

Work of the European and UK Space Agencies : fourth report of session 2013-14 : report, together with formal minutes, oral and written evidence / House of Commons Science and Technology Committee.

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House of Commons
Science and Technology
Committee

Work of the European and UK Space Agencies

Fourth Report of Session 2013–14

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House of Commons
Science and Technology
Committee

**Work of the European
and UK Space Agencies**

Fourth Report of Session 2013–14

*Report, together with formal minutes, oral and
written evidence*

*Additional written evidence is contained in
Volume II, available on the Committee website
at www.parliament.uk/science*

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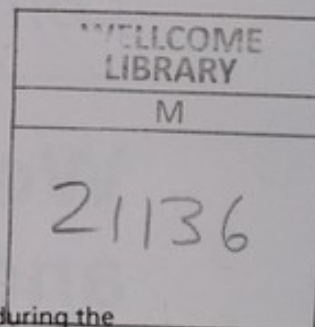
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Science and Technology Committee

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The Reports and evidence of the Committee are published by The Stationery Office by Order of the House. All publications of the Committee (including press notices) are on the Internet at <http://www.parliament.uk/science>. A list of reports from the Committee in this Parliament is included at the back of this volume.

The Reports of the Committee, the formal minutes relating to that report, oral evidence taken and some or all written evidence are available in printed volume(s). Additional written evidence may be published on the internet only.

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The current staff of the Committee are: Dr Stephen McGinness (Clerk); Jessica Montgomery (Second Clerk); Xameerah Malik (Senior Committee Specialist); Victoria Charlton (Committee Specialist); Darren Hackett (Senior Committee Assistant); Julie Storey (Committee Assistant); Henry Ayi-Hyde (Committee Office Assistant); and Nick Davies (Media Officer).

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Summary

Space technology provides the basis for much of modern life, with services supporting communications, environmental monitoring, navigation and security. The UK space sector contributes £9.1 billion a year to the UK economy and directly employs 28, 900 people. It is also one of the UK economy's fastest growing sectors, with an average growth rate of almost 7.5%. The sector has the potential to be a great success story for the UK economy, with ambitions to increase its annual turnover from to £40 billion by 2030.

The UK Space Agency was designed to support this growth. We were pleased to see the commitment of its staff to ensuring the sector's success. However, there is more work to be done. There are real concerns about whether the Agency has enough resources to meet the demands placed on it. In addition, the Government could do much more to define its own requirement for space services, particularly the use of satellite applications, so that industry can use this demand to spur on growth.

We welcome the new commitments made by the Government to the European Space Agency (ESA) at its 2012 ministerial meeting. The UK appears to be securing good value for money from this organisation in terms of industrial return and the ability to participate in impressive science missions. We were pleased to hear an enthusiastic welcome from the ESA for the UK's increased engagement and we look forward to seeing its base at Harwell develop. To further develop this relationship, the Government should seek to increase the number of UK nationals in senior positions at ESA by extending support and encouragement to suitably qualified UK candidates for future director-level positions.

The EU's role in space is important, both in terms of its sponsorship of major programmes and its potential consumption of satellite applications. However, this role is distinct from that of ESA. Whilst ESA is a technical authority, the EU should focus on being an intelligent customer of its services. The Government should use its influence within Europe to ensure that this important distinction between the roles of the two organisations remains.

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1 Introduction

1. On 26 April 1962, Britain launched its first satellite, Ariel 1. Great progress has been made in the fifty years since. For example,

- the UK has participated in science missions including planetary exploration, observation of the Sun and study of the wider Universe;¹
- the UK space industry has grown to be worth over £9 billion;² and
- in May 2013 Major Tim Peake was assigned to a long-duration mission to the International Space Station, scheduled for 2015, making him the first British astronaut³ since Helen Sharman in 1991.⁴

2. Space technology now reaches into many areas of modern life,⁵ it enables weather forecasting and environmental monitoring, facilitates global communications and navigation networks, and supports security and defence missions.⁶ Space science provides the basis for a number of smart materials which can be used “for a range of applications from astronauts’ gloves to kids’ braces”.⁷ Space also “plays a significant role in attracting young people” to science-based careers.⁸

3. There have been a number of policy developments since the Science and Technology Committee’s 2007 inquiry into the UK’s space policy, including:

- The launch of the UK Space Agency in 2010, with a mandate to provide “strategic leadership to the UK’s civil space activity”;⁹
- Development of the Space Innovation and Growth Strategy as a “20-year vision and strategy for the future growth of the space industry”;¹⁰
- The establishment of a Satellite Applications Catapult by the Technology Strategy Board to “become a world-class centre for the development and commercial exploitation of space and satellite-based products, services and applications”;¹¹ and
- Entry into force of the Lisbon Treaty, which gave the European Union a role in space policy.¹²

¹ Ev 62, para 3

² Ev 80, para 19

³ http://www.esa.int/Our_Activities/Human_Spaceflight/Astronauts/Timothy_Peake

⁴ http://news.bbc.co.uk/onthisday/hi/dates/stories/may/18/newsid_2380000/2380649.stm

⁵ Ev w4, para 3

⁶ <http://www.ukspace.org/applications-of-space/>

⁷ http://www.esa.int/ESA_in_your_country/United_Kingdom/Space_technology_and_its_earthly_uses

⁸ Ev w1 para 3

⁹ Ev 78, para 2

¹⁰ <http://www.bis.gov.uk/ukspaceagency/what-we-do/space-and-the-growth-agenda/uk-capabilities-for-overseas-markets/the-space-innovation-and-growth-strategy>

¹¹ <https://sa.catapult.org.uk/about-us;jsessionid=01DBDFF840E23F21B69E838832BA4AF2.2>

4. Space is considered a “key sector for Britain’s future”.¹³ The UK space sector contributes £9.1 billion a year to the UK economy and directly employs 28,900 people.¹⁴ It is also one of the UK economy’s fastest growing sectors,¹⁵ with an average growth rate of almost 7.5%.¹⁶ The UK space sector has an ambitious target to capture 10% of the global market for space by 2030, equivalent to a space industry worth £40 billion.¹⁷ The UK Space Agency is “tasked with fostering the growth of the UK space sector” that should help achieve this target.¹⁸

The UK Space Agency

5. The UK Space Agency is an executive agency of the Department for Business, Innovation and Skills. It was created in April 2011 “to lead and foster the growing UK space sector, delivering a world-class space-programme with maximum economic, scientific and social benefit”.¹⁹ The Agency has “three core functions”:

- “Funding and delivery of civil space projects and downstream space related activities nationally, bilaterally and via the European Space Agency;
- Development of policy including advice to Ministers and oversight of EU space policies (e.g. EU space industrial policy), EU programmes (e.g. Galileo, Copernicus, Horizon 2020), and representing the UK in the United Nations on space matters; and
- Regulation of UK space activities to meet international obligations including licensing of UK-based satellite operators.”²⁰

The European Space Agency

6. The European Space Agency (ESA) is an international organisation with 20 Member States.²¹ Its mission “is to shape the development of Europe’s space capability and ensure that investment in space continues to deliver benefits to the citizens of Europe and the world”.²² ESA’s purpose is “to provide for, and to promote, for exclusively peaceful

¹³ Ev 78, para 1

¹⁴ UK Space Agency Civil Space Strategy 2012-16, foreword, <http://www.bis.gov.uk/assets/ukspaceagency/docs/uk-space-agency-civil-space-strategy.pdf>

¹⁵ <http://www.bis.gov.uk/ukspaceagency>

¹⁶ Q2 [Professor Holdaway]

¹⁷ <http://www.bis.gov.uk/ukspaceagency>

¹⁸ Ev 58, para 1.3

¹⁹ UK Space Agency Civil Space Strategy 2012-16, foreword, <http://www.bis.gov.uk/assets/ukspaceagency/docs/uk-space-agency-civil-space-strategy.pdf>

²⁰ UK Space Agency Corporate Plan 2013-14, p4, <http://www.bis.gov.uk/assets/ukspaceagency/docs-2013/corporate-plan-final-2013-14.pdf>

²¹ Ev 78, para 7

²² Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland and the UK. Canada takes part in some projects under a Cooperation Agreement. http://www.esa.int/About_Us/Welcome_to_ESA/What_is_ESA

²³ http://www.esa.int/About_Us/Welcome_to_ESA/What_is_ESA

purposes, cooperation among European States in space research and technology” and it does so:

- “by elaborating and implementing a long-term European space policy, by recommending space objectives to the Member States, and by concerting the policies of the Member States with respect to other national and international organisations and institutions;
- by elaborating and implementing activities and programmes in the space field;
- by coordinating the European space programme and national programmes, and by integrating the latter progressively and as completely as possible into the European space programme, in particular as regards the development of applications satellites;
- by elaborating and implementing the industrial policy appropriate to its programme and by recommending a coherent industrial policy to the Member States.”²³

Our inquiry

7. We launched our inquiry on 15 February 2013.²⁴ We asked for evidence about the strengths and weaknesses of the UK Space Agency and ESA, the role of the EU in the space sector, the relationship between ESA and the EU and the relationship between the UK and ESA. We received over 25 submissions of written evidence and held three oral evidence sessions.²⁵ In addition, we visited Harwell, Oxfordshire, to learn more about the site’s development as a leading science, technology and business campus. We also visited ESA’s centre for Earth observation, ESRIN, and the Fucino Space Centre to find out about developments in European space sector. We are grateful to those who provided evidence and hosted our visits to Harwell, Frascati and Fucino.

8. We were pleased to hear much positive feedback about the UK Space Agency and to find a sense of momentum within the Agency. We hope that the evidence submitted to this inquiry will be taken into account during the consultation on the Space Innovation and Growth Strategy 2013, launched in September 2013.²⁶ In this report we comment on some of the areas for improvement which were highlighted to us during this inquiry, which we hope will contribute to the Agency’s “restack” of its strategies over the coming months.²⁷ We then turn to relations between ESA and the UK. Finally, following the European Commission’s suggestion that a closer governance relationship between ESA and the EU might be necessary, we consider relations between these two organisations.

²³ http://www.esa.int/About_Us/Welcome_to_ESA/ESA_s_Purpose

²⁴ <http://www.parliament.uk/business/committees/committees-a-z/commons-select/science-and-technology-committee/news/130214-space-agencies-inquiry-announced/>

²⁵ A full list of witnesses is provided at the back of this report.

²⁶ https://connect.innovateuk.org/documents/1583550/3708320/IGS%202013%20Accelerating%20Space%20Enabled%20Growth%20Consultation%20Report?version=1.0&dm_i=UXN,1TMI0,6MOPQX,6IT47,1

²⁷ <https://www.bis.gov.uk/ukspaceagency/news-and-events/2013/Sep/igs-consultation>

9. There was a distinct scarcity of women amongst the witnesses fielded for our evidence sessions during this inquiry. Information from the UK Space Agency indicated that the gender balance amongst their staff was approximately equal.²⁸ However, when we questioned industry representatives, they admitted that women's representation within the field was an issue. Richard Peckham, UKspace, stated that industry did "need to attract more women into space, for sure" whilst John Auburn, Telespazio VEGA UK Ltd, told us that, although the company recruited "a lot" of women, "the women don't get to the top of the tree".²⁹ We will be considering issues relating to the representation of women in science and engineering careers in a separate inquiry into *Women in STEM careers*.³⁰

²⁸ Ev 85

²⁹ Q 47 [Richard Peckham] and Q 48 [John Auburn]

³⁰ <http://www.parliament.uk/business/committees/committees-a-z/commons-select/science-and-technology-committee/inquiries/parliament-2010/women-in-stem-careers/>

2 Space in the UK

Work of the UK Space Agency

10. The creation of the UK Space Agency in 2011 was intended to bring about “a significantly strengthened focus for the Government’s objectives for space”.³¹ As such, the Agency was mandated “to provide strategic leadership to the UK’s civil space activity with a central focus on the growth of the industrial sector”.³² David Parker, Chief Executive, UK Space Agency, explained that the Agency:

was created to do three things: bring coherence and leadership to space activities in the UK from the government side; promote growth and opportunities in the sector itself to stimulate its development; and, because of the excitement of space, to use space as a tool to inspire and excite people.³³

We heard that the Agency’s creation was “a big step towards re-establishing the UK as a space-oriented nation”³⁴ and that, thus far, it had performed “well”,³⁵ been “a success”,³⁶ was a “very significant improvement”,³⁷ and had delivered “a more ambitious, growth-oriented space policy”.³⁸ We welcome these positive reports about the Agency’s work. Here, we pick out three areas in which we have heard concerns about its operations: resourcing, support for businesses and progress in defining Government demand for space services.

Resourcing

11. The Agency consists of 44 staff, based mainly in Swindon.³⁹ It is therefore relatively small, compared to the other “big four” European space nations.⁴⁰ France’s CNES has 2,400 staff, Germany’s DLR has 230 (with 1,000 more within its research teams) and Italy’s ASI has 250 staff.⁴¹ The UK Space Agency itself acknowledged its “modest size”, which means “that it relies on industry, national laboratories and academia for domestic space projects rather than doing this work within Government”.⁴²

³¹ EV 78, para 1

³² *Ibid.*

³³ Q 118 [David Parker]

³⁴ EV 48

³⁵ EV w3, para 15

³⁶ EV 51, para 4.2

³⁷ Q 2 [Professor Smith]

³⁸ EV 57, para 0.2 and EV 64, para 0.2

³⁹ EV 78

⁴⁰ Q2 [Professor Holdaway] and EV w12

⁴¹ EV 79

⁴² *Ibid.*

12. This small size contributed to concerns expressed to us about whether the Agency could cope with the demands of a growing sector.⁴³ UKspace described the Agency as “significantly under-resourced”⁴⁴ and Mullard Space Science Laboratory speculated that these resources “may not be up to the ambitions” expressed by Government for the sector.⁴⁵ In addition, Professor David Southwood, Royal Astronomical Society, told us that “the average space scientist would be concerned about how overstretched the staff are”.⁴⁶ We also heard speculation that continued growth in the UK’s space industry would require increased resources for the Space Agency.⁴⁷

Support for business

13. David Parker told us that small or medium-sized enterprises would be “particularly significant” in securing growth in the space sector.⁴⁸ We heard positive feedback about the Agency’s support for business during our visit to Harwell, where the Managing Director of Elecnor Deimos, a Spanish aerospace company, explained the importance of the UK Space Agency in driving the company’s decision to set up a UK base and highlighted the support which had been provided for the company to start operating in the UK. Despite this, during our inquiry we have heard from a number of companies encountering difficulties with applying for licences or project funding. For example, Alba Orbital Ltd stated that the UK’s satellite licensing process was “currently the most expensive, lengthy and difficult to navigate procedure in the world”.⁴⁹ Richard Peckham, UKspace, thought that the Agency “could beef itself up a little” in its ability to help UK companies to export their products.⁵⁰ When it came to funding applications, Dr Hugh Lewis, PHS Space Ltd, told us that:

You have to invest a significant amount of time and significant proportion of the money you would receive back just to go through the bidding process.⁵¹

14. David Parker acknowledged that applications for funding or exports could involve a “complicated process”, but insisted that the Agency tried to intervene and help where it could.⁵² He pointed to the success of companies such as Surrey Satellites Ltd as an indication that these processes could be navigated successfully. The Minister also recognised that, when it came to licensing or export applications, “the system for approvals needs to work more smoothly”⁵³ and undertook to look at the system for such approvals.⁵⁴ **We welcome the Minister’s commitment to review whether the processes for approving**

⁴³ Q 4 [Professor Holdaway]

⁴⁴ Ev 59, para 4.2

⁴⁵ Ev 52, para 4.1

⁴⁶ Q 4 [Professor Southwood]

⁴⁷ Q 44 [Richard Peckham]

⁴⁸ Q 119 [David Parker]

⁴⁹ Ev w22, para 2

⁵⁰ Q 30 [Richard Peckham]

⁵¹ Q 40 [Dr Lewis]

⁵² Q 152 [David Parker]

⁵³ Q 154 [Rt Hon David Willetts MP]

⁵⁴ Q 154 [Rt Hon David Willetts MP]

licences or export applications could be made to work more smoothly. *We recommend he publishes the outcome of this review in the response to this report.*

Growth through smarter Government

15. Applications derived from satellite data can be used in a variety of sectors, including, for example, maritime, fisheries and agriculture.⁵⁵ We heard that most growth in the space sector would come from the development of such downstream applications and “the use of space data in everyday life”.⁵⁶ For example, the UK Civil Space Strategy 2012–16 states that

Government will increasingly rely on satellite-derived services and data, because in many areas information gathered from space enables government to make better informed policy. Space can provide data on the environment, climate, weather, security, agriculture, coastal management and disaster mitigation—effectively using these resources will help to meet the current and future policy challenges in these areas.⁵⁷

16. The UK Space Agency aims to “support the development of smarter, more efficient government through the use of space data” by providing strategic leadership in the sector, acting as a centre of expertise and helping government departments to define what services they could use. The Civil Space Strategy states that “by becoming an anchor customer, the public sector could enable service-providers to attract private investment, develop export markets and stimulate wider market uptake”.⁵⁸

