good at designing the systems to receive the data and turn them into useful information.

Q198 Chair: Is that also your opinion, Mr Ackroyd?

Neil Ackroyd: I think we can draw an analogy with a similar challenge we had with geospatial or mapping data. We had some great pockets of good use of data in specific sectors. Four or five years ago, with Government support, that was put into a single service agreement, for access to that data across the whole of Government. We have gone from 200 or 300 to nearly 4,000 public bodies using that data. How you provision the data, serve it and make the information easy to access and use is a critical part of this problem set. I agree that the technical infrastructure around satellite-based data, or MoMo sense data, has not been put in place to facilitate that. There are specific use cases—Copernicus is a good example—where data might be turned into a product to respond to a specific flood event. You do not see that scaled across to have a service-level provision to meet specific downstream business needs. You see good point practices, whether it is precision farming or flood response, but you cannot see integration of the content and data into a service provision. As we found with mapping data, that would make a huge difference to uptake.

Q199 Chair: That is very helpful. Professor Boyd, can you take us through the cost-benefit analysis that DEFRA did to ensure that applying Earth observation data to issues such as crop monitoring, marine conservation and so on will enable you as a Department to deliver services in a cost-effective way? You are considered a lead Department in this area, so trying to understand what led you to make that decision and what analysis created the environment to enable that would be helpful.

Professor Boyd: The analysis is at a number of different levels. There is a gut feeling that this is a good thing and that DEFRA has a number of policy objectives that would be helped particularly by Earth observation data. There are a number of different types of data that come from satellites. There is communication and there is navigation, but we are talking here about Earth observation. DEFRA is responsible for the landscapes and environments of the UK, and Earth observation data naturally lend themselves to informing us about the status and trends in those assets. In order to address that, we have created a centre of excellence in Earth observation within DEFRA. That was a matter of

looking across the DEFRA group—in other words, the Environment Agency, Natural England, the Marine Management Organisation and all the other organisations in DEFRA—and asking how much skill and expertise we have in this.

Having done that, we decided it was too thinly spread, so we brought it all together under one overarching management structure called the DEFRA centre of excellence for Earth observation. Its function essentially is to be the intelligent customer for DEFRA. It has the skills and capabilities to process data itself, but my suspicion is that through time it will move to be more of a commissioning body, to use the wider private sector to supply what DEFRA needs in terms of capability in Earth observation, because we are simply not big enough to hold all the skills ourselves.

In terms of cost-benefit, it was clearly sensible to bring together all the skills in one place so that they could properly interact and we could see critical mass, but underlying that is an economic case. For example, in some of our applications we can see a reduction of about 80% in the cost of monitoring, let us say, the common agricultural policy areas for which we have responsibility. There is roughly a 10:1 benefit—in other words, £10 of benefit for £1 spent—in the analyses we have done to date, so it is all pointing in the right direction.

We also have a Secretary of State who is very keen on open data. Open data have brought about this revolution in Earth observation. We have the Copernicus system with open data, and the Americans have made the whole of the Landsat dataset open as well, so that can take us back, potentially, to the early 1960s. A lot of other satellite systems are going up—for example, the Chinese are putting up satellites—that will simply make the data completely open. We have to be in a position to be able to take the benefits of those open data. The formal analyses we have done so far represent a small amount of the kind of benefit we can get. We do not fully understand what the benefits will be in the long run, and only by practising the approach we are taking to Earth observation data will we start to tease out where the benefits lie. I think they will be a lot greater than the formal analyses say.

Q200 Chair: That is very helpful and interesting, because my next question was going to be about the extent to which you think skills shortages and the lack of digital data analytical skills are holding back our exploitation of space satellite technologies across Government. You said the solution within DEFRA was to centralise the skills, but you think that long term it is going to be essentially outsourcing of some kind. What do you think the cross-Government, or even cross-organisation, answer is?

Professor Boyd: There is definitely a shortage of skills, and it comes in two forms: the deep skills to handle and process data and turn it into a useful product, but also the skills that are mainstreamed within the average civil servant, for example, to be able to take data in a reasonably well-processed form and turn that into a product that is useful to them in decision making. That is a matter of trying to make sure there is a general upskilling of capability in the public service. Of course, we would want to try to recruit people with appropriate STEM-type skills but also interests in this area.