17. Despite good intentions, we have consistently heard that more needs to be done to reach this goal. Richard Peckham, UKspace, told us that the Agency should take a leading role to “amalgamate the different users” of space data in the public sector “even procuring on behalf of Government”.⁵⁹ He argued that the Agency needed to build “more critical mass in London” in order to effectively “promote space across Whitehall”⁶⁰ because:

As an industrialist, if it looks like you are just trying to sell something, sometimes it is not necessarily easy to get the meetings you need with different Government Departments, whereas the space agency is part of Government, is looking at value for money for Government and not trying to sell something. It is a partnership, and the agency has a role to play to bring together those different constituents.⁶¹

He proposed that the publication of an over-arching national space policy document, scheduled for later in 2013, could be used to highlight the work of the Agency in this field.⁶²

⁵⁵ Q 126 [David Parker]

⁵⁶ Q 125 [David Parker], Q 120 [David Parker]

⁵⁷ UK Civil Space Strategy 2012–16, p 18, <http://www.bis.gov.uk/assets/ukspaceagency/docs/uk-space-agency-civil-space-strategy.pdf>

⁵⁸ UK Civil Space Strategy 2012–16, p 18, <http://www.bis.gov.uk/assets/ukspaceagency/docs/uk-space-agency-civil-space-strategy.pdf>

⁵⁹ Q 31 [Richard Peckham]

⁶⁰ Q 30 [Richard Peckham]

⁶¹ Q 32 [Richard Peckham]

⁶² Q 33 [Richard Peckham]

John Auburn, Telespazio VEGA UK Ltd, concurred that the Agency should "help federate what the Government need and define a service" so that industry could respond.⁶³

18. David Parker told us that a "programme to reach out across government" was in the process of being developed,⁶⁴ but the Minister confirmed that there was more work to be done:

One of our jobs, which is not yet finished, is to raise the level of awareness, both in the commercial sector and across government, of the value of satellite data for completely standard, day-to-day activities which people might not have previously thought of as depending on space: agricultural uses or disaster monitoring. Both the commercial and the public sector could do more of that⁶⁵ [...] I push to the limit my colleagues' tolerance of my saying to them, "Have you thought about a space application to help with your problem?" reminding them that you can get broadband services in remote areas via satellite and use satellites to get information about the performance of agriculture literally field by field.⁶⁶

19. It seems clear that Government could do more to aggregate its own demand for space-derived services. The publication of the national space policy later this year should be used as an opportunity to communicate the potential uses of space to Government departments and push discussions on the use of space applications up departmental agendas. *We recommend that the Government extends further support to the UK Space Agency in its efforts to coordinate demand for satellite applications across Whitehall. The Government should define the challenges currently facing the public sector which may be solved through space technology so that the UK Space Agency can engage industry in helping to solve these. The Government should engage proactively with the UK Space Agency to develop a strategy to achieve this.*

⁶³ Q 33 [John Auburn]

⁶⁴ Q 126 [David Parker]

⁶⁵ Q 155 [Rt Hon David Willetts MP]

⁶⁶ Q 184 [Rt Hon David Willetts MP]

3 ESA and the UK

UK funding for ESA

20. ESA's total budget for 2013 was €4.2 billion. The graph below illustrates the UK's contributions to this budget.⁶⁷

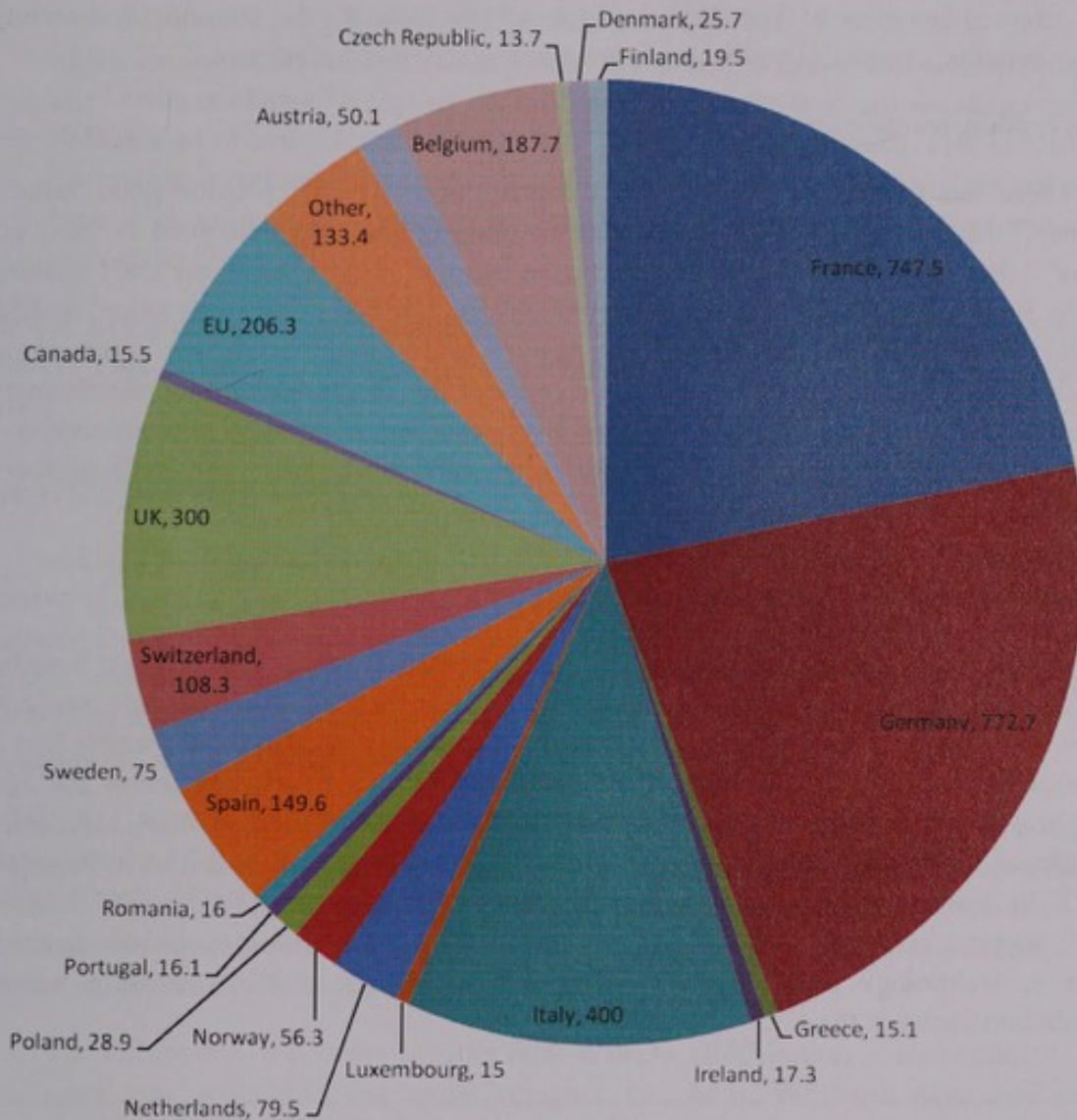


Figure 1 Member State contributions to the European Space Agency (in M€)

21. In November 2012, following a high-level ministerial meeting at ESA (the 'ministerial council'), the Government announced it was increasing the UK's contributions by £60 million a year.⁶⁸ This would bring the UK's total annual contribution to ESA to £240 million.⁶⁹ The Minister assured us that this was extra funding, which would not detract

⁶⁷ Ev 72 appendix 1

⁶⁸ <http://www.bbc.co.uk/news/science-environment-20250533>

⁶⁹ Q 161 [David Parker]

from the overall science budget.⁷⁰ He outlined the case for this spending increase as follows:

I bought the argument that there was an important industrial return for Britain. Secondly, a lot of space science cannot be done on your own; it is a collaborative activity, and there are worthwhile research projects in space that we can do via ESA. Thirdly—this was partly dependent on how the negotiations panned out—we were able, through our membership of ESA, to get a role in the international space station, hence the value of Tim Peake's flight, setting aside all the scientific and technical benefits, in signalling to younger people the excitement of science.⁷¹

This funding increase was set for five years from 2013–14.⁷²

22. There was consensus that the UK's contributions to ESA provide good value for money.⁷³ Furthermore, the recent increase in funding has been welcomed as "very good news"⁷⁴ that had produced "shockwaves across Europe".⁷⁵ As a result, the UK's credibility in the European space sector had increased and the UK had a "stronger voice" in ESA.⁷⁶ David Parker, Chief Executive, UK Space Agency, told us that the UK was "a growing and much more prominent player in ESA" as a result of this increased funding commitment.⁷⁷ Jean-Jacques Dordain, Director General, European Space Agency, also welcomed the investment, saying that it was "the most important news" from the 2012 ministerial meeting.⁷⁸

Return on UK investment

23. Whilst Major Tim Peake's mission to the International Space Station might have been the most high profile outcome of the recent investment increase, other tangible results also appear to have been secured, particularly at the Harwell site in Oxfordshire, where ESA has announced its intention to expand its operations. ESA's European Centre for Space Applications and Telecommunications (ECSAT) was first opened in 2009, but "will be developed by ESA following agreements reached between the UK and ESA in November 2012" in order to reflect "the increased importance given to space by the UK".⁷⁹ ECSAT "will support activities related to telecommunications, integrated applications, climate change, technology and science".⁸⁰ This will sit alongside ESA's existing business incubation centre at the site.

⁷⁰ Q 160 [Rt Hon David Willetts MP]

⁷¹ Q 160 [Rt Hon David Willetts MP]

⁷² Q 162 [Rt Hon David Willetts MP]

⁷³ Q12 [Professor Holdaway]; Q 12 [Professor Smith]; Q 15 [Professor Holdaway]; Q 38 [John Auburn]; Q 97 [Jean-Jacques Dordain]; Q 147 [David Parker]; Ev w2, para 12; Ev 49, para 19; Ev w5, para 18; Ev 63, para 20–22

⁷⁴ Q 100 [Jean-Jacques Dordain]

⁷⁵ Q 33 [John Auburn]

⁷⁶ Q2 [Professor Holdaway]

⁷⁷ Q 122 [David Parker]

⁷⁸ Q 101 [Jean-Jacques Dordain]

⁷⁹ http://www.esa.int/About_Us/Welcome_to_ESA/ECSAT

⁸⁰ http://www.esa.int/About_Us/Welcome_to_ESA/ECSAT

24. David Parker told us that the expansion of ESA's operations at Harwell was "an example of the much stronger influence that the UK now has in the European space community".⁸¹ He said the development "anchors the UK in ESA and ESA in the UK. It gives access to the know-how and capability of ESA, and ESA is able to take advantage of everything that is already happening in the campus at Harwell".⁸² Jean-Jacques Dordain outlined his vision for Harwell as follows:

Harwell, for me, is not only a new centre of ESA in the UK but it is a new type of ESA centre. For me it is a pilot for what I would like to have as ESA centres in the future, which are open centres, and not any more ESA centres with a wall around, a fence. The beauty of Harwell is that we are putting ESA facilities in a campus where there is already a lot of competence and expertise. That makes a difference. That is Harwell. Innovation is coming from connecting different expertise. Innovation does not come from a closed circle. It is only by connecting different expertise that you raise innovation.⁸³

The UK has secured a demonstrable return on its investment in the European Space Agency. This should encourage the Government to make similar commitments in future.

The UK's position in ESA

25. The 2012 funding changes firmly establish the UK amongst the top four players in ESA in terms of financial commitment. However, unlike France, Italy and Germany, the UK has relatively few nationals working in senior positions within ESA. The absence of a UK national at director level has been highlighted to us as particularly problematic. We heard that having a UK director was important for "industry", "the national perspective" and "changing some of the cultures in ESA".⁸⁴

26. Jean-Jacques Dordain argued that a lack of sufficiently qualified UK candidates was the most significant reason for the absence of a UK director. At the last round of recruitment, he stated, "8% of the total of candidates were British candidates" and this was less than half the number of candidates fielded by France, Germany or Italy. Whilst he hoped that a UK director would eventually be found, he cautioned that:

The influence of a country is more related to the contribution of that country. The more you contribute, the more influence you have. We have more and more weighted votes at ESA. The influence is much more to have a competitive industry, because they are making the proposals, and to have competitive scientists.⁸⁵

27. Richard Peckham, UKspace, offered a slightly different explanation for the absence of a UK director:

⁸¹ Q 139 [David Parker]

⁸² Q 137 [David Parker]

⁸³ Q 115 [Jean-Jacques Dordain]

⁸⁴ Q 35 [Richard Peckham]

⁸⁵ Q 111 [Jean-Jacques Dordain]

There are two factors. Certainly, one issue is that we have not put forward enough good candidates. The other is about the will to do it and then prosecuting your case. Germany, France and Italy each has three directors. For them, clearly this was a national priority; they were going to have three directors, and they pushed it at all levels politically, making sure there were good candidates and encouraging people to apply. We just did not do that. We put in the application. We had probably a couple of quite good candidates, but the rest of the push did not come with it. [...] You really need to push; it is part of the overall negotiation when you are negotiating how much subscription you put in. You just have to make clear that this is part of the deal.⁸⁶

28. The Minister told us that he “would rather we did have a director” but that “it is hard to judge exactly how important it is”.⁸⁷ David Parker appeared to partially concede that more could be done to support future applicants as he told us that:

Maybe we have to do more work on the UK side to get good candidates going forward. There will be opportunities when the next round happens in a couple of years’ time, but do we need to have a director just to have influence? No. Would it be a good thing? Yes, of course.⁸⁸

There is likely to be a reshuffle within ESA in 2015, which could provide an opportunity for a UK national to secure a director-level position.⁸⁹

29. The UK’s presence in ESA could be further strengthened by the appointment of a UK national in post as director. Simply hoping that UK candidates will apply and be successful is insufficient. *We recommend that the Government take steps to put in place support mechanisms for potential candidates alongside a concerted drive to increase the UK’s representation amongst ESA’s senior staff.*

⁸⁶ Q 34 [Richard Peckham]

⁸⁷ Q 165 [Rt Hon David Willetts MP]

⁸⁸ Q 144 [David Parker]

⁸⁹ Q 165 [Rt Hon David Willetts MP]

4 ESA and the EU

The EU's role in space

30. The Treaty of Lisbon established a legal basis for the EU to pursue a European space policy.⁹⁰ The EU may therefore “promote joint initiatives, support research and technological development and coordinate the efforts needed for the exploration and exploitation of space”, and to do so it should “establish any appropriate relations with the European Space Agency”.⁹¹ Augusto Gonzalez, Head of Space Policy Unit, European Commission, told us that “the priority of the European Union is to make sure that whatever we do in space delivers benefits for citizens”.⁹² The EU's presence in the space sector has grown significantly in recent years, and an estimated €12 billion is expected to be spent on its space policies from 2014 to 2020.⁹³ The EU has three major space programmes: Galileo, its satellite navigation programme, Copernicus, an Earth observation programme, and EGNOS, the European Geostationary Navigation Overlay Service.⁹⁴ Whilst these are EU programmes, ESA has been tasked with delivering much of the technical output for these programmes.⁹⁵

A “rapprochement” of ESA and the EU

31. In its Communication *Establishing appropriate relations between the EU and the European Space Agency*⁹⁶ the European Commission outlined five factors it considered to be “structural obstacles” in its relationship with ESA.⁹⁷ These were:

- “Mismatch of financial rules”: the EU's Financial Regulation requires procurement for EU programmes to be carried out according to “the strict principle of best value”.⁹⁸ In contrast, ESA operates a policy of geographic return, whereby the contracts secured by industries in each Member State should be proportionate to that Member States' contributions to the organisation.⁹⁹ The Commission argues that “this has given rise to difficulties, particularly whenever programmes are funded through mixed ESA and EU appropriations”.¹⁰⁰

⁹⁰ http://europa.eu/legislation_summaries/institutional_affairs/treaties/lisbon_treaty/ai0027_en.htm and Q 69 Q 73 This competence is shared with Member States (Q 131)

⁹¹ <http://www.lisbon-treaty.org/wcm/the-lisbon-treaty/treaty-on-the-functioning-of-the-european-union-and-comments/part-3-union-policies-and-internal-actions/title-xix-research-and-technological-development-and-space/477-article-189.html>

⁹² Q 69 [Augusto Gonzalez]

⁹³ Q 73 [Augusto Gonzalez]

⁹⁴ Q 69 [Augusto Gonzalez]

⁹⁵ Q 73, Q 74 [Augusto Gonzalez]

⁹⁶ *Establishing appropriate relations between the EU and the European Space Agency*, COM (2012) 671, <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2012:0671:FIN:EN:PDF>

⁹⁷ COM (2012) 671 p3

⁹⁸ COM (2012) 671 p3

⁹⁹ Ev 70, para 5.3

¹⁰⁰ COM (2012) 671 p3

- "Membership asymmetry": ESA's membership includes 18 EU Member States alongside Switzerland and Norway.¹⁰¹ Its membership therefore significantly overlaps with, but does not exactly match, that of the EU. The Commission argues that as ESA undertakes increasing amounts of work in the delivery of the EU's space programmes, this asymmetry gives non-EU members of ESA "disproportionate leverage",¹⁰² as "member states who are not members of the European Union can cast a vote and influence a decision-making process on fundamental matters in EU programmes".¹⁰³
- "Asymmetry in security and defence matters": the Commission argues that "in order to contribute towards objectives of the Commons Security and Defence Policy, the EU has to establish ever closer and stronger links and synergies between the civil and defence dimensions of space".¹⁰⁴ Once more, it argues that the membership "asymmetry" of ESA and the EU are therefore problematic in a space policy context.¹⁰⁵ In particular, Mr Gonzalez highlighted Copernicus and Galileo as programmes which have "a security dimension".¹⁰⁶
- "Absence of mechanisms for policy coordination": cooperation between ESA and the EU is currently organised through the 2004 EU/ESA Framework Agreement, rather than through more formal structures.¹⁰⁷ The Commission argues that because "there is no formal mechanism at policy level to ensure that initiatives taken within ESA are consistent with EU policies", "specific mechanisms for coordination and cooperation need to be agreed in time-consuming negotiations at programme level".¹⁰⁸ It believes such negotiations could be avoided with formal agreements to structure coordination.¹⁰⁹
- "Missing political accountability for ESA": the Commission argues that "the fact that ESA as a European agency has no formal link with the European Parliament deprives ESA of the direct link with citizens that any EU policy enjoys".¹¹⁰ It therefore supposes that bringing ESA closer to the EU would make the Agency "directly" accountable to European citizens.¹¹¹

32. As a result of these issues, the Commission has concluded that:

¹⁰¹ Ev 67, para 1.1

¹⁰² COM (2012) 671 p3

¹⁰³ Q 78 [Augusto Gonzalez]

¹⁰⁴ COM (2012) 671 p3

¹⁰⁵ COM (2012) 671 p3

¹⁰⁶ Q 78 [Augusto Gonzalez]

¹⁰⁷ Ev 69, para 2.3

¹⁰⁸ COM (2012) 671 p4

¹⁰⁹ COM (2012) 671 p4

¹¹⁰ COM (2012) 671 p4

¹¹¹ Q 78 [Augusto Gonzalez]

The need for greater operational efficiency, symmetry in defence and security matters, political coordination and accountability can only be resolved, in the long term, through the rapprochement of ESA towards the European Union.¹¹²

Three possible forms for such a "rapprochement" have been put forward. These are: "improved cooperation under the status quo, bringing ESA as an intergovernmental organisation under the authority of the European Union [...] or transforming ESA into an EU agency".¹¹³

33. We put these "obstacles" to Jean-Jacques Dordain, Director General, European Space Agency. Whilst acknowledging that "in the current relationship, there is room for improvement", he described himself as "not keen for an institutional change".¹¹⁴ Indeed, he did "not consider" the five issues raised by the Commission as obstacles, and explained that ESA's financial system had already been changed to be consistent with EU regulations.¹¹⁵ He dismissed the Commission's difficulties with membership asymmetry, saying he would "not kick out Switzerland and Norway, because, frankly speaking, we need Switzerland and Norway".¹¹⁶ He also dismissed the Commission's concerns about cooperation on defence and security matters.¹¹⁷ ESA stated that the "optimum" resolution to the Commission's concerns "would be one which most effectively maintains the strengths of the ESA system while significantly improving the efficiency of its relationship with the EU".¹¹⁸

34. We heard widespread scepticism regarding the Commission's proposals, which echoed the concerns of ESA's Director General. For example, UKspace stated that the EU should "avoid imposing modifications on the successful ESA model" as "ESA and the EU can work well together with distinct and complementary roles";¹¹⁹ the National Oceanography Centre stated that the rapprochement "does not seem desirable, since it will undoubtedly disrupt ESA's ability to deliver";¹²⁰ Mullard Space Science Laboratory stated that it seemed "unlikely that oversight by the EU would in any way increase operational efficiency";¹²¹ Professor David Southwood stated that the Commission's proposals "seem rather one size fits all";¹²² and the UK Space Agency stated that "the strategic obstacles set out by the Commission are over-stated, though there are some issues that need to be addressed".¹²³ David Parker told us that:

We have not seen the rationale for why there would be any benefits in transferring the European Space Agency lock, stock and barrel to the European Union. ESA has a

¹¹² COM (2012) 671 p4

¹¹³ COM (2012) 671 p4

¹¹⁴ Q 102 [Jean-Jacques Dordain]

¹¹⁵ Q 104 [Jean-Jacques Dordain]

¹¹⁶ Q 105 [Jean-Jacques Dordain]

¹¹⁷ Q 104 [Jean-Jacques Dordain]

¹¹⁸ Ev 70, para 2.8

¹¹⁹ Ev 57, para 0.5, para 2.2

¹²⁰ Ev w6, para 2.2

¹²¹ Ev 52, para 2.1

¹²² Ev 48, para 7

¹²³ Ev 81, para 34

very effective relationship with the science community; it works, so there is nothing particularly to be improved there. It has an effective working relationship with industry in developing commercial technology, so we don't see there is anything to be gained. Where the European Union can really make a contribution is at the high political and policy level of supporting relationships in space activities between Europe and, for example, free trade discussions, perhaps with the United States, and also investing in space infrastructure where they support European Union policies. Those are the directions in which we would like to see the European Union's involvement in space head off.¹²⁴

35. The Minister told us that he thought the Commission's concerns were "misplaced" and "they were trying to invent problems that were not there".¹²⁵ When questioned on the proposals, he stated:

The Commission seems to suggest that transforming ESA into an EU agency might be necessary to make it easier to manage EU funds through delegations to ESA. We believe that instead we should focus on what is best for growth and science, rather than tidy-mindedness. ESA has served our space sector well as an independent intergovernmental organisation. In preliminary discussions in both the EU and ESA, several member states, notably the UK and Germany, have arrived at the view that there is no obvious case for ESA to become an agency of the EU. There are legitimate questions about how it can work better with the EU. It gets about a quarter of its funding from the EU and sometimes it acts as an agent for the EU, as it is commissioned to carry out work and deliver programmes such as Galileo. There are issues about different auditing and funding rules, which can be tidied up, but it is not obvious that the solution to such problems is to go as far as ESA becoming an EU agency.¹²⁶

36. We instead heard an alternative view for how the relationship between ESA and the EU should develop. Jean-Jacques Dordain set out explicitly what he hoped for from the EU as follows:

I consider that the EU is the world of the European citizen, while ESA is the space world. I am not expecting, let me put it this way, the Commission to explain to me how we make a satellite. We know how to make a satellite. What I am expecting from the European Commission is for it to tell me which of the European policies can benefit from space infrastructure. There are a lot, starting with-I am French-the agricultural policy, but also the environment, security and development policies can all benefit from space infrastructure. I need the European Commission. I need a guide. I am not a specialist in agriculture or security. This is what I am expecting from the EU. Again, I am not expecting from it satellites-we know how to make satellites-but I am expecting from it to describe the demand of European policies that can benefit from space infrastructure.¹²⁷

¹²⁴ Q 134 [David Parker]

¹²⁵ Q 173 [Rt Hon David Willetts MP]

¹²⁶ <http://www.publications.parliament.uk/pa/cm201213/cmgeneral/euro/130211/130211s01.htm>

¹²⁷ Q 102 [Jean-Jacques Dordain]

The Minister appeared to agree with this assessment, stating that “the EU can use ESA to deliver EU programmes and be a downstream customer, building up the use of ESA technology”.¹²⁸

37. The Commission’s proposals are scheduled for discussion at the next ESA ministerial council meeting, where the Minister will be involved in putting together ESA’s strategy for how it should interact with the EU.¹²⁹ **The EU will be an important player in the space sector over the coming years. However, its role is distinct from that of the European Space Agency (ESA). ESA has specific strengths made possible through its current structure and organisation. Rather than seeking to oversee ESA’s work, the EU should focus on developing its role as a policymaker and customer for space services, leaving ESA to act as a technical or design authority. *We recommend that the Government resists attempts by the European Commission to bring the European Space Agency under its control. We also recommend that Sir Mark Walport, Government Chief Scientific Adviser, raises the scientific rationale behind this recommendation with Professor Anne Glover, the Chief Scientific Adviser to the President of the European Commission.***

¹²⁸ Q 173 [Rt Hon David Willetts MP]

¹²⁹ Q 19 [Professor Holdaway]

5 Conclusion

38. The space sector has the potential to be a great success story for the UK economy, particularly if industry can achieve its ambitious target to reach an annual turnover of £40 billion by 2030.¹³⁰ To achieve this, significant growth in the use of space applications will be needed. A key element in facilitating this growth will be figuring out how to aggregate demand from Government for space services. This is also true at an EU-level. The upcoming publication of the national space policy should be used as a catalyst for discussions between Government departments as to how to make the best use of the services that can be provided by space infrastructure. If the Government can federate and clearly define its service need, industry seems keen to meet it.

39. The Minister has previously highlighted space as one of his “eight great technologies” which “Government should be promoting”.¹³¹ We have seen a lot of exciting developments in the sector in recent months; developments at Harwell, the establishment of the Satellite Applications Catapult to “support UK industry and become a world-class centre” for satellite-based products,¹³² the announcement of Government support for the SABRE rocket engine¹³³ and the assignment of Tim Peake to the International Space Station. For the Minister to achieve his vision of the UK as a “world leader” in satellites and the analysis of satellite data, we need to see such excitement extend across Government, reflecting the range of uses of satellite applications, rather than simply being confined to the work of a single sector or agency.

40. The EU’s role in space is important and is likely to expand over the coming years. However, this expansion should not be directed towards governance of ESA, but towards making sure that European citizens are getting the real benefits of space. The EU is positioned well to help industry compete globally and to expand the use of space applications.¹³⁴ ESA and the EU have distinct strengths which should be maintained and coordinated.

41. Discussions with industry have highlighted to us the importance of maintaining long-term support for the space sector. This is particularly valuable in attracting business from elsewhere in the world to the UK. David Parker, Chief Executive, UK Space Agency, told us that “consistency of support for fundamental science is absolutely valuable” and “the message that has been transmitted is that the UK has a long-term vision”.¹³⁵ Rob Douglas, Chair, UK Space Agency Steering Board, concurred that “it did benefit the space agency and the sector hugely that there was continuity of policy at the change of

¹³⁰ UK Space Agency Corporate Plan 2012, p8, <http://www.bis.gov.uk/assets/ukspaceagency/docs-2013/agency-corporate-plan-2012.pdf>

¹³¹ <http://www.policyexchange.org.uk/images/publications/eight%20great%20technologies.pdf> p9

¹³² https://sa.catapult.org.uk/news-view/-/asset_publisher/nzNaGF403FPD/content/duke-of-york-officially-opens-satellite-applications-catapult

¹³³ <https://www.gov.uk/government/news/200-million-boost-for-uk-space-industry>

¹³⁴ Q 58 [John Auburn]

¹³⁵ Q 129 [David Parker]

administration".¹³⁶ We would like to see this continuity of support maintained over the coming years.

¹³⁶ Q 129 [Rob Douglas]

Conclusions and recommendations

1. We welcome the Minister's commitment to review whether the processes for approving licences or export applications could be made to work more smoothly. We recommend he publishes the outcome of this review in the response to this report. (Paragraph 14)
2. It seems clear that Government could do more to aggregate its own demand for space-derived services. The publication of the national space policy later this year should be used as an opportunity to communicate the potential uses of space to Government departments and push discussions on the use of space applications up departmental agendas. We recommend that the Government extends further support to the UK Space Agency in its efforts to coordinate demand for satellite applications across Whitehall. The Government should define the challenges currently facing the public sector which may be solved through space technology so that the UK Space Agency can engage industry in helping to solve these. The Government should engage proactively with the UK Space Agency to develop a strategy to achieve this. (Paragraph 19)
3. The UK has secured a demonstrable return on its investment in the European Space Agency. This should encourage the Government to make similar commitments in future. (Paragraph 24)
4. The UK's presence in ESA could be further strengthened by the appointment of a UK national in post as director. Simply hoping that UK candidates will apply and be successful is insufficient. We recommend that the Government take steps to put in place support mechanisms for potential candidates alongside a concerted drive to increase the UK's representation amongst ESA's senior staff. (Paragraph 29)
5. The EU will be an important player in the space sector over the coming years. However, its role is distinct from that of the European Space Agency (ESA). ESA has specific strengths made possible through its current structure and organisation. Rather than seeking to oversee ESA's work, the EU should focus on developing its role as a policymaker and customer for space services, leaving ESA to act as a technical or design authority. We recommend that the Government resists attempts by the European Commission to bring the European Space Agency under its control. We also recommend that Sir Mark Walport, Government Chief Scientific Adviser, raises the scientific rationale behind this recommendation with Professor Anne Glover, the Chief Scientific Adviser to the President of the European Commission. (Paragraph 37)

Formal Minutes

Monday 14 October 2013

Members present:

Andrew Miller, in the Chair

Stephen Metcalfe
Graham Stringer

Stephen Mosley

Draft Report (*Work of the European and UK Space Agencies*), proposed by the Chair, brought up and read.

Ordered, That the draft Report be read a second time, paragraph by paragraph.

Paragraphs 1 to 41 read and agreed to.

Summary agreed to.

Resolved, That the Report be the Fourth Report of the Committee to the House.

Ordered, That the Chair make the Report to the House.

Ordered, That embargoed copies of the Report be made available, in accordance with the provisions of Standing Order No. 134.

Written evidence was ordered to be reported to the House for printing with the Report.

[Adjourned till Wednesday 16 October at 9.00 am]

Witnesses

Wednesday 12 June 2013

Page

Professor David Southwood, Senior Research Investigator, Imperial College London, and President, Royal Astronomical Society, **Professor Alan Smith**, Director, Mullard Space Science Laboratory, University College London, **Professor Shaun Quegan**, University of Sheffield, appearing on behalf of the Natural Environment Research Council (NERC), and **Professor Richard Holdaway**, Director, RAL Space, appearing on behalf of the Science and Technology Facilities Council (STFC)

Ev 1

John Auburn, Vice President European Space Institutions, Telespazio VEGA UK Ltd, **Dr Hugh Lewis**, University of Southampton, appearing on behalf of PHS Space Ltd, and **Richard Peckham**, Business Development Director (UK), Astrium

Ev 10

Wednesday 3 July 2013

Augusto Gonzalez, Head of Unit, Policy and Space Research, European Commission

Ev 19

Jean-Jacques Dordain, Director General, European Space Agency

Ev 24

Wednesday 10 July 2013

David Parker, Chief Executive, UK Space Agency, **Catherine Mealing-Jones**, Director Growth, Applications and EU Programmes, UK Space Agency, and **Rob Douglas**, Non-Executive Chairman, UK Space Agency Steering Board

Ev 32

Rt Hon David Willetts MP, Minister of State for Universities and Science, Department for Business, Innovation and Skills, and **David Parker**, Chief Executive, UK Space Agency

Ev 41

List of printed written evidence

1	Professor David Southwood (ESA 002)	Ev 48
2	Space Action Network (ESA 004)	Ev 50
3	Mullard Space Science Laboratory, University College London (ESA 005)	Ev 51
4	PHS Space Ltd (ESA 006 and 006a)	Ev 53, Ev 56
5	UKspace (ESA 007)	Ev 57
6	Royal Astronomical Society (ESA 011)	Ev 61
7	Telespazio VEGA (ESA 014)	Ev 64
8	Director General of the European Space Agency (ESA 016)	Ev 67
9	Research Councils UK (ESA 019)	Ev 74
10	UK Space Agency (ESA 022 and 22a)	Ev 78, Ev 86

List of additional written evidence

(published in Volume II on the Committee's website www.parliament.uk/science)

1	Royal Aeronautical Society (ESA 001)	Ev w1
2	Surrey Satellite Technology Ltd (SSTL) (ESA 003)	Ev w2
3	College of Science and Engineering, University of Leicester (ESA 008)	Ev w4
4	National Oceanography Centre (ESA 010)	Ev w6
5	Professor Michael Sheehan (ESA 012)	Ev w8
6	Unite (ESA 017)	Ev w11
7	Royal Academy of Engineering (ESA 018)	Ev w11
8	Institute of Physics (ESA 020)	Ev w14
9	Dr Kevin Madders (ESA 021)	Ev w16
10	Met Office (ESA 023)	Ev w20
11	Alba Orbital Ltd (ESA 025)	Ev w22
12	CGI IT UK Limited (ESA 015)	Ev w22

List of Reports from the Committee during the current Parliament

The reference number of the Government's response to each Report is printed in brackets after the HC printing number.