There is a shortage of deep skills, but we take the view that we are not going to carry most of those deep skills ourselves in the long term. Most of that will be supplied by the

marketplace. There are two reasons why we are taking this approach: one is to get better at doing our own policy making, and the other is to try to drive the marketplace from which we will eventually benefit by being an early adopter of the capabilities before us. By being an early adopter, we want to help to drive the marketplace in a direction that is helpful to us.

Q201 Jim Dowd: Mr Marnick, my questions are directed to you. Radio spectrum is an increasingly scarce resource, although appropriate technology makes it much more versatile than it has been heretofore. Demand for it grows increasingly, not just by satellite operators but mobile phone companies and plenty of others. What criteria do you adopt in deciding how to allocate such a precious resource?

Philip Marnick: In space there are two precious resources. The first is satellites, but the second is geo-location spots—places in space where you can put satellites. You may have noticed that a week ago we issued a new consultation in relation to spectrum for space, to try to understand where growth was coming from, and therefore where we had spots for doing it. At the moment, in our region of the world, about 68% of weighted spectrum is allocated to space, both science and navigation and communication systems, and everything else. The UK currently allocates about 22% of that spectrum; that has been asked for and is used in space. You can contrast that with some of the other areas that are doing it.

The great thing about space is that a lot of the applications are very geo-located. They are in a particular location, apart from television, which is broadcast and received everywhere. There are Earth stations that receive it in particular places, so it shares with a lot of other applications. Some of the main bands used for today's satellites are used by fixed links and everything else, so we have ability between sharing and demand to do it.

Earth observation was one of the key areas where technology was not helping, because you need more spectrum to be able to get a closer picture of the Earth. At the last WRC we allocated another 600 MHz of spectrum to that area to enable that to happen. Our criteria are to look at where the demand is, to see where the best interest is in what we are trying to get to and how we can balance that demand. One of my main challenges is, therefore, to try to see how you can get different segments of industry working together to understand the challenges of the others. One of the bits is that everybody says, "I'm very important and I can't possibly share. How do I get it?" By getting people to work together we are doing that. With space particularly, we have introduced an MOU to see how we can understand what the real requirements are. As you have said throughout a lot of your questioning over this period, some of it is growth in the applications that use it, and they do not directly relate to the spectrum that is needed to deliver the services. We have been trying to make sure we understand that and get together and, therefore, put it together.

Q202 Jim Dowd: I was going to ask what steps you are taking to meet the unusual demands of the space sector, but you have just covered it and I am grateful for that. Most Members of this place will know that the telecoms companies, in particular mobile companies, have a very extensive and elaborate lobbying operation compared with the much smaller voice of the space and satellite industry. Are you confident that you are not just giving in to those who shout loudest?

Philip Marnick: The space industry is a phenomenally strong lobby, not just in the UK but globally, because it operates globally. At the moment, about 8% of spectrum is used by mobile, so it is not as high as most people think. The challenge of mobile is that it is nationwide to enable us to get coverage, so we do not think we rely on that. What we are looking at is real evidence of where growth and demand are, and how we can forecast growth and pinch points and see what happens, so for us it is creating criteria based on evidence as opposed to the people who shout the loudest.

Q203 Jim Dowd: How significant a factor is the scarcity of radio spectrum for the space sector in the UK to reach its full commercial and technical potential?

Philip Marnick: It is always a challenge. Most mobile usage has been in the sub-1 GHz bands, up to about 3 GHz recently as we have gone higher. While there are lots of satellite operations there, a lot of the new satellite demand is in much higher frequencies, so the challenge has not been as great as people thought. We need to make sure, however, that as we move to the fifth generation of mobile, where we are looking at millimetric waves, we understand the needs of both sectors. In the last WRC, the UK took the very strong position of trying to find bands where 5G mobile can go that did not impact on other services. We thought we needed to have it by about 2019-20, and that we needed something where there was a reasonable probability of things co-existing, so we took a very strong position to try to make sure that happened. We are trying to protect some of the bands used by satellites and others.

Q204 Jim Dowd: Provided it is addressed intelligently and from an informed point of view, the allocation of spectrum in space should not be a constraint.

Philip Marnick: It should not be a constraint, but, as you say, everybody fights for every bit of spectrum, so you have to make sure you understand where the demand is and how you can make it work. It is my job in life to make all of that happen.

Chair: No pressure.