Session 2013–14

First Special Report	Educating tomorrow's engineers: the impact of Government reforms on 14–19 education: Government Response to the Committee's Seventh Report of Session 2012–13	HC 102
First Report	Water quality: priority substances	HC 272–I (HC 648)
Second Special Report	Marine science: Government Response to the Committee's Ninth Report of Session 2012–13	HC 443
Third Special Report	Bridging the valley of death: improving the commercialisation of research: Government response to the Committee's Eighth Report of Session 2012–13	HC 559
Second Report	Forensic science	HC 610
Fourth Special Report	Water quality: priority substances: Government response to the Committee's First Report of Session 2013–14	HC 648
Third Report	Clinical trials	HC 104

Session 2012–13

First Special Report	Science in the Met Office: Government Response to the Committee's Thirteenth Report of Session 2010–12	HC 162
First Report	Devil's bargain? Energy risks and the public	HC 428 (HC 677)
Second Report	Pre-appointment hearing with the Government's preferred candidate for Chair of the Medical Research Council	HC 510–I
Second Special Report	Engineering in government: follow-up to the 2009 report on Engineering: turning ideas into reality: Government Response to the Committee's Fifteenth Report of Session 2010–12	HC 511
Third Report	The Census and social science	HC 322 (HC 1053)
Fourth Report	Building scientific capacity for development	HC 377 (HC 907)
Fifth Report	Regulation of medical implants in the EU and UK	HC 163 (Cm 8496)
Sixth Report	Proposed merger of British Antarctic Survey and National Oceanography Centre	HC 699 (HC 906)
Third Special Report	Devil's bargain? Energy risks and the public: Government Response to the Committee's First Report of Session 2012–13	HC 677
Fourth Special Report	Building scientific capacity for development: Government and UK Collaborative on Development Sciences Response to the Committee's Fourth Report of Session 2012–13	HC 907

Fifth Special Report	Proposed merger of British Antarctic Survey and National Oceanography Centre: Natural Environment Research Council Response to the Committee's Sixth Report of Session 2012–13	HC 906
Seventh Report	Educating tomorrow's engineers: the impact of Government reforms on 14–19 education	HC 665 (HC 102, Session 2013–14)
Eighth Report	Bridging the valley of death: improving the commercialisation of research	HC 348 (HC 559, Session 2013–14)
Sixth Special Report	The Census and social science: Government and Economic and Social Research Council (ESRC) Responses to the Committee's Third Report of Session 2012–13	HC 1053
Session 2010–12		
First Special Report	The Legacy Report: Government Response to the Committee's Ninth Report of Session 2009–10	HC 370
First Report	The Reviews into the University of East Anglia's Climatic Research Unit's E-mails	HC 444 (HC 496)
Second Report	Technology and Innovation Centres	HC 618 (HC 1041)
Third Report	Scientific advice and evidence in emergencies	HC 498 (HC 1042 and HC 1139)
Second Special Report	The Reviews into the University of East Anglia's Climatic Research Unit's E-mails: Government Response to the Committee's First Report of Session 2010–12	HC 496
Fourth Report	Astronomy and Particle Physics	HC 806 (HC 1425)
Fifth Report	Strategically important metals	HC 726 (HC 1479)
Third Special Report	Technology and Innovation Centres: Government Response to the Committee's Second Report of Session 2010–12	HC 1041
Fourth Special Report	Scientific advice and evidence in emergencies: Government Response to the Committee's Third Report of Session 2010–12	HC 1042
Sixth Report	UK Centre for Medical Research and Innovation (UKCMRI)	HC 727 (HC 1475)
Fifth Special Report	Bioengineering: Government Response to the Committee's Seventh Report of 2009–10	HC 1138
Sixth Special Report	Scientific advice and evidence in emergencies: Supplementary Government Response to the Committee's Third Report of Session 2010–12	HC 1139
Seventh Report	The Forensic Science Service	HC 855 (Cm 8215)
Seventh Special Report	Astronomy and Particle Physics: Government and Science and Technology Facilities Council Response to the Committee's Fourth Report of Session 2010–12	HC 1425
Eighth Report	Peer review in scientific publications	HC 856 (HC 1535)
Eighth Special Report	UK Centre for Medical Research and Innovation (UKCMRI): Government Response to the Committee's Sixth Report of session 2010–12	HC 1475
Ninth Report	Practical experiments in school science lessons and science field trips	HC 1060–I (HC 1655)

Ninth Special Report	Strategically important metals: Government Response to the Committee's Fifth Report of Session 2010–12	HC 1479
Tenth Special Report	Peer review in scientific publications: Government and Research Councils UK Responses to the Committee's Eighth Report of Session 2010–12	HC 1535
Tenth Report	Pre-appointment hearing with the Government's preferred candidate for Chair of the Technology Strategy Board	HC 1539–I
Eleventh Special Report	Practical experiments in school science lessons and science field trips: Government and Ofqual Responses to the Committee's Ninth Report of Session 2010–12	HC 1655
Eleventh Report	Alcohol guidelines	HC 1536 (Cm 8329)
Twelfth Report	Malware and cyber crime	HC 1537 (Cm 8328)
Thirteenth Report	Science in the Met Office	HC 1538
Fourteenth Report	Pre-appointment hearing with the Government's preferred candidate for Chair of the Engineering and Physical Sciences Research Council	HC 1871–I
Fifteenth Report	Engineering in government: follow-up to the 2009 report on Engineering: turning ideas into reality	HC 1667 (HC 511, Session 2012–13)

Oral evidence

Taken before the Science and Technology Committee

on Wednesday 12 June 2013

Members present:

Andrew Miller (Chair)

Jim Dowd
Stephen Metcalfe
David Morris
Stephen Mosley

Pamela Nash
Graham Stringer
David Tredinnick

Examination of Witnesses

Witnesses: **Professor David Southwood**, Senior Research Investigator, Imperial College London, and President, Royal Astronomical Society, **Professor Alan Smith**, Director, Mullard Space Science Laboratory, University College London, **Professor Shaun Quegan**, University of Sheffield, appearing on behalf of the Natural Environment Research Council (NERC), and **Professor Richard Holdaway**, Director, RAL Space, appearing on behalf of the Science and Technology Facilities Council (STFC), gave evidence.

Q1 Chair: Gentlemen, thank you very much for coming in this morning. It would be helpful, before we formally start, if the four of you could introduce yourselves. We are a little thin on the ground this morning because, for reasons that totally baffle me in the way this place works, we lose several members to the Welsh Grand Committee, which happens to be meeting today. I am sure the Committee must have some important work on. Could I start by asking you to introduce yourselves?

Professor Holdaway: I am Richard Holdaway, director of RAL Space, which is part of the Science and Technology Facilities Council. We undertake R and D and commercial exploitation with the European Space Agency, NASA, industry and academia worldwide. We have been doing that for 30-odd years. We have a large number of pieces of hardware in space, and a lot of our current emphasis is on exploitation and the growth agenda, and as such we have spun out seven companies in the last five years to help that end product.

Professor Smith: I am Alan Smith, director of the Mullard Space Science Laboratory, which is part of University College London. We are one of the largest organisations in the UK building and studying instrumentation for space research and involved in a large number of ESA and other national programmes. I am also chairman of the Space Action Network, which is an organisation comprising the heads of most of the large space groups in space science, earth observation and space engineering.

Professor Southwood: I am David Southwood. I am attached to Imperial College, but I am retired from the European Space Agency, where I worked in both earth observation and space science. At the moment I am president of the Royal Astronomical Society, which looks after the interests of the scientific community in astronomy and much of geophysics—much of earth science but not all. I am also a member of the steering board of the UK Space Agency.

Professor Quegan: My name is Shaun Quegan from Sheffield. I work in the National Centre for Earth Observation, which is the umbrella for a large part of

the earth observation science carried out under NERC. I lead the BIOMASS mission, which in May was selected as the seventh Explorer mission. I have previously been involved in the Earth Science Advisory Committee of ESA. I previously led one of the research councils' centres of excellence for earth observation.

Q2 Chair: Thank you very much. Since the UK Space Agency was established, how effective do you think it has been? What do you think its main achievements are?

Professor Holdaway: It has been very effective in the transition into an agency from its predecessor, British National Space Centre. It is what the whole community, as well as Government, was looking to happen. That transition has gone pretty well. It is a small agency compared with the likes of the European Space Agency, NASA and France and Germany. It is a small agency with a large budget and a small number of staff.

You ask about its most important successes to date. Without doubt, that has been the outcome of last year's ministerial, which has seen a significant increase in the UK subscription to ESA, which now puts us third in terms of overall budget.

That is very important for a number of reasons. It gives us a stronger voice in the larger programmes, both scientifically and from the technical point of view, and also sets the scene for the next five years of the ESA programme and the community within the UK that both supports and follows that programme. It is indicative of the current and previous Government's support for the space sector, which, as I am sure you know, is one of the fastest growing in the UK economy. It is now worth over £10 billion a year. It is heading towards 100,000 employees and is growing very rapidly, not just in the UK but in terms of the global market, which is also growing very quickly. This puts the UK in a very strong position. The UK Space Agency, together with support from the community in general and industry in particular, has been very supportive of the lead-up to the ministerial

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and now has the onus to deliver growth and jobs and has to help grow the economy.

Professor Smith: I agree with all that Richard has said. From the space science perspective, it has been a very significant improvement over the BNSC and the division of responsibilities among the research councils, particularly STFC. The UKSA is a much more responsive organisation. It seems to have a more effective relationship with ESA in its new guise; it is more respected in that regard. We have just been through a process of negotiation of participation in some future space science missions. Those negotiations have been conducted more effectively, I would say, and the community has been very appreciative of the fact that this has been done in an equitable way but very effectively.

Professor Southwood: I agree with what my colleagues have said but would add a few things. It is still bedding down; it is not fully staffed, and inevitably that means people are dissatisfied because of concerns.

Q3 Chair: Does that imply it is not properly resourced?

Professor Southwood: There is now a plan to increase its staffing to a more reasonable level. That has been done over the last year. There has been a modelling of the requirement, and new hiring is to come. The problem is that we are in an age of austerity, quite correctly—I am not criticising that—so there are procedures to go through when in other parts of BIS people are losing jobs and so on.

Q4 Chair: Can you give examples of things that have not worked out as well as they should because of the resource pressure?

Professor Southwood: It is slowness of response and people having to spend too much time on human resources issues. In the submissions to the Royal Astronomical Society this was a concern of the community, without being able to point to any major disaster. In the last year there has been a Council of Ministers at ESA, and clearly that had to occupy the agency very fully. At the same time, the community felt that on day-to-day issues the response was slow. To be perfectly frank, I am not saying it is not going to be sorted out. We are on a good path and there is a plan, but I would not be surprised if the average space scientist would be concerned about how overstretched the staff are. They are working enormously long hours. You can do that for a year or two, but you worry about people falling over. We are past the danger period, in the sense that people can now see there is a plan. The reason it is not in place yet is simply that you have to follow due procedures within the civil service, and so on.

Professor Quegan: NERC's position is an amalgam of the previous three. The UK Space Agency played a very important role in getting a strong response in the ministerial, which has been crucial for NERC science through the earth observation envelope programme and the climate change initiative, which are central to NERC's mission. Like David, the worry for NERC is the slow response time, and often this

has not allowed the UKSA to take full advantage of the organisations that contribute to it. It can also be rather slow or late in getting requests for information to organisations. In some cases, late requests have made it difficult to fully consult in time so the information supplied was not complete.

Professor Holdaway: To follow up what David said about resources, for an agency that is working in a sector that is growing rapidly and has just had a big expansion of the ESA programme for which it is responsible, it is important to have the right number of people. Most people recognise that it does not have quite enough staff. But a secondary issue, which is every bit as important, is about the right type of staff with the right skills. One consequence of the due process that David mentioned in how they recruit is its inability in the last six months or so to recruit people, first, with sufficient space and, secondly, business experience. A lot of what the agency does is strategy and policy, and there are plenty of people with that background in the agency, but the general feeling is that there are not enough people with space science, particularly space technology, and business experience.

Q5 David Tredinnick: Could I ask a supplementary question before I get on to the relationship with the research councils? Where are you trying to make up that shortfall? Are you going to India, as certain companies are in my constituency? Where are you finding the graduates you need if we cannot produce them here?

Professor Holdaway: There are two questions. One is: where do we get the experienced people to work with the agency? A number of organisations—certainly both research councils STFC and NERC—as well as industry are helping by seconding people into the agency to work either part time or full time for a fixed period. That has been the case for some years and works relatively well but does not give the long-term continuity that is required.

The second half of your question is about how the sector itself is managing in terms of recruiting scientists, in particular engineers from universities and apprentices, who are every bit as important as engineers. For us—I am sure I am not alone here—our biggest problem is the flow or, rather, the lack of flow of suitably qualified engineering graduates within the UK. If you look at the numbers, about 20,000 engineers graduate within the UK; China has 200,000 every year. As most western countries do, we have a real problem, which is being addressed partly by organisations such as the research councils, UK Space, the Institute of Physics and the Royal Academy of Engineering, and there are a number of other initiatives around, but they are all making small step changes. What these really need is a quantum jump in the number of people coming through with the right technical background.

Professor Smith: Our masters courses in space research in those areas are populated largely by overseas students, who then return to their countries. Although the education is there, we are not seeing the

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throughput of UK individuals coming through that method.

Q6 David Tredinnick: I don't know how we want to pursue this. There are even further problems. On Friday I was at the Motor Industry Research Association in my constituency. I talked to the chief executive about the fact that, when we get graduates, so many graduates go off to become accountants because the mathematical qualifications are so much better. They all end up at Pricewaterhouse in the City, when they should be with you and the space agency.

Professor Quegan: From the point of view of NERC, through the National Centre for Earth Observation we train a significant number of postdocs and postgrads. In my experience, most of them stay within the sector. I have not seen any of my students go into the sectors you are talking about.

Professor Southwood: There is a distinction, in that astronomers tend to come from physics, and, if you are a geophysicist and you come out with a geophysical qualification, companies are lining up for you.

Q7 David Tredinnick: From the Royal School of Mines.

Professor Southwood: They have already made the choice to pursue a career in earth science, if you like. I don't think that is true for an astronomer. Therefore, they are tempted by accountancy and so on, because of the longer-term view.

Q8 David Tredinnick: Are you saying that geophysics graduates of the Royal School of Mines and Imperial College would follow the path you are suggesting?

Professor Southwood: As far as I know, the graduates of earth science and engineering at Imperial tend to stay in earth science.

Q9 David Tredinnick: How effectively do you think the UK Space Agency works with the research councils?

Professor Southwood: It has been a concern. The space agency, to be as effective as it has been over the last year or so, is and has had to be top-down. It has to look after the national interest. On the other hand, science people prefer, quite correctly, peer review and a lot more bottom-up, deciding what the priorities are in science, from the science community as a whole. The space agency has left much of the science policy responsibility in the hands of the research councils. That is a trust, in the sense one is trusting that the research councils will not then decide that the space agency has its problems in building spacecraft, or whatever it does, and the councils can then say that space is not a priority for them. There has to be a partnership. Indeed, at the moment there are procedures put in place by the space agency with the research councils. They understand what the space agency is doing; they give them plenty of lines of communication.

The question is getting that sense of ownership of the science, because the peer review for exploiting the

science that comes out of space remains in the hands of the research councils. That is a trust, if you like, that is passed from the space agency to the research councils. We all believe that, for the best scientific solution, peer review is the testing thing, but, if you have peer review of a space programme by people who don't do space, often they do not understand its full significance. The research councils have to get the right balance and recognise that they do not get the funds to build space missions, invest in ESA and so on. They get to tell the space agency what they would like to see done, but only if they tell them that the decisions come through the space agency. Once the data and so on start coming back there is exploitation. Just as we would expect to hand data that can be used commercially to industry and develop industry, so the space agency expects to see science handled by the research councils under the Haldane process of peer review.

Professor Smith: I would make two points in this area. While peer review for science is not challenged by me or the people I represent, when it comes to strategic relationships with nations such as China and India, the opportunity to engage in their science programme has additional benefits beyond the immediate science return. The immediate science return may not compare with what you might get in a major ESA or NASA mission. In those situations, research council peer review is unable to support such engagements because it will vote only for the best possible science given its limited resources, so there is no money to make strategic scientific relationships with these emerging nations.

Q10 Chair: It must work to a certain degree, because certainly STFC funds a number of large-scale programmes that do not have any immediate obvious payback to the public purse. There must be a strategy there somewhere, surely. You don't think there is.

Professor Smith: There may be, but I am talking in terms of space. Richard has been on many more, but we have been on delegations to China, India, Brazil, Russia and places like that, to try to drum up scientific relationships. When we come back to the UK there is no support within the research councils for that science, because it is not the top quality science that can be achieved through, for instance, the ESA programme. Therefore, it always falls below the line in terms of science. The additional commercial benefits—opening up trade and so on—of engaging with these nations in the longer term are not counted in that, because peer review of science cannot and does not deal with those things. There needs to be a mechanism whereby the UK Space Agency can support such things, but it cannot; it refers back to the research councils. I have another one, but that is one area. I have a feeling that some people want to dive in.

Professor Southwood: I would add another one of a similar nature. We now have a Briton, Tim Peake, training to fly on the space station. I don't think that would ever have got a straight vote from a research council. Psychologically, maybe it is very important in empowering the British people. If you look at the public attraction that Tim Peake has become, you

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realise that it has nothing to do with science but something to do with being a human being.

Mr Willetts negotiated this successfully for Britain. It is not science; it is not going to be voted through by a peer review group looking at the value of the science that will emerge. Tim will do science; maybe it will be great—we don't know. But an enormous amount more comes back strategically in terms of empowering children and the British people. Look at the number of MPs who went to the Commons Terrace to meet Tim Peake. That is more MPs than I have ever seen for a space event before. There are things where peer review does not work and there is a need for strategic action. I have chosen an extreme case deliberately. I would agree very strongly with Alan that, if we are to increase our nation's leverage in countries like Brazil, Russia, India and China, we will have to start.

Q11 David Tredinnick: What you are talking about is a lot of goodwill out there in other countries. It is not the first time we have had co-operation. I remember 20 years ago as a Member of Parliament going to Baikonur Cosmodrome to watch "the girl from Mars," as she was called, go into space. There was terrific interest in that, and we had receptions here too. The whole "good will" thing is very important. Listening to you, Professor Southwood, is there not a problem with poor communication between the UK Space Agency and the research councils? It sounds as if it is not very joined up and there is a lot of work to be done.

Professor Southwood: We are working hard to join it up. Before today, I tried to find examples where I could really say it is broken. The system is working well enough. I cannot come with any hanging evidence to show that things are not working properly. What is missing is the sense of ownership of the science in the end by the research councils. They have given advice when asked, and they have peer-reviewed when they have needed to do that. They have not quite got used to the idea that they still own the ultimate product on the science side, but we are working on that. I am not entirely pessimistic about it.

Professor Holdaway: Can I clarify what is partly a misunderstanding here? There is a dual key mechanism between the agency and the research councils, as I am sure you know. The agency is responsible for some of the upstream R and D and the big missions; both research councils are responsible for the science exploitation. The question is: how well joined up is that? There is always room for improvement, as there is in anything in life.

There is very close collaboration between the research councils and the agency. The chief executive of STFC sits on the space agency board. There is a lot of cross-membership of the peer review groups within the research councils and the advisory bodies within the UK Space Agency. Everything that feasibly can be done is probably done. What is probably still missing at the moment, as the agency learns how to work even more closely with the research councils, is the long-term strategy. ESA has a very long-term strategy. The space agency mirrors that with its upcoming

programmes, but what the research councils probably do not do in a sufficiently joined-up way is have a long-term science strategy that says, "When you, ESA, with the support of the UK Space Agency, approve this mission to fly in five or 10 years' time, we, the research councils, will make sure that the science community develops to be able fully to exploit it in five or 10 years' time." That is the bit that is missing.

Professor Quegan: There are lines of communication both ways between the UK Space Agency and NERC, but the gap that Richard has identified is exactly there. For example, NERC wanted the UK Space Agency to support a mission in the ESA selection that has just taken place, but it is not at all clear where the funding to support that mission will come from inside the UK. I am talking about the BIOMASS mission. At this point it is not clear at all whether there will be a chunk of money from NERC to support the mission.

Q12 Stephen Metcalfe: I have a relatively simple question. Does the UK get value for money from its engagement with ESA?

Professor Holdaway: The simple answer is yes, very successfully. Juste retour within the European Space Agency works very well for the UK, particularly for industry. Within ESA itself about 15% of the programme is mandatory; the other 85% is opt-in/opt-out, which makes it very democratic. Countries can opt in and out as and how they wish. They do not opt in if they are not interested in a particular programme. They opt in if, first, they are interested, and, secondly, they have the ability to provide hardware or science input, or, more particularly, exploitation of the mission afterwards. It does not matter whether it is a science mission, earth observation or, more importantly in terms of the economy, navigation and coms. So I think it works very effectively.

The European Space Agency has very strong leadership, which both personally and as a council has been very supportive of the UK position or strengthening that position. This is why we have seen ESA's agreement to start up and expand quite rapidly the European Centre for Satellite Applications and Telecommunications at Harwell. We may come on to that later in the discussion. That is a very important benefit locally—i.e. in the UK—for the UK's membership of ESA, so overall it works very well.

Professor Southwood: I would agree with that. The term I would use is "leverage". It requires industry also to leverage. The UK Space Agency through ESA can put things in front of industry. Industry then has to compete. We know they will get a certain fraction of wins, but you can win really useful stuff—the sharp end of technology, if you like—and the real test for me is less to do with the space agency, which is a facilitator, than industry, making sure that it bids and wins the things it can then leverage elsewhere. That has been pretty good in the past. It is up to the space agency to know what our industry can do to make sure there is a level playing field and that UK industry can exploit the fact that it is involved in a much bigger programme but you are getting the jobs that will allow you to build up commercial activity outside, otherwise

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it becomes very incestuous. On the whole, the UK has done rather well in avoiding that thus far, but it requires an intention on everybody's part to do that.

Professor Smith: I agree with all of those points. From a space science perspective, the source of science available to us through the European Space Agency, both in space science and in earth observation, is unparalleled. It would not have been possible for us to undertake the science programme that we do in the UK without access to those missions. So value for money is not really the word. I worked in ESA for a few years. ESA tries to benefit its members in a very active way. Its job is to benefit the space industry of its nations, and it really does that. I genuinely believe I see it doing that. I believe it tries its best to deliver that.

Q13 Stephen Metcalfe: Are any countries doing better than us in getting greater value for money?

Professor Smith: You can look at the *juste retour* figure and the way that, for instance, France or Germany is organised. France, Germany and Italy have much larger national space programmes than the UK. In fact we do not really have a national space programme. Their very large engagement gives them leverage, access and so on, which perhaps we lack, but we have a major space prime in the UK, which gets a lot of leverage out of that. If you look in detail, it goes up and down. In the past, the UK underperformed on its *juste retour*; at the moment it seems to be doing very well. Other nations might be doing a little better.

Q14 Stephen Metcalfe: Generally, you are happy with the return we get.

Professor Southwood: I don't think *juste retour* is guaranteed; it is a question of the quality of *juste retour*. It is also what the country wants out of it. In Britain, we want an industry that is innovative, creative and so on. We have an industry that does that. It is rather free-rolling in its approach to space. The French want guaranteed access to space, so they have a large emphasis on launchers. They certainly get value for money on launchers, but we are not interested in that. The *à la carte* nature of the agency is very critical here, but using *juste retour* as the only test is, in all fairness to my old colleagues in ESA, not quite good enough. You have to ask: what is the national interest? What does the UK want out of it? We know that, if there is a space policy in the UK, it is about having an industry that is creative, innovative and a community from which that feeds. *Juste retour* is fine; that is guaranteed. Look at the leverage you get, and it is a challenge to industry and to the agency to make sure that industry puts its effort into the things that will bring a return, because we are a nation of shopkeepers, as the French would describe us.

Q15 Stephen Metcalfe: Quite; thank you for that. Professor Smith, you touched on the fact that the benefits of being involved in ESA are not just about value for money. You also touched on the fact that you get access to larger projects for space data that you would not otherwise get. Can you give specific

examples of the projects with which we are involved that we would not otherwise be able to pursue on our own?

Professor Smith: In space science, XMM was a mission built by the European Space Agency. It was the largest X-ray telescope to look at processes in galaxies and within our galaxy, which pushed the bounds of physics. That very expensive mission was completely unaffordable to the UK. There are the four Cluster satellites studying the Earth's magnetosphere, which is completely unaffordable to the UK. There is the visit to Saturn. The Mars Express and Venus Express Missions are completely unaffordable to the UK. As to future missions, Gaia will fly this year and it will study a billion stars in our galaxy. That is completely unaffordable to the UK by order of magnitude. I could give you another five or six of those. There are so many examples. We would not be able to do one of those. More importantly, we have communities of scientists in all these areas. If we decided to pull out of ESA and put all our money in one area, we would be able to support only one narrow area of science to that degree; all the others would disappear overnight.

Professor Holdaway: Membership of ESA is absolutely essential not just for the science community, whether it is outward-looking, the astronomy side, or downward-looking, earth observation. It is essential for British industry as well. You have to have big satellites to do certain pieces of physics. The laws of physics prevent you from doing everything on small satellites. A large satellite such as the Herschel spacecraft was very successful and was turned off yesterday. That was a multi-billion-pound programme. No single country could afford that, so you do it by joining together with others. That is happening more and more globally. Even the European Space Agency works very closely with the Russians, who are not members of ESA. It also works, through an initiative David started some while ago, with the Chinese. The whole programme scientifically as well as technically is becoming more global, and, for the UK to participate to get the greatest benefit for its scientists, it has to do this on a global programme. A smaller satellite, in which the UK leads the world, can do some very clever things, but it has limited scope. It is a little like what car you drive. If you want something to go very fast and to be very sleek, you buy a Ferrari, but if you don't need that, yes, you can do it with a Mini, but if you go for something small it has limited capabilities.

Professor Quegan: On the earth observation side, there are seven earth explorers. All of those are optional, unlike the space programme. The UK is the principal investigator on three of those, so, even though we may not get exactly the one we want in a particular call, in those three out of seven we are the leading PIs. We have had tremendous scientific value from that. We gain from all the other ones, of course, and we could not have built any of those instruments as a nation.

Q16 Stephen Metcalfe: You would describe the operations of ESA as being efficient, but in every

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organisation, however efficient and well organised, there is always room for improvement. What areas would you identify where there could be improvements?

Professor Holdaway: One of the biggest problems the community has with the European Space Agency, although it is no different from working with the European Union or even NASA for that matter, is the time it takes for decisions to be made. There is the obvious problem with ESA that it has a large number of member states, all of whom speak relatively different languages. Documents have to be translated into different languages, and that itself takes time. There are lots of different cultures. That takes time. Although ESA is often criticised as being a not particularly efficient organisation, most people regard their own organisation, whatever that might be, as inefficient. ESA has tried very hard over the last five or six years to become more efficient and quicker in its decision-making process, while recognising that, although many space programmes are 20 years from start to finish, you can do things much more quickly if you speed up the process at the beginning, particularly in terms of procurement. That is one area where ESA is making major moves to speed up the process, so that between approval and getting something launched is much nearer to three or four years than 10 or 12 years.

Professor Smith: ESA is taking on more and more complex space missions as time goes by. In order to cope with that complexity it needs to be more elaborate in its processes, and that becomes expensive, and the relationship between the two is not linear. As things get more complicated, the cost goes up and up. Outside ESA there is a sense, not that it is out of control—that is too strong—but that it needs to be reined back a little. Some of these processes are now becoming quite expensive to follow.

The other side of it is that, to be selected for an ESA mission before any money comes from the nation to ESA, the level of technological development that is expected to have been funded nationally is now very high. It is quite expensive. Typically, ESA selects only one in four or five of the missions that have reached that level. You can see that quite a lot of nugatory technological development has gone on. It may have benefits elsewhere, but it is still relatively nugatory technological development. ESA's mission selection process and the offloading of risk into member states before selection need to be addressed.

Professor Southwood: I have worked for ESA. I am always a bit cautious about saying too firmly that an organisation is efficient. You need endlessly to question that. One does need to ensure that, within the agency, there is endless consciousness of the concerns outside of the customer, if you want to call them that. That varies across different parts of ESA. We are tending to concentrate on the space science. There was a major review of that about seven years ago and that did shake things up, because everybody has to ask why they are doing things. It is like bringing in management consultants. Often, the act of bringing them in is the best thing for the organisation, as much

as what advice you get. It is simply people having to ask, "Why do we do this? Do we have to do this?"

I would not want you to get too complacent. It is an organisation that needs to look at itself from time to time and continue to have this sort of criticism from the outside to respond to. Because of the fact that it is, by and large, an à la carte programme, joining different parts of the agency, with different parts having rather different management cultures and levels of efficiency, it should be endlessly looking at itself and trying to establish best practice. I would not want to be overconfident that everything is rosy.

Professor Quegan: In comparison with NASA, their missions are much more expensive and their procedure tends to be much less efficient than ESA's. When ESA makes a decision to fly a mission, it does not suddenly change its mind two years later. You get five-year periods of stability, ensuring that selected missions are actually going to happen down the line. In NASA it does not happen like that.

Chair: We are rapidly slipping behind time, so we need to be a bit more sharp, colleagues.

David Tredinnick: I will try and speed up. I want to ask about the Harwell campus, but may I just correct the record? The reason I mentioned the woman from Mars was that she was the first British cosmonaut. She did not actually go to Mars, but it was known when she went up from Baikonur that she had worked for Mars, as in Mars bars.

Chair: We know that, and our audience will know that.

Q17 David Tredinnick: Professor Southwood, you have said that the European Space Agency has been prevailed upon to set up a British base on the Harwell campus. What would you and your colleagues like to see the centre at Harwell achieve?

Professor Southwood: As an ex-ESA person, I would like to see some of the more innovative ways of doing things that have developed in the UK over the last 20 years or so seep into the more staid and institutionalised areas of the agency. That is one of the arguments. The other argument is that the UK is going to invest in space.

From the point of view of British people, I want to see leveraging of UK involvement in ESA but, at the same time, acting as an irritation that will ultimately give rise to a pearl in the organisation itself. It has been set up in a way different from any other ESA centre. It is right next to the catapult centre, which has been set up on a national basis. The challenge is out there not just to us scientists but also UK industry and ESA to make that gel. As far as I am concerned, institutionally, we have done about as much as possible to try to see if we can change the ESA culture our way by Harwell, so the measure will be its industrial success.

Q18 David Tredinnick: How would you expect the Satellite Applications Catapult to progress over the next year?

Professor Southwood: I want to see it concentrating on applications downstream, partly because that is an area that in a way is much more open and there is

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much more variety ahead. Indeed, you can take the skill set we produce in astronomy, geophysics or whatever and it naturally fits into that environment and moves into commercially productive work. I want to see academia feeding into it. I want to see industry not regarding the money going in as anything but something against which it has to play. It has to be leverage. UK plc, the Government or whoever—us, the taxpayer—need to ask, “Where is the return?” The target areas are clear. They are mainly downstream, but it may be a mix of upstream and downstream. You change sides when you launch, if you are wondering what that means, but it needs to be watched and to make sure it does deliver. I think we have done a lot to get things new.

Professor Holdaway: For sure it needs to be watched, but it is a lot more than just watching. The real point behind your question is: what is the Harwell space cluster about, and how does the ESA centre and the catapult fit into it? The answer is very clear. The internationalisation of the Harwell space cluster was announced by Peter Mandelson as one of the last things he did under the last Government. That mantle was then picked up by David Willetts and the Secretary of State, Vince Cable.

The remit was very clear. It is to do something that started in the summer of 2005 when David Sainsbury, the Minister at the time, and I sat in the back of the ambassadorial car in China and said, “What can the UK do that France, Germany and Italy are better doing in terms of value for money for the taxpayer, in particular for exploitation of that skill base for the economy?” By the end of that car journey we had come up with a concept, which was a little like CNES in France. It brings together industry, academia, the ESA, research institutes and entrepreneurs.

If you fast forward eight years, that is exactly what you have now at Harwell. You have ESA with its Space Applications and Telecoms Centre; you have the catapult as well where the remit is very clear; it is about innovation and taking that through to market. You have RAL Space, my outfit, which is the largest R and D science and technology outfit in Europe. You have the ESA Business Incubation Centre, which is very important. It is getting ideas out of the science and technology base into industry. It is the guys behind us to whom you will be talking in the next session who will be doing that exploitation, but they cannot do it without these other facilities on the campus providing the science and engineering that can then be pulled through to industry. It is that whole package that the current Government expect to deliver the wealth, the jobs creation and the growing of the economy.

Q19 Pamela Nash: I will start by saying that I have a long-term enthusiasm for space, so I would refer anyone who is listening, or reading this at a later date, to my declaration in the register of interests. I want to start by looking at the European Commission's work on space policy. It is currently pursuing a separate space industrial policy and this will continue in Horizon 2020. How do you think this will affect UK

space policy? Do you think this works well alongside the work of ESA, or could it be problematic?

Professor Southwood: This is a very tricky one, and the answer is probably different in different areas. We are part of the European Union and space is big infrastructure. It is big and so, in a sense, we do it with other Europeans. Therefore, it is very rational to see the activity within the European Union.

The problem is the suitability of the administration of the Union—that is the Commission—to handle things. The distinct question is whether we have a European Commission that is right for handling something like space. Different countries might have different vested interests. For the UK in many of its interests, there is the very direct approach of ESA and you can call it juste retour, but that is not the test of whether the thing is good; it is the way you try to leverage things. On the face of it, that is not present in the Commission environment and may equally well have no technological structure that one has in the European Space Agency, the UK Space Agency and the research councils. It is really not the right way to handle something that is so technologically demanding.

On the other hand, when it comes to integrating space into our lives—we already have it integrated into our lives—it is manifestly inappropriate to do that through an R and D agency. It should be done through the European Union, which is a quasi-governmental agency.

Finally, you come to the issue of what you do in areas where, as yet, Europe does not determine policy—for example, defence. In defence, space is very critical. If you are not aware of that, you do not know what space can do. There again, it is very hard to say that we should hand over everything to the Union at a point where we have not got the full political environment that is appropriate. Space comes into so many different things that we need to keep some national handles on the controls, and at the moment that is probably more easily done through the European Space Agency, particularly on the development side.

On the regulation side, it is clear that regulations in space go global quite rapidly. You have national regulations, but it is a bit like the environment. We share the environment with the rest of the Europeans; we share space with the rest of the Europeans, so there is a lot to be said for making sure that regulatory authority and so on goes through the Union. As for agencies for regulatory purposes, or civil public services, again, the Union is the natural place to put them, in my view.

Professor Holdaway: For me, the key part of the question is: how do the two organisations work alongside? It is a little like the debate we had earlier on about the agency versus the research councils. Bearing in mind, as David says, that ESA is primarily R and D, whereas the European Union is much more about how it affects the member states' individuals, it is more operational. That is why the EU now has responsibility for Galileo and for GMES. Through that responsibility, the EU is now the largest single funder of the European Space Agency, and therefore it is perfectly right that it has a voice there, but that is not

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the same as saying it has the majority voice, or even subsumes it.