Q205 Derek Thomas: Mr Marnick, we have heard from experts that your proposals to amend Ofcom's management of satellite filings go beyond what is required by the International Telecommunications Union. Is there a risk that that places an onerous responsibility on satellite operators, and why have you taken a tougher line than others?

Philip Marnick: We do not think we are taking a tougher line than others. One of the big challenges is not necessarily spectrum but people's orbital slots. In the space industry there are an awful lot of what we call paper satellites, with people making filings for things that will not turn into reality. We have been asking people, and will look to ask them, to provide information they have themselves anyway, so we are not doing anything that is putting an increased burden on them. We are asking whether the programme is real and whether there is a business plan to show it exists. If so, we can put our effort into making sure we deal with things that are real as opposed to things where, "I want to position myself a bit better." In doing that, we look after the UK itself and the Channel

Islands and the Isle of Man. We also represent all the overseas territories, and the same rules apply there as in the UK.

At the moment, we are one of the largest filers of stuff. We compete against the Americans, the French and other people. We see companies moving between areas of the world to enable them to get the slots they want, and we have not seen a drop-off in people wanting to come to the UK. As to the people who deal directly with us, we understand what they need and can try to fight our corner better to make sure we get it. We are trying to make sure that we can give fair access to the people who need it, that we do not have as many paper satellites as most people would want and, therefore, that we make the slots in space available to as many people as possible.

Q206 Derek Thomas: In a way, you have answered my next question, but I will ask it anyway. In terms of the risk of satellite operators going overseas, where the regime might be more attractive, are you suggesting that the indication is that that is not the case, and would not be the case?

Philip Marnick: Some satellite operators file through multiple countries anyway; for example, people file through Gibraltar or Luxembourg. People do that all the time to enable them to ensure they optimise their position in the system. Do we think people will go overseas as a result of this? We have not had any real indication that people will do so.

Q207 Derek Thomas: When do you expect the results of your satellite filings consultation to be published?

Philip Marnick: Shortly.

Q208 Derek Thomas: Following your “shortly” answer, will firm policy proposals be made?

Philip Marnick: Yes. We would like to make everything as clear and precise as we possibly can.

Q209 Chris Green: Mr Ackroyd, Ordnance Survey’s written evidence states that it is developing a new strategy “predicated on overseas growth” in the use of geospatial data from satellites. Is that because you do not anticipate much growth in the UK?

Neil Ackroyd: It is probably a range of things, and there are three key ones. We certainly have seen and are seeing a slowdown in the adoption of geospatial information in what is a very small country with a very well-developed geospatial industry. There is obviously some very high-quality data here. Ordnance Survey operates a mixed model of growth. We contract with Government but also with commercial partners and commercial resellers. There is a certain degree of tension with that commercial aspect on open data. As more data is released as open information, the income generation is not coming directly but through first or second-order benefits and so forth. At Ordnance Survey, which is in a very fast technology industry, we see the need to mitigate that reduction in income

generation capability by increasing our ability to generate services and service business overseas.

The real driver is the globalisation of the industry in which we operate. Britain is a very small country in the global footprint. Our technologies and capabilities are well developed in this country, so we see an opportunity to take those and apply them to the increasing demand for higher-quality geospatial information now being driven by the smarter city agenda, land reform and the widespread adoption of geospatial information through mobile devices. All of that is creating a globalisation of the market, and we can either ignore it, in essence staying in a constrained environment, or try to supplement our responsibilities to map GB with opportunities to generate new income streams.

Q210 Chris Green: I suppose it is helpful that you are a Government-owned company. That philosophy of being a company selling to the market is key, but your written evidence states that you would welcome an opportunity to discuss your growth strategy with policy makers in BIS. Given that you are a wholly-owned Government company with BIS as your only shareholder, surely you have those regular opportunities anyway.

Neil Ackroyd: That comment is about the integration of different policies. For example, if you look at information about how Earth observation data is used, it comes through a range of different Departments; it can come through BIS, DEFRA or DFID. When you look at the global opportunities, they tend to span our own Department's responsibilities. A development opportunity that is World Bank-funded—it might be a development in central Africa—falls within a different remit from one that might be around innovation funding or innovation streams. Currently, it is more about cross-Government opportunity than specific opportunity within the Department, and bringing that together.

Q211 Chris Green: What work have the Government undertaken to examine Galileo in terms of the impact it might have on the delivery of Government services?