It is very important that ESA maintains its ability to be responsible to its member states through things like the opt-in and opt-out programmes, but there is a great win for everybody if that relationship can be put together in the right form. That is what the member states are doing at the moment. They will be discussing it six months before the next ESA ministerial. At that next ministerial, they will make very clear their position on how ESA should interact with the European Union, and that will be informed by, among others, the British Government.

Q20 Pamela Nash: Are you confident that that will result in greater co-ordination between the EU and ESA?

Professor Holdaway: My glass is always half full, so, yes, I am relatively confident, but there is a lot of work to be done. That comes back to something we were talking about earlier. That will be very much led not just by the Minister's office but by the European Space Agency. It has to have the right people with the right skills to make sure that the UK position is very clear and has the full support of both industry and the academic sector as well as Government.

Professor Quegan: This is to do with the logistics of support applied at the moment to ESA programmes. There are optional programmes within ESA, but if you go to a different funding model, as would normally be applied by the EU where everything is competitive, there is no great attraction to opt in to a programme if you don't get geo-return—your financial input could simply go to a different country. Those two systems interact with each other quite badly. We need a different system to make things work.

Professor Smith: I have worked with the EU and ESA in both these areas. I have a couple of quick observations. ESA has a much more profound understanding of space technology than the EU—enormously more profound—so, in working with them, you are working with people who understand the subject. Working with the EU, you tend to be working with people who don't, which makes it very difficult. The EU also tend to be more constraining in the way you work with them, so they will put in place many more rules about who you can work with and what you do. Those compromise the quality of what you can do. It is horses for courses here. I believe we should be very careful. But the people who understand about space R and D in Europe are ESA, and we should turn to it for advice in that area.

Q21 Graham Stringer: In one hour of questions we have had one mention of Galileo. Is there any scientific payback for this country from the Galileo project? We have a huge financial commitment to it.

Professor Holdaway: Galileo is not primarily a science mission.

Q22 Graham Stringer: I know, but it is a huge project that puts satellites for GPS systems around the world. I just wonder whether there was any scientific payback for this country from that huge project.

Professor Southwood: First and foremost, it is not directed at science and it is not run as if it is science; it is run to provide a public service. Scientists are pretty creative, and they will use the signals from Galileo to measure how the tectonic plates are moving and that kind of thing. It will give high-resolution capabilities that, if we were not building Galileo, would not be available to us, because GPS will have to match Galileo. It is opening up scientific capabilities. It probably has other uses in that the signals are very well defined. You can use them to investigate the environment by picking up the signals, say, bouncing off the surface of the sea. There are all sorts of ancillary use of it, but, if I wanted to solve those problems and was given all the money that was given to Galileo, I would not do it that way, but scientists are creative.

Professor Smith: The upper ionosphere is studied through delays in the transmissions to these satellites. It is a very difficult measurement to make any other way. There are some, but it is not built for a science mission.

Q23 Graham Stringer: How do you manage the risk of these expensive satellites being whacked by space debris?

Professor Smith: That is a different issue.

Graham Stringer: It is a different issue.

Professor Southwood: It is a separate issue. The Galileo orbits are not the worst case for space debris, so the concern there is less about Galileo itself. It is in orbits that, as far as I know, are not threatened. You are far more threatened in the low-altitude, low earth orbit where much of earth observation is done, simply because it is getting very crowded, and of course in geosynchronous orbit for communications. The most serious concerns are in low earth orbit. There is a growing space debris concern there. We have people up there in the space station in low earth orbit, and we do experience hits from bits of debris damaging sensors and so on.

At the moment we are probably not totally dependent but very dependent on the American defence system NORAD, which is extremely good, but it is not ours. As space becomes more and more integrated into our lives, we need to make sure that we have the capacity to keep knowledge and mitigation ready to deal with space debris. At the moment in operations, we rely on NORAD to give us the warning, "There is something coming towards your spacecraft orbit. Turn it away so that whatever it is, if it hits, will hit the side of the thing and not right in the eye." That is provided as a free service by the Americans out of the goodness of their heart. That is very nice. When you move to things like Galileo, where you might be using the system, for example, to land aeroplanes all over Europe or control lots of aspects of civil life, honestly we should have our own eyes watching out for the risks.

Professor Smith: Galileo is a multi-satellite mission programme, so if you did lose a satellite it would not be the end of coverage. Nevertheless, it is a risk. A more concerning risk is in the space weather side of things, because, there, a single event could take out

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multiple satellites. All the satellites are designed the same, so if one is vulnerable they are all vulnerable. We have joined ESA's space situation awareness programme focused on space weather. We are the second largest contributor to it, albeit it is quite a modest contribution to the programme. There is an awareness. For collision avoidance and issues like that, it is a global problem and it has to be dealt with globally. If we are going to be taking stuff out of space, one nation cannot do that on its own.

For space weather, on the other hand, it is entirely possible that we would try to protect our assets through some sort of early warning system and so on, and we could make a major contribution to that. It is a serious issue, and we should be taking it very seriously.

Professor Holdaway: The whole issue of the security of space utilities is now being raised at a multinational level. Security from the point of view of near-earth objects is pretty well understood. There have been seven known collisions of debris with spacecraft over the last 10 years. It is going to happen from time to time, whatever we do, and there is no realistic way of vacuuming up old satellites, even though that technology has been looked at.

A much bigger problem, as Alan has just said, is space weather. The issue is solar activity. It is not because solar activity is getting better or worse as time goes on, but that our technology is increasingly more vulnerable to it. We know how reliant we are on GPS and, in the future, on Galileo, and it is not just the civil-military debate about GPS on how accurately you know where you are; it is everything else on earth that depends on accurate timing from GPS.

Q24 Chair: Isn't part of the problem the lack of joining up between space, both civil and military, and power engineering on the ground, homeland security issues and those sorts of matters?

Professor Holdaway: It is indeed; it is all those issues. Space weather and the threat from space weather is now the number two item on the National Risk Register; it is second only to pandemic flu. One of the reasons for that is the continuing vulnerability of the technology. The other reason is that you may recall that back in 1859 there was a very large solar event that knocked out the telegraphy system.

Q25 Chair: We don't still talk about that.

Professor Southwood: I recall it was a Tuesday.

Professor Holdaway: It was a Monday, I think. However, in July last year there was a solar event as big as the Carrington event. Why didn't that affect us? The answer is that fortunately most of the coronal mass ejection went out at right angles to the Earth-sun line. Had that been one week later, a massive storm would have hit the earth. Therein lies the imponderable: what effect would it have had on the security of ground-based utilities, like the power supply, as well as space-based utilities? A lot of emphasis is now going into understanding that problem. The European Space Agency is starting that programme probably 10 years later than it should have done. The UK, through the office of John Beddington,

when he was chief scientific adviser, was a major force in working together with NOAA in the United States looking at the whole space weather protection system. That is now growing apace, and the UK has a major lead in that.

Q26 Graham Stringer: I think this Committee helps push space weather and the possibility of future Carrington events up the risk register. Five years ago the Government thought it was science fantasy rather than a real threat. Is there a clear institutional responsibility for looking at the risk of another Carrington event?

Professor Holdaway: Scientifically, yes. The UK Space Agency is working with the European Space Agency, but it is much broader than that. The Department for Transport, Defra, the Ministry of Defence and Met Office are now also party to the overall UK programme to look, first, at quantifying the size of the problem, and, secondly, the mitigation strategy. Other than through the chief scientific adviser's office, there is no central organisation looking at it. However, Cabinet has a committee, which one of my guys chairs, that brings together all of these parties. Although there is no single Government Department that currently has that responsibility, it is now becoming a shared problem across Government.

Professor Quegan: A recent report lays out the problem and the issues involved, and the actions that should be taken in terms of understanding and mitigating the risk, which is rather a matter for engineering.

Professor Southwood: There are now plenty of people aware of the problem and working on it, and there is plenty of communication about it. As you said, though, there is nobody who ultimately carries the can if it happens. It would probably be sensible to identify clear institutional responsibility. If there were a hurricane, you would expect the Met Office to tell you in advance, as far as it could. That responsibility is quite clear. I do not think you can point to a clear agency here. There are many people working on the problem and developing our capacity to predict, but it would be a good national step to have somebody identified as having ultimate responsibility for warning of the risk—if you like, the owner of the risk or at least the owner of the responsibility for telling people about it.

Professor Quegan: Does it have to be in the UK? For example, NOAA has its own space weather centre based in Boulder. They make these observations.

Professor Southwood: Since it is global, you can look at the NOAA site. The Americans do that. It could be European. I am not saying it has to be the Met Office in the UK, or anything like that. There should be somewhere where people who have systems that are at risk know to keep looking to see whether the risk is red, yellow or green.

Professor Smith: There is a slight join-up here with the research councils. At the end of the day, one would wish for an early warning system for space weather. The problems start with turbulence on the surface of the sun. Our scientific understanding of what goes on

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on the surface of the sun, what is developing on the surface of the sun and the likely effect on a spacecraft in earth orbit is not well joined up at all. We do not understand the processes well enough. We need to understand the science behind this very complicated magnetothermodynamic system that is going on. A couple of days ago I was speaking to one of our solar physicists, who said, "On one day we might predict a major event; two days later the polarity could have changed and we would expect it to be completely benign. We do not understand the physics, why that is changing and how it is joined up end to end." In any approach or any roadmap, it has to be underpinned by a profound scientific understanding of the processes; otherwise we will just end up with an awful lot of false alarms.

Q27 Graham Stringer: I have a science question. The bigger the ejection, is there a direct proportion to that to the speed with which we are hit by it? Is it more difficult to predict?

Professor Holdaway: Not necessarily. There are two things. Size does matter, but energy matters even more. The other issue is the direction from which the solar mass ejection comes. It does not come head on towards the earth—

Q28 Graham Stringer: I understand that. Its polarity is also a factor.

Professor Smith: The earth's magnetosphere has to be aligned in a way to the magnetic cloud that is coming.

If they are not aligned, they will bounce off each other; if they are aligned, they will come together, and that is the big one.

Professor Holdaway: It may be of interest to the Committee that all of the stuff you see on BBC television, which shows almost live, or 15 minutes old, pictures and video of what is happening on the sun—the solar activity—comes from a NASA spacecraft that sits a few tens of thousands of miles above the earth. The technology is all British. The cameras that take those pictures and videos were built in the UK, and that is the sort of stuff that Pallab Ghosh and Jonathan Amos show on the BBC live and on the website. The reason I mention it is that RAL Space built those cameras; e2v, who are world leaders in detectors, built that technology. It is a global programme. It is great UK science and technology, but, as with the European Space Agency, it is somebody else's launch vehicle and platform. We couldn't afford that, but we can afford to build the cameras and contribute the science.

Chair: Gentlemen, that has been an extremely interesting session. I realise that we have had to cut a few of you off from time to time. If when you read the transcript there are things you would want to add, please feel free to do so in writing because we are anxious to get a full picture of this very complicated area. Thank you very much for your attendance.

Examination of Witnesses

Witnesses: John Auburn, Vice President European Space Institutions, Telespazio VEGA UK Ltd, Dr Hugh Lewis, University of Southampton, appearing on behalf of PHS Space Ltd, and Richard Peckham, Business Development Director (UK), Astrium, gave evidence.

Q29 Chair: Gentlemen, you have been sitting at the back listening, so you have some idea of the questions we are going to ask. Can I first invite you to introduce yourselves?

Dr Lewis: I am Hugh Lewis from the university of Southampton. I am here representing Dr Hedley Stokes of PHS Space Ltd. Dr Stokes and I represent the UK Space Agency on the Inter-agency Space Debris Coordination Committee. I am the United Kingdom representative on the United Nations expert group on space debris, space operations and tools for collaborative space situational awareness. That is the United Nations Committee on the Peaceful Uses of Outer Space.

Richard Peckham: I am Richard Peckham. I am the previous chair of UK Space, which is the trade association for the space industry. My current role in the trade association is to lead on the innovation and growth strategy—so the delivery of that.

John Auburn: My name is John Auburn. I am Vice President of European Space Institutions for the Telespazio group, so I work very closely with ESA, the Commission and EUMETSAT. My role here is to represent the UK part of that Group—Telespazio VEGA UK Ltd.

Q30 Chair: Thank you very much. I start with more or less the same question with which I began the previous session. What have been the main achievements of the UK Space Agency since its establishment? Where do you see room for improvement?

Richard Peckham: As the previous speaker said, its crowning achievement has been the management of the last ESA ministerial council. Compared with how it used to work, where the budgets were split among lots of different user departments, it has been such an improvement. It works very closely with industry. We work together in building the business cases. We were very targeted, so we targeted where that investment would go. We did not want to invest in everything, so we looked at where the best return on investment would come. That has to be its biggest achievement. I would also mention in particular the creation of a national space technology programme, which did not exist before. That is an important first step. It is not a massive programme, but it is important. As you heard before, it is providing leverage. If you can give the UK industry a step up, it is in a better position to bid for the bigger programmes, both EU and ESA.

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The third aspect is the bringing of ESA to Harwell and the development of this cluster at Harwell. There is now a lot of evidence on the effectiveness of clusters. If you can bring people together, you spawn new business, start-ups and so on. Having the catapult, Richard Holdaway's RAL spacelab and ESA there will help to create the critical mass that we think will push economic growth. I would put those three things in terms of achievements.

As to what things it could do better and how it might improve, like the rest of Whitehall, the first thing to happen was that it lost staff. It created the agency, but with all the general cuts that were happening and good redundancy terms being offered and so on, some of the older people retired. So it started, initially, from a position of more weakness, if you like, having to rebuild and get in the qualified staff. Its heritage has been very much around the European Space Agency. It knows how to look after ESA very well, and that is probably being managed very expertly. The European Union is still a little bit new for it. The responsibilities for EU programmes like Galileo and GMES were previously those of other Departments, so those people were then brought into the agency. Getting the balance right now with the growing importance of the EU has not yet been reflected in the agency, so it needs to beef up a little the way it interacts and manages the EU.

On the economic growth side, it needs to do some beefing up of its interaction with industry and how it can support industry. One particular aspect is exports. Helping UK companies to export is an area where the space agency could beef itself up a little. Another area is how it promotes space across Whitehall. Being in Swindon in a sense does not help. It is increasing its resources. As Professor Southwood said, it has been given some additional budget to increase resources, and it is looking at seconding people from industry, which is very positive because it can get some experienced people who can help with some of these things. But building more critical mass in London is probably something it needs to do so that it can better engage.

Q31 Chair: But it is not just about the agency and Whitehall. You are representing a significant private sector group of companies. How does the private sector engage with the Whitehall machine?

Richard Peckham: We engage in quite a number of ways. There are lots of users of space across Whitehall, but the problem that we found from the industry side is that it is quite fragmented. For a long time we have felt that the agency has a role to amalgamate the different users to bring them together, to create bigger programmes with the space agency, even procuring on behalf of Government. For instance, earth observation data might be used by the Environment Ministry and Department for Energy and Climate Change, and perhaps by different agencies that work for the various Departments. Amalgamating those users together would be helpful. At the moment we deal perhaps with 10 or 20 different organisations.

Q32 Chair: Practically, how would you do that? That argument is true of mathematics or engineering that

crosses disciplinary boundaries. How would you propose to restructure things so that there was a better mechanism?

Richard Peckham: I don't know; that is quite difficult. I think the way to do it is for them to procure on behalf of them, so it is understanding which Government Departments are using space data and looking at how we could bring those together. Industry has a role to play, because we know who some of those people are. I certainly agree that it is not just for the agency to do it; it is something that we need to do together. It does need insiders. As an industrialist, if it looks like you are just trying to sell something, sometimes it is not necessarily easy to get the meetings you need with different Government Departments, whereas the space agency is part of Government, is looking at value for money for Government and not trying to sell something. It is a partnership, and the agency has a role to play to bring together those different constituents.

Q33 Chair: Do you think the explanation you have just given is one of the reasons we hear arguments that the space agency is under-resourced and all the component parts of Government that indirectly use it do not fully understand the joined-up picture?

Richard Peckham: That is certainly one of the issues. I should mention that two very important pieces of work are going on at the moment. One is to produce a national space policy. That was recommendation number one when we did the innovation and growth strategy in 2010. The other is to produce a national space security policy. These are both in hand and, as I understand it, quite imminent. Producing and publishing a national space policy will go quite a long way towards other parts of Government even recognising that there is a space agency. Lots of people probably don't even know that we have a space agency, if you talk to civil servants. Putting in place a national space policy across Departments and one that assigns responsibilities to different Departments, as well as making clear the role of the space agency, will go quite a long way towards solving this problem.

John Auburn: To pick up the first point, I totally agree with Richard. The result of the ministerial was extraordinary; it was something that even five years ago we would not have expected. I have seen, effectively, shock waves across Europe—I represent many different countries as part of my job—especially in Italy. Effectively, the UK in a couple of years will overtake Italy in its contribution to ESA. In football terms, we will become top of the Championship, whereas France and Germany are fighting for the Premiership. There is quite a big gap, as you know, in football between those two divisions. It is not only the result. We are now seen as a real, credible player, taking space very seriously. That is a fundamental thing. We have to thank many people, not just the space agency, but certainly David Willetts, the Minister, and your Committee in 2007. Things that have come through in the last few years have dramatically changed the landscape for space.

As to the space agency, I see significant weaknesses, primarily in the lobbying and political influence with ESA and the European Commission. My personal

advice would be that we need senior people based in Paris and Brussels acting on behalf of the complete UK plc, so that we know much better what is happening; we influence much more what the Commission is doing and have a stronger voice within ESA. Rather than just turning up for the programme boards, the council and so on, we are there lobbying—fighting in the streets—to get a better position not only for industry but also for academia. This affects everyone.

On the subsequent question, industry is now very mature. We can offer services. We have gone a step from PPP; now we can go to a service. If the space agency can help federate what the Government need and define a service—"We want to do this"—industry can respond.

Chair: That is helpful.

Dr Lewis: We can fully endorse what has already been said with respect to the space agency. From our perspective, the formation of the agency and its activities in the last two years have been very well received. I pick up the point about the UK's credibility following the establishment of the UK Space Agency. In the committees I am working in, that credibility is an important issue.

I perhaps disagree with my colleague with respect to the idea of the visibility of the space agency. The UK Space Agency is highly visible now—much more so than the previous attempts at putting together space activity in the UK. From my perspective, working in a higher education establishment, it is very clear to me that undergraduates working in the aerospace sector have very high visibility of the UK Space Agency. For some of them, having the space agency there almost as a goal or incentive to move them through their studies and to aspire to work in the space industry, ultimately perhaps to direct space policy, has been very important for us.

Q34 Stephen Metcalfe: You have already touched on how effective the space agency has been representing the UK interests in Europe, particularly within the European Space Agency. I think you have all accepted that it has quite a degree of influence. Do you think that influence would be improved if there was a UK director of the European Space Agency, and why do you think there is not one at the moment?

Richard Peckham: I would differentiate a little bit. I don't think it would change the influence, but it would certainly change the appearance. Why has there not been a director? There are two factors. Certainly, one issue is that we have not put forward enough good candidates. The other is about the will to do it and then prosecuting your case. Germany, France and Italy each has three directors. For them, clearly this was a national priority; they were going to have three directors, and they pushed it at all levels politically, making sure there were good candidates and encouraging people to apply. We just did not do that. We put in the application. We had probably a couple of quite good candidates, but the rest of the push did not come with it. It was just, "Here's a good application," hoping the process would work and that one or two would get accepted. You really need to push; it is part of the overall negotiation when you are

negotiating how much subscription you put in. You just have to make clear that this is part of the deal.

Q35 Stephen Metcalfe: Would there be a benefit from it, other than just perceptual?

Richard Peckham: Yes. There is always a benefit in terms of networking and having good access. They will be very proper and correct; they are not going to give preferential treatment and give contracts to British companies, but, in terms of influencing the whole organisation, having British voices there is important—absolutely. It is important for industry, but it is just as important in regard to the national perspective and our way of looking at things, perhaps changing some of the cultures in ESA, such as public private partnerships. The UK has done quite a few innovative things and taken different approaches to business. To bring forward that cultural thing it is very important to have British voices in ESA.

John Auburn: Industry works very closely and has regular meetings with what we call the ESA Brits—that is the senior British members in ESA. We worked very closely with it when David Southwood was the last ESA director. It was the Chatham House Rule, if you like. We had very open discussion. We were adding value because we were giving insight to what was happening in the UK politically and otherwise; they were giving us real insight to what was happening at the top table of the executive. They were not going over the top or breaching anything, but it added a lot of value to industry. It helped us to plan better and influence matters, because the better they understood our voice the more they could influence within the directorate.

Q36 Stephen Metcalfe: How good do you think the UK Space Agency is at influencing the kind of programmes that ESA takes forward?

Richard Peckham: It has been very influential. ESA has a formal set of committees for the different programmes. We have the right people there: scientists, the space agency and so on. We sit on all of those. Interacting with ESA is a strength of the agency. That has been its background and history; it knows how to manage ESA. Generally speaking, we have a good say in what missions are selected and so on.

Q37 Stephen Metcalfe: Those are meeting our policy objectives as a country.

Richard Peckham: Yes, definitely. As you have heard before, most of the ESA programmes are optional, so the ones that we don't want to join we don't have to join and we can put the money where we agree it meets our policy objectives.

John Auburn: I would agree in most part. Other countries definitely have more influence. France probably has the most influence. In terms of decisions that matter to industry, we do not yet have the strength or numbers. It is more a numbers game, having the right people influencing ESA. We are just too small in terms of a space agency to push hard. More can definitely be done to compete. Even smaller countries like Spain probably have more influence politically on

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decision making than the UK. We play cricket; that is, I think, an issue.

Chair: I have the rules of cricket in French, if you ever want to see them.

Q38 David Tredinnick: I am fascinated by this. I am getting mixed messages. On the one hand, I am being told we are in the Championship League; suddenly we are about to overtake Italy; we are too small. Are we not really punching above our weight, to get another metaphor in here? Are we not hugely successful in the UK Space Agency? Everyone is saying it is a triumph and it is giving us more influence. Is UK membership of the European Space Agency good value for money, or not?

John Auburn: It is excellent value for money. If you look at the raw numbers, we are now at about 10%. If it were GDP, it would be 15%. As to how ESA sees us, we are still an anomaly because we are below where it would like us to be, but because we select the correct programmes—we are not in launchers and in the ISS, the space station—we do punch above our weight and we get the return on investment through industry exploiting the technology. In the telecoms market we have shown that the return on investment is at least six to one. In the first session the witnesses were talking more about the return in the context of *juste retour*; I am talking about industrial return.

Q39 David Tredinnick: I am sorry to interrupt you, but you are saying that we are adopting a UK classic marketing strategy for a smaller organisation—i.e. the UK—and we are not trying to take on the main players, in this case the Germans and French. We are targeting the market very specifically. For example, we heard from the last panel about a satellite that had British technology and cameras in it. That would be an example of how we have targeted the market very carefully. It is an American satellite—I forget what it is called—which has British camera technology in it. Is that an example of effective target marketing? Is that the strength? Am I putting words into your mouth, or is that right?

John Auburn: I totally agree with that. If you look at the more commercial markets, we are the biggest subscriber to the telecoms programme, and that programme will come to Harwell and be managed from Harwell. We are the bigger subscriber to what is called the integrated applications promotion, which could be the key market in the future. That is developing new applications and services that use, say, telecoms, navigation or remote sensing, or combinations thereof. It is because we are focused more on growth that we have selected and put our money in pretty much the optimum way. It is now up to industry to deliver on that. That is the important point.

Q40 David Tredinnick: May I ask Dr Hugh Lewis about the problems facing small and medium-sized enterprises? This is something you have highlighted, isn't it? I will leave it to you to answer the question.

Dr Lewis: That is correct. From the perspective of small to medium enterprises, the UK could probably do even better than it is doing now, simply because

the process by which funds are returned to the UK and the bidding processes are weighted heavily towards the large industry players. The amount of money that comes in in the form of contracts is relatively small, and the process of bidding for a small to medium enterprise essentially is quite a risky business. You have to invest a significant amount of time and significant proportion of the money you would receive back just to go through the bidding process.

Q41 David Tredinnick: You have specifically criticised the bureaucratic hoops that you have to go through. You want some hoops removed, don't you?

Dr Lewis: If you compare it with the process academia would go through in bidding for research council money—

Q42 David Tredinnick: Is it too complicated? Is that right?

Dr Lewis: The research council process is relatively straightforward. We would expect to be writing a six-page case for support. Compare that with the process of bidding for ESA funding. We are submitting 80 or 90-page documents outlining the technical work, and another complex document outlining the management. Admittedly, this is a consortium effort, but, from the point of view of small to medium enterprises, approaching that as the leader of that consortium, it is a very difficult position to be in as a small to medium enterprise to manage that process and have the funds and the time available to go through that.

Q43 David Tredinnick: To continue the footballing analogy, I am now going to kick you a soft ball. Does the UK need a larger national space programme? Why or why not? Obviously, you will answer yes, because everybody always answers yes when there is an opportunity to have more resources. There is not an organisation in the country that won't say it wants more resources and can probably justify it. At a time when we have huge pressures on Government budgets and flatlining in the health service, what possible justification is there for a larger national space programme at this time?

Richard Peckham: Well, the answer is yes.

Q44 David Tredinnick: How do you justify that at this time?

Richard Peckham: We would like to see more balance between national and international. At the moment nearly all of our money goes into ESA or through ESA, let's say. Although a lot of that comes back, it is directed through ESA. To have a larger national programme would give you more flexibility to decide whether ESA is the best route for our national objectives or whether we have an option. At the moment we don't really have an option. We also might want to partner with other nations, as you heard before. At the moment we have no flexibility. If we want to do something with Russia, NASA, India or China, there is not that flexibility.

Whether you can justify it over health or something else, I would look to you people to make those sorts of decisions. It is not for us. We can make some very

strong justifications in terms of economic growth; we can bring to you some arguments that show return on investment. There are a lot of societal benefits from space programmes. We can offer those. Unfortunately, when you mention space, a lot of people think it is some sort of "vanity" and "out there" stuff, but most of space is very much down-to-earth stuff; it is about TV, navigation, Google Earth and weather forecasting. It is very much things that are supporting our daily lives. GPS is an example. Everybody is now finding it very useful, and it is probably saving lots of money. There is definitely a leverage effect, in that infrastructure enables lots of other capabilities; it certainly enables a lot of applications.

Q45 David Tredinnick: You mentioned Russia. Have you been to Star City in Moscow? Isn't that where they do all their work? Have you been there to talk to them about possible co-operation? How close are we to the Russians?

Richard Peckham: Russia for industry is certainly now a growing market for us. A number of our companies are doing business in Russia, but more as an export market than a co-operative venture. Russia was one of the leaders in space in the past, but its technology and ability to do quality control have fallen behind. It is looking to western companies to help bring it back up the curve. It is ready to buy at the moment, but it is looking more to co-operate, do joint ventures and start to build more things in Russia longer term.

Q46 David Tredinnick: Wasn't one of their advantages that they had the Buran rocket system, which was based on the V2, which had a greater payload, but the computer technology was not good enough? Is there any way we could make use of that greater payload, or is that now history?

Richard Peckham: Russia is still a good provider of launches; it still remains good at that, although even there the reliability has been less good recently. It has had quite a few launch failures, but some of its old ballistic missiles still provide a cheap means of launching smaller satellites. Surrey Satellite Technology, for instance, still makes use of a number of these older Russian launches.

David Tredinnick: Finally, on the business of expanding the space programme, should we not really be focusing on the Harwell centre now and the satellite applications cluster there? What would you like it to achieve as a starting point? Should the UK Space Agency be supporting it? I am so sorry; I apologise and withdraw that question. It was originally given to me, and then I was asked not to ask it. My colleague Jim Dowd has that question.

Q47 Jim Dowd: I suspect you already know what I am going to ask. David, thank you very much indeed. It is my fault for turning up late; I do apologise. I am going to ask another question before I come to that, very briefly, just as a matter of observation from the last panel and yourselves. Are there any women involved in this activity, or is it just boys' toys?

Richard Peckham: There are not enough, for sure. It is a big issue. There are more women coming in, but it

is not only a space problem; it is more an engineering problem. There are still not enough women coming into engineering and STEM subjects. If you look at Astrium's graduate intake, definitely more ladies are now coming in as graduates. I am probably preempting another question you might ask, but we find no problem at all recruiting. Space is seen as quite a sexy, interesting thing to do. Astrium takes on 30 graduates every year, and we get hundreds of good quality UK applicants for those posts, and more women, but it is still a general problem. We do need to attract more women into space, for sure.

Q48 Jim Dowd: More women into space.

Richard Peckham: The space sector.

John Auburn: We also recruit a lot of women, but the women don't get to the top of the tree, which I see as maybe a bigger issue, whereas in France I see the opposite. Many space companies have been led by a woman. Thales Alenia Space was led by a woman. We may be a bit behind culturally in doing that.

Q49 Jim Dowd: On to Harwell then, as David said. What would you like to see the centre at Harwell and the applications cluster achieve?

Richard Peckham: There are two aspects of Harwell. There is the cluster to which I have already referred: the catapult, RAL Space, ESA and the business incubator. There is the impact of the cluster and there is the catapult centre. The Technology Strategy Board has set up the Satellite Applications Catapult. I would say it did it extremely professionally; it got an industry delivery team. It was very industry-led in terms of what it should do, its mission and so on. I am very optimistic that this will achieve some real results in starting up new businesses and helping existing ones. It is trying to provide a link between what we call the upstream—the space technology—and turning that into real applications that help everyday life and create jobs. I am very optimistic. It is very focused on not growing itself but growing the industry. All its metrics are about its impact on the wider aspects.

One other aspect is that we have to make sure it is not just Harwell. Harwell is working on how to connect to the rest of the UK so that it is not just Harwell. Part of the refresh of the innovation and growth strategy we are doing at the moment is very much looking at how Harwell can also connect with other centres of excellence around the UK—Leicester, Nottingham, Glasgow and Bristol. There are a number of areas around the UK where there is a lot of space expertise, so we have to make sure it is not all Harwell. It has taken that on board and it is trying to connect around the country as well.

Q50 Jim Dowd: Has it been broadly successful so far as a concept?

Richard Peckham: It is too early to say. It started only on 1 April. It already had some projects fed in. It has started up, and so far so good. Its focus at the moment is having to build its infrastructure, recruit staff and so on. It has created a board, but it is very early days. I guess that in a year's time we will see how it is doing, but we are very hopeful. It is certainly

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doing all the right things at the moment. It is engaging with the industry, the space agency and research councils. It is doing the right things now, and we will see in a year's time what impact that has had in creating new businesses and jobs.

John Auburn: There is a very important role for the space agency to help facilitate the link, which to me is vital, between ESA at Harwell and the catapult, to attract industry there. My company was the first space company to have an office at Harwell, so we have been very active in that. It also has to make sure that the relationship with STFC is sound. There are teething troubles; it needs a real push to make sure everything is optimised and we do not end up with more internal political battles between different parts of Government.

Q51 Jim Dowd: Do you feel it is an effective way to support SMEs?

John Auburn: It is very effective. Access to space is difficult in terms of hardware. For an SME to get to that stage is almost impossible, but through applications it is much easier because it is the downstream side; it is creating software tools. Through the innovation of the SMEs, they are coming with some very clever ideas with some support and experts there. The team there is very strong. The team is taking from our companies—from Astrium and Telespazio; people are being recruited, which is good and bad. The whole innovation culture has been established there and is driving the SMEs, but I want to see it all working coherently with ESA and industry surrounding it.

Dr Lewis: To pick up the point Richard made, it is very important that that centre reaches out beyond the Harwell campus. A lot of industry is not located in that region, with perhaps less than ideal visibility of what is going on there, so working outwards from Harwell is critical.

Q52 Pamela Nash: I mentioned to the previous panel the EU's Horizon 2020 programme. Will that support space research throughout Europe and here in the UK? How much confidence do you have in it?

Dr Lewis: It is difficult to judge what Horizon 2020 will bring at this point. We can perhaps look at the recent programmes. From our perspective, one of the issues that perhaps we recognise is the lack of technical staff in the EU, in the sense that there is a lack of technical oversight on the projects. That would need to be addressed within the Horizon 2020 programme, essentially to assure the quality of the research being undertaken and enable a positive and constructive dialogue between the consortia conducting the research and the EU.

Richard Peckham: If you look back at the old framework programmes, from an industry point of view they are less attractive. UK academia has engaged strongly and done very well, and got a lot of money from them. Industry has not engaged so strongly, basically because it is seen as less attractive. You get back only 50%, so it has to be something you really want to do if you are going to invest your money in these programmes. It is seen as quite bureaucratic; there is a very long delay from when

you put in your bid. By the time you have done all these complex consortium agreements and so on it could be 18 months to two years before you are under contract. For SMEs that is an even bigger issue, but it is pretty unattractive to a lot of the big companies as well. There have been exceptions. In some of the large programmes, where industry has had a strong say in setting them up, they are probably very attractive to industry, but in other cases it is sometimes quite prescriptive. The EU says, "We want to do this, this and this and, by the way, you've got to invest 50% of your money in doing it." It has to be something that ties up with your own strategy to do that.

Looking forward to Horizon 2020, it seems that it has addressed some of these problems. There is cost reimbursement for very small companies. They are not going to be forced into international collaborations; it could be a single company. Based on what we are hearing about Horizon 2020, it should be better and should have solved some of the problems that existed in FP, but it is essential that, on space, it co-ordinates very closely with the European Space Agency so that it does not duplicate. As Hugh said, using some of the expertise that ESA has would obviously help because it does not have the technical expertise in some of these areas, but it definitely has a role to play. We talked about Galileo and GMES. Space situational awareness is something else the Commission is looking at, because it is not something that one nation wants to do; it is the sort of thing where you want to bring people together. Space situational awareness might be the next thing in which the EU should engage.