Neil Ackroyd: We have been a strong advocate of Galileo, primarily because it adds a layer of integrity and new service provision on top of GPS or GNSS. We think that is still substantively untapped. The Galileo programme has been slow in its evolution. I had the pleasure of starting off in a GPS programme back in 1983 and that was slow in its evolution. These things take longer. Galileo is bringing a level of opportunity that has a chance to reinvigorate applications into much more precise use of signal services: for example, advanced train control systems and autonomous vehicles. All of these technology-based ambitions are driven by two criteria: one is the vehicle or the platform knowing where it is; the other is knowing where it is in relationship to other things that it does not necessarily want to intersect with. There is a strong combination of mapping data and positioning data. A smart vehicle is not just mapping its own world and hoping that it makes a good judgment; there is an intermediation with mapping that has gone on and an authority that allows app mediation, to say, "That thing that you think is a post box is a small child, because we know it is not a post box." There is a mediation thing around our technology ambitions for autonomous vehicles and the almost traditional approach to mapping the country and providing authoritative data. Those will become even more important in the future rather than less important. Having available a reliable European-

owned positioning infrastructure is part of that, as is having very fast update methodologies, big data capability and digital skills.

This is probably the fastest period of technology change I have seen in my career, certainly in the past two to three years, in terms of both the ambition of this country to be involved in some of these big technology programmes but also the technology's capability. Sometimes we lose sight of that. It is a very fast-changing period.

Q212 Chris Green: I will come on to the Space for Smarter Government programme in a moment, but in terms of the Galileo project is there an application in DEFRA?

Professor Boyd: For Galileo, less so than Copernicus. The Copernicus system is changing our whole attitude to the capabilities of Earth observation support policy. Galileo will provide good positioning information and that sort of thing, but from our point of view we are most interested in detecting change in the landscape. Sometimes you need to get positioning information for that, but most of it is about getting data layers for land cover maps and that sort of thing. There is limited application for us in Galileo, but until you explore some of the new technologies you never quite know what they are going to do for you. That is where it comes back to having the skills and capabilities to look at what is coming in and adapt quickly and intelligently to the opportunities before us, knowing the outcomes we require. It is people who can understand and translate what the technology is doing and giving us, and what policy delivery is required for understanding, say, changes in the landscape and that kind of thing.

Q213 Chris Green: To what extent have DEFRA and Ordnance Survey been involved in the Space for Smarter Government programme, and how effective has it been?

Neil Ackroyd: We tend to be more involved with the catapults because they focus more on the downstream implementation or user aspect of it. When we look at space, there is a slight tension with Ordnance Survey's use. Because we map so accurately, the majority of satellite data does not meet the resolutions we require. We are more dependent on fixed-wing aircraft, and, looking forward, we see value in UASs as a significant option to satellite-based data. If you are looking at precision farming, many of the benefits are in field variability; the resolution from a satellite is not necessarily ideal for that level of granularity, but a small low-cost UAS is.

We certainly see the value in land use change, especially in mountain moorland areas where there is a high cost to mapping them conventionally. Generally speaking, we tend to use flown imagery because we can get the resolution and coverage we need. Britain has a certain level of inconvenience in the optical spectrum because of the amount of cloud. It is hard to guarantee that you will get coverage quickly enough unless you target the mission to the geography you want. That is driven by a different set of requirements from DEFRA's. Our requirements are more about high-precision sub-decimetre mapping and less about the broader classification of vegetation or land use.

The power will come in the integration of the technologies, where the end user is not making an active choice about whether it is imagery captured from satellite, drone or fixed-wing aircraft. The ability to integrate information into a seamless mosaic is a very

powerful capability that is coming. You can see that being tied into farming, especially a greater increase in precision applications; I think only about 20% of farmers are using precision farming at the moment. If you get into a space where it is easier to use, with much better prescription application, reduced use of chemicals, reduced run-off and more precise and higher crop yields are all there. I take a very optimistic view of that. Those are clear and specific benefit cases that can be built, and that is why the integration of the new technology, of which Galileo will be part, in things like precision farming is a very appealing combination for the future. There is also an element of custodianship. It is not just more productive land but better and more effectively and environmentally managed land. There is a great combinational opportunity arising in land use.

Q214 Chris Green: It's nice to talk about farming.

Neil Ackroyd: Yes.

Professor Boyd: We work in a pretty seamless way with the Space for Smarter Government programme. I think it would have been extraordinarily difficult for us to set up the centre of excellence without their support and their funding of specific projects in our area, particularly those relating to our small business research initiative, which is funding projects in Earth observation on flooding, CAP delivery, marine projects and those sorts of things. We have a very strong working relationship with SSG, and I would like to see that continuing in the future, if at all possible. All the indications are that they are very keen to work with us, so it is a very hand-in-glove relationship.

Q215 Chris Green: From 2014-15 the budget was doubled, and for 2015-16 there seems to be more growth in the future. I suppose that is driven in part by demand from DEFRA and Ordnance Survey.

Professor Boyd: All I can say is that we work very well with them, and that increase in budget is probably a response to the fact that there are good outcomes as a result of our relationship with them. I want to encourage them to spend more.

Q216 Carol Monaghan: Mr Ackroyd, you have already spoken about future potential technologies that can be developed as a result of space data. Where do you see the greatest market potential for the growth in the use of space data?

Neil Ackroyd: Comments were made earlier about environmental management, environmental response and disaster response. Those are key areas where space brings a unique capability to provide vast tranches of data quite quickly, but it is a more complex market than it was perhaps even five or six years ago when we had only a number of choices. The choice was to put up a fixed-wing aircraft or to try to task a satellite and hope that, with all the other priorities and difficulties of tasking satellites, we would get the image or information we needed. Satellites are quite hard to task. You wait passively hoping for the data to arrive over a long period of time, and then you can build an analytic set. To target and task a satellite can take quite a lot of effort and still not get the results you need. There is a pragmatic reality in how space reacts to very fast response requirements. It is good at building a record and it is good at building comparative

capability to do a good analysis. To take the recent floods in Cumbria, even though we tasked a satellite for information, because the floods were primarily in an urban area the angle of the satellite view and the resolution did not give us the information we needed, so we had to augment it with ground-based capability. At a broad level it gives us long arms, but the real value comes when we integrate it with other components in a data view.

A point was made earlier about layers of information. Our ability to create that view, whether it is based on existing information, satellite information, specific response information or employing assets in the field, is the bit we have not successfully achieved yet. That in itself will be the driver for greater consumption of satellite data and UAS information, which is also a very powerful collection of imaging information.

There are other areas where satellites will increase their capability to do things that we cannot do with existing solutions. One is the ability to put sensors up there that provide a much greater range of data, whether it is satellite radar or multi-spectral, to give information about crop health. Those are only just coming on stream. With the latest Sentinel launches as part of the Copernicus system, we are starting to get new information we have not had before. We are still learning how to use that. I think the agricultural application is probably the strongest use case for Great Britain—outside communications, of course, which are related to broader public consumption as well. For Ordnance Survey, it is the integration of multiple datasets, which plays back exactly to the point about whether we have the digital skills and expertise. In the past seven or eight years we have noticed a reduction in those skill sets within Government, partly because of the challenges around budgets, which means that some of the more specialised skills have been harder to protect, and partly because we find those skills developing very quickly in other geographies: for example, in India and China. There is a natural economic reality in looking for those skills. The volume of skills is significantly higher, and they are generally correlated to technology hubs. Hyderabad is a good example of a technology hub that brings together and integrates a lot of different skills. We find it quite hard to hire the skills we need, and quite a lot of our capability is now offshore. That is just a practical example, first, of the ability to scale and, secondly, of the basic reality. It is really hard to get those skills in GB. They are specialist skills and they are not that hard to get in consolidated groups sitting in other parts of the world. China has invested hugely in imaging, mapping and remote sensing, to the point where they probably have the single largest capability in the world in not just mapping but in producing content from it. Even the capabilities of our friends in the platform providers are built in places such as India and the Philippines. The geo-technology dimension has become radically different in the last five or six years.

Q217 Carol Monaghan: It is interesting, because what you say links with one of our other inquiries—digital skills. It sounds as if there will be real economic issues as a result of our not being upskilled in the UK. That is possibly for our other inquiry. We have been told that the space sector lacks understanding of the needs of the potential users of data and, also, that potential data users are not aware of the possibilities of space data. How do we co-ordinate that?

Neil Ackroyd: When you unpick it, everything is always more complex, isn't it? We did a good job in this country in investing in cubesats, microsatellites or nanosatellites, but the

real downstream exploitation of that has occurred off the west coast of California with companies like Skybox and PlanetLapse. That is just a nanosat technology. I spent 15 years working for a US west coast company in Silicon Valley, and the cultural investment is so radically different—their willingness to accept higher risk. At the moment, in this country, we try to underpin some of the risk with Government funding, but there is not a clear step to the next level of risk funding. We do not have people willing to invest at a higher level of risk, as you do in a west coast technology company where there is much more speculative risk investment funding. By its nature, space is risky. The downstream application of space requires not just a lot of software development and technology in the upstream but quite a lot of risk in putting satellites in space. We have seen a lot of the Swarm satellites—the new technology industry—moving out of this country, which is a real shame, but it is understandable when you look at the culture of venture capital investment or the willingness to make risk investment. It is hard to get that level of risk investment in this country. Innovate UK is looking at how it can relate VC-type innovation funding to Government projects, and that is a very powerful opportunity. It is hard to do, because people start to want detailed business cases and value for money assessments: “It’s novel and contentious.” Well, of course it is. That is the purpose of doing it; it is novel, contentious and risky. When projects hit those barriers in this country, we should not be surprised that it takes three or four years to get through them. I have seen that regularly in my career. In this country you come up with a good idea, and “It’s novel and contentious,” which means everybody gets nervous about doing it. Our risk appetite is low. Maybe that is because our reward appetite or reward recognition is low as well, but that balance is a problem and one that I see quite regularly in our own investments.

Q218 Carol Monaghan: Professor Boyd, DEFRA has produced a road map for the use of Earth observation data across the Department. Is work under way to produce a wider road map of the Government’s overall needs where space-based services and data are concerned across Government?

Professor Boyd: You are probably aware that an initiative has been ongoing for the last six to nine months to look at cross-Whitehall capability in Earth observation. That was led by Stephen Lovegrove, the DECC permanent secretary. I supported him as co-chair of that group. That is in the process of developing its conclusions. At this stage, we would not call the next stage a road map, but that may well be something down the road and we may well call it that in due course.

The road map DEFRA produced maps out the centre of excellence, and there is a project called the Earth observation data integration project that we have going as well. That is a test case to pilot methodologies that can then be potentially scaled up. That road map is potentially a template for a cross-Government road map, but we are dealing with a much more complex problem. DEFRA itself is quite complex and has a complex problem to solve in terms of how it uses Earth observation data. It is magnified several times when you look at it across Whitehall. While DEFRA is interested in understanding change in the landscape—to put it in very broad terms, change at different spatial and temporal scales—that can be used in other contexts. For example, DCLG could look at change because of its interest in planning regulations and those sorts of things. There are transferable issues.

Across Government we have identified two other areas where there is generic need. One is in emergency response and the other is in security. Each of those will need a different set of solutions. We are looking very seriously at how we build the skills across Government, as we are doing in DEFRA, and trying to find the resource to make sure that happens, but it will probably require a level of reorganisation of the distribution of resources currently put into satellites and Earth observation. We are not dealing just with satellites but with AUVs as well to make sure that happens. To date, the governance structure for the delivery of Earth observation data has been designed to put satellites up and get the data out, not to receive data and turn it into information. We need to change that governance structure, and it will take a bit of time, but it is ongoing.

Q219 Carol Monaghan: Do you think the chief scientific advisers, for example, might play a role in building Government's capacity to use the data?

Professor Boyd: I would hope that they do, and certainly my interest in it is driven by my own belief that this is a game changer for Government, not just for DEFRA for which I have responsibility. But, as I said earlier, government is a system, and changing that system to be able to use this opportunity intelligently does not happen overnight; it is a long-term process that must be designed very carefully. You could end up with a disruptive process that would mean that business as usual is hard to deliver. We do not want that; we want to be able to do business as usual but change our systems and processes in such a way that we are evolving into a new way of doing things, rather than having a dramatic change that might be difficult to manage.

Chair: I thank all of you for taking the time today to come and give evidence to us. It has been a fascinating and very helpful end to our oral sessions on satellites and space. You have answered all our questions fully, but we will probably have a few further questions to ask as we write up our report. If we do, I hope you will write back to us and clarify those points. All that remains for me to do is to thank you very much for the time you have taken today and to close this session.