John Auburn: We believe that one of the core elements is £250 million a year on space technology. That is really vital for industry. If the improvements that Richard talked about happen so that it is quicker and more transparent, this will really complement what ESA is doing. The problem with ESA is that the fundamental technology is part of the mandatory programme, which is always kept very low level because you need every member state to say, "Okay; we'll put up that budget." It does not happen. It is vital that it really complements what ESA is doing. We need to put a lot of pressure on ESA and the Commission effectively to manage these two technology programmes that are vital to industry.

Q53 Pamela Nash: Do you think the UK Space Agency at the moment is effectively working with the EU space programmes?

John Auburn: I think a lot more can be done. I would like to see someone based in Brussels being deeply involved, rather than the occasional trip to try to change things. You have to be there, actively involved.

Richard Peckham: If you look at the resources on ESA versus the resources on the EU, there is definitely some rebalancing that should be done there. When they are looking at hopefully increasing resources, some of these extra resources should certainly go into strengthening the dialogue with the EU.

Q54 Pamela Nash: You talk about the rebalancing of resources.

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Richard Peckham: At the moment most of the UK Space Agency's resources are focused around ESA and the relationship with ESA, so it should look to make more effort on the EU. As it strengthens the agency, it should look at putting more resources on EU relationships.

Q55 Pamela Nash: That is interesting. Finally, I want to ask about the responsibilities for space research at the moment. Do you think that we have got the right balance between ESA and the EU in the space programmes of the EU, or do you think that should be looked at?

John Auburn: To me, it should be quite simple. Fundamental research should be done by the EU—by the Commission—and the downstream services. It should aggregate users to take what is coming out of ESA programmes and use them for public good. I do not think it is doing enough of that. In between, ESA will do more of the technology. In practice, it is not happening; in theory, it knows what should happen. That is why having £250 million a year is so important for industry. That is where it needs such close collaboration, and I don't think it is happening at the moment—in fact I know it is not happening at the moment.

Richard Peckham: The most important thing is that they are joined up, talk to each other and agree. I would not be too prescriptive and say it should do this and the other organisation should do the other. They should be joined up and agree between themselves and also with member states as to what is done so that they are not duplicating but adding some value.

Q56 Jim Dowd: The Commission identified a number of problems in its relationship with ESA in the recent past and suggested that a rapprochement between ESA and the EU could help reduce them. Clearly, any intelligent person is going to say amen to that, but is it likely or possible? What form would it take?

Richard Peckham: Certainly, something is going to happen. Within EU and ESA, I guess the big topic at the moment is that future relationship. I know that ESA has been consulting quite widely. It had a big session in Paris just recently and invited a lot of its stakeholders, both industry and government there, to try to get a better view of it and a more formal relationship between the two. It does need to be sorted out exactly who does what.

The Galileo and GMES programmes were lessons of how not to do things. They have learned a lot as they have gone through, and hopefully those lessons have been learned and it is certainly looking better now. If you look at Galileo now compared with five years ago, it is running much more smoothly.

The roles of ESA and the EU are now quite clear. Putting that on a more formal footing, yes, it needs to be sorted out. I do not know that the industry is qualified to say exactly what that should be, but we would not want to lose what ESA is good at. ESA is good at a lot of things, so don't muck that up just by wanting political control. Leave ESA to do what it is good at, but get the EU to do what is appropriate for it. Operational programmes are never going to be an

ESA responsibility. Galileo and GMES would not have happened through ESA. These are long-term operational things and the EU is the right body to be leading them, but it should be using ESA for technical R and D, where clearly it has the expertise and heritage of running those sorts of complex programmes.

Q57 Jim Dowd: If we take the EU and ESA and add the UK into the equation, are the activities across the three well co-ordinated at the moment? If not, what can be done to improve that?

Richard Peckham: From the UK's point of view, we really do not have a space programme, other than this very small technology programme. We rely on ESA and the EU to participate in their programmes. In that sense the UK does not come into it. The UK's role is to make sure our policy objectives through ESA and the EU are delivered. It is an evolving thing, and there is more work to be done in that relationship.

Q58 Jim Dowd: So it is more a question of integration with the other two organisations than advocating alternatives.

Richard Peckham: Yes.

John Auburn: We can give some clear roles for the Commission: foster the European institutions; ensure a level playing field; and allow industry to compete globally. ESA cannot do that. That is the Commission's role. To me, the key one is to expand the utilisation of space applications. It can help industry enormously and get the real benefits of space. We get all this data. A lot of it is not used, and a lot more could be used. Aligning the complex research and technology to societal needs is their role. None of that is ESA's role. It is really a matter of getting a clear distinction between ESA and the Commission and making sure that they work efficiently. They have talked about having maybe an ESA director who works with the European Union on its programmes. In the past there was a director doing that, and it worked reasonably well. Maybe we should have another look at that.

Q59 Graham Stringer: Dr Lewis, in the written evidence it states that there is a good chance of loss of innovation to this country. Can you expand on that? Is there a remedy to it?

Dr Lewis: The issue stems perhaps from the difficulties I have already mentioned with respect to bidding for funding from the European Space Agency, the European Union and even through the UK Space Agency as well, in the sense that the process is time-consuming and expensive certainly for small to medium enterprises. In a way, a barrier has been set up to expanding upon or exploring ideas. Opportunities are being missed simply because there is a reluctance on the part of some small businesses to participate in the bidding process. That is the mechanism that we are trying to elaborate in the written evidence.

Q60 Graham Stringer: What is the remedy to that?

Dr Lewis: It is to enable small businesses, maybe even academia as well, to participate in the bidding

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process, whether that is making the process itself more straightforward and removing the hoops that need to be jumped through for that particular sector. That would certainly encourage more of those types of businesses to be involved in those programmes.

Q61 Graham Stringer: To change the subject back to the discussion we had at the end of the last session about space weather and space debris, how well do you think that is being managed? How could the management of those risks be improved?

Richard Peckham: Not very well at the moment. I referred earlier to the production of a national space policy and national space security policy. Certainly, a national space security policy would address that. We need a clear lead Department to look after this. It has not been clear until now. My understanding—I have not seen the document—is that the space agency will be made clearly responsible, and it will work closely with the MOD and others to discharge that responsibility. The most important thing is to get a clear lead Department whose job it is to manage this.

Q62 Graham Stringer: In the previous evidence session we heard doubts about how practical it was to Hoover up space debris. Do you think that is a fair assessment? Do you believe we could Hoover it up, and how can clearing up this debris be encouraged?

Richard Peckham: Quite a lot of work is being done on different technologies to do the clean-up. You have probably seen in the press a lot about a device that can harpoon satellites and reel them in.

Q63 Graham Stringer: Fishing lines.

Richard Peckham: Yes, and nets and so on. There are some quite big regulatory and institutional issues. You have probably seen the James Bond film "Moonraker" in which satellites are swallowed up. It also could be seen as a space weapon if you are going to take out satellites. There is quite a complex international issue here about going to collect things, but it needs to be done. You heard before that there has been a collision of a satellite in the lower earth orbit. We are fine in the Galileo-type orbits and certainly geostationary orbits, but the lower earth orbit is getting very crowded. There has been a collision, so something needs to be done. There is research looking at various techniques to Hoover up some of the debris.

Jim Dowd: I think it was "Dr No" and not "Moonraker", by the way.

Q64 Graham Stringer: How can it be encouraged?

Dr Lewis: Perhaps a misconception abounds that cleaning up space is absolutely necessary. At the moment, in low earth orbit, the number of junk objects up there is sufficient essentially to sustain the environment. The argument is whether or not we are willing to accept the risks that the current environment poses to operational spacecraft. If we are willing to accept it, there is perhaps less of a motivation to clean up the environment; if not, we have to do something about it. The technology is being investigated, alongside the legal and financial issues. It is not cheap to do. The estimates are in the order of billions, possibly trillions. To achieve something that is

meaningful is very difficult. But there is still a fundamental question to be answered, which is that, if we go forward with mechanisms to clean up the space environment, we have to ensure the reliability of those systems, otherwise there is a danger that we contribute to the problem rather than solve it. Finding that balance point is going to be tricky in the future.

Another issue, which was mentioned in the previous session, is that it is very easy to say we need to focus on the low earth orbit and we can safely ignore medium earth orbit, which is where Galileo will be, and geostationary orbit. That is not the case. There are international guidelines in place at the moment that essentially inform space operators as to what they should do in a responsible manner at the end of a mission. As to where Galileo is going to be, it is very important that thought be given to what happens to the spacecraft after they have reached the end of their mission. At the moment there are a number of navigation satellite constellations proposed and a number already there, and there is no co-ordination in how the spacecraft are disposed of. It could be that a disposal orbit chosen for Galileo interferes with the operational orbit for another constellation, and vice versa. There is a very important need to address that; similarly, in geostationary earth orbit. This issue is not necessarily in the public eye. It is to do with regulation in terms of guidelines and essentially the responsible and sustainable use of space. It is very easy to focus on space debris as an immediate problem, but there are very important long-term issues that still need to be dealt with.

John Auburn: It is a truly global issue, and there could be an opportunity to get many agencies to work together—ESA, NASA, Russia and Japan—because everyone has the same issue. There have been major symposia recently where this is now a possibility. For ESA, the end of the Envisat mission, which is eight tonnes of potential debris, has focused very much on whether it can go and pull that down. This is a real driver now. Because it is global, it is even beyond ESA. We should now be looking globally at inter-agency agreements working together.

Q65 Chair: Just out of interest, Mr Peckham, are those risks insured risks?

Richard Peckham: Commercial satellites are certainly insured. An ESA one probably would not be. You just accept that you would have to rebuild if something happened, but commercial satellites are insured.

Q66 Chair: Does that include collision damage, so to speak?

Richard Peckham: I believe so. I am not an insurance expert.

Jim Dowd: It's only third party, fire and theft.

Q67 Chair: It is interesting to reflect on what that might cost and what the add-on is, compared with the long-term costs—

Richard Peckham: I will check my facts and get back to you on that.

Dr Lewis: My understanding is that, while the risk from space debris is important, there are other risks

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spacecraft face from an operational standpoint. Essentially, there is no hike in premiums as a result of the space debris risk—at the moment.

Chair: Gentlemen, thank you very much for a very informative session.

Wednesday 3 July 2013

Members present:

Andrew Miller (Chair)

Stephen Metcalfe
Stephen Mosley

Pamela Nash
David Tredinnick

Examination of Witness

Witness: Augusto Gonzalez, Head of Unit, Policy and Space Research, European Commission gave evidence.

This evidence was taken via video conference.

Q68 Chair: Good morning. Thank you very much for joining us this morning. This is a parliamentary Select Committee inquiry, and as such this is a public event. There are people sitting in the audience observing our exchanges. First, I would be grateful if, for the record, you would be kind enough to introduce yourself. I cannot hear.

Augusto Gonzalez: It seems to be working fine.

Chair: That is better.

Augusto Gonzalez: We took advantage of the few moments of quiet to do the presentations very rapidly. My name is Augusto Gonzalez. I am head of the space policy unit within the Directorate-General for Enterprise and Industry. I will be representing the Commission this morning at this hearing. With me, for support, I have brought along a few colleagues, just to balance the numbers. On my right I have David Blanchard, Deputy Head of Unit, Galileo and EGNOS—Programme Management. I have Peter Breger, Deputy Head of Unit, Copernicus services; and I also have Dinka Dinkova, Policy Officer, Policy and Space Research.

Q69 Chair: Thank you very much. We have at last made a good connection, so hopefully we can carry on. I will start with a general question, and then I will ask my colleagues to pose a few more. What is the EU's role in space policy? What are its strategic priorities over the next, say, five to 10 years? How is that role shared with member states?

Augusto Gonzalez: As to the Commission's position on space policy, first we have the Treaty of Lisbon 2009, which sets out the competence of the European Union in this domain. Beyond that, in April 2011, the Commission issued a communication entitled "Towards a Space Strategy for the European Union that Benefits its Citizens." This is Com (2011) 152, which sets out its priorities for the coming years.

In a nutshell, the priority of the European Union is to make sure that whatever we do in space delivers benefits for citizens. That is the main preoccupation. We are driven by the interests of our citizens. More concretely, we have three major programmes. We have Galileo, the satellite navigation programme. We have GMES, Galileo and EGNOS. The first priority is the successful implementation of this programme, quite clearly. The second is the successful implementation of what has now become Copernicus, which used to be called GMES, which stands for global monitoring for environment and security. It is an Earth observation programme delivering Earth

observation services. We also have our research programme. Against this background of delivering services and benefits for citizens, we have these three main priorities for the successful implementation of these programmes.

There are other central priorities as well. To my mind, the most important is the connection between space and security. There is a very strong security component in Galileo. There is also a security dimension in Copernicus. By and large, the Commission attaches a great deal of importance to security, ensuring both that space infrastructure with Galileo and Copernicus help us enhance security on earth, but also making sure that we provide security for our space infrastructure. This has become one of the latest initiatives of the European Commission. We have put on the table of the Council of the European Parliament a proposal for a decision to encourage member states to co-operate in setting up, in layman's terms, an anti-collision alert service for satellite operators.

Q70 David Tredinnick: I would like to ask you whether or not you feel there have been various issues in connection with Galileo's progress. How do you think the programme is progressing?

Augusto Gonzalez: The programme is progressing very nicely. The measure of success of Galileo is in the fact that we have four satellites in orbit that already allow us to identify and set a position by means of those satellites. That is a measure of success. The objective is to make sure that products and services are provided by the end of 2014, and member states seem to agree with the Commission that progress has been very good, in that member states' heads of government have decided to allocate over €6 billion for Galileo and GMES in general over the next financial period. There is, I believe, ample proof that we are being successful. There is no space programme that does not suffer from difficulties, and that is the case in general, not just for Galileo but for many others. I think there is the perception and conviction that we are on the road to successful implementation of GMES, Galileo and EGNOS.

Q71 David Tredinnick: How do you see developments in the next few years? What progress are you hoping to make now that you have got these four satellites in space?

Augusto Gonzalez: The whole constellation will have to be put in orbit, and the various services covered by GMES will have to become operational. There is no

reason for us to believe that this will be the case within the next financial period.

Q72 David Tredinnick: Do you think it is correct to say that the Galileo project was subject to political interference? Would you comment on that? If you think it was subject to political inference, what do you believe was the outcome?

Augusto Gonzalez: I have no reason to believe that there was political interference. I will limit my intervention to purely the operational and pragmatic angle. It is no surprise that a programme of the scale of Galileo runs into some form of difficulty. This is totally normal. The programme was designed in a certain way. Some adjustments were necessary, and I believe that we are now on the road to successful implementation and delivery of this programme and services as planned.

Q73 Stephen Metcalfe: Could you describe for us the working relationship between the EU and the European Space Agency? Could you also tell us what you believe to be the strengths but also the weaknesses in that relationship?

Augusto Gonzalez: The European Union has relied on the European Space Agency for the implementation of its programmes. That is clearly the case for Galileo, GMES and Copernicus, and will continue in future. This is what has transpired and is already, to all intents and purposes, a project that has been formally adopted. This is what the Commission proposes as well for Copernicus. I would qualify our relationship with ESA as excellent.

In recent times, the space scene has evolved, in that the presence of the European Union has grown tremendously. The programmes that I referred to will amount, once the MFF is adopted, to almost €12 billion over a seven-year period. That is an enormous amount of money. We have gone from €4.8 billion in the previous seven years to €12 billion for the next seven years. This means that the EU's presence in budgetary terms in the space sector has more than doubled. This is against the background of the Lisbon Treaty, which confers upon the EU clear competence in space matters.

In this changing environment, the Commission thinks it is very important to assess what improvements can be made to our relationship. Nothing is ever perfect. You have no doubt seen the Commission's communication of November 2012, which identified a number of structural obstacles and suggested the way in which we can improve the framework for relations with ESA. Let's not forget that one of the things the treaty says is that the European Union is to establish appropriate relationships with ESA.

Having analysed the situation, the Commission states in its communication that a rapprochement between the European Union and ESA would be a good thing and help us overcome these obstacles: the mismatch of rules; the asymmetry in membership, particularly when it comes to defence and security matters; and, more particularly, the fact that it can bring an added level of political stability to space matters through this rapprochement.

The Commission is currently conducting a cost-benefit analysis on certain scenarios that would give us a better view as to the possible options for this renewed framework of relationship between the European Union and ESA. The Commission is already working to make sure that in implementing the programmes there is a clear and consistent approach, and everything that the Commission and the EU do in financial terms to achieve their objectives has to be within the European Union's financial regulation. We want to make sure that the approaches to the space programmes I referred to earlier are as well.

We are in a situation where we have identified the issues and are analysing the ideal options to overcome them, and make our relationship work better to achieve maximum efficiency in achieving our goals.

When we talk about ESA, we talk about member states. Member states are the European Union. We need to discuss all these things with them, and, when we talk about ESA, we are talking about its member states as well. In all this discussion, there is a very close interaction with member states to make sure that, basically, our views are aligned. ESA is also working to improve its relations with the EU. We are also talking to the executive again with a view to making sure that our views are aligned to the maximum possible extent.

Q74 Stephen Metcalfe: Would you describe your relationship, therefore, more as a partnership, or is it a supplier-client relationship? Depending on which one of those you think it is, when you have disagreements, how do you resolve them? What process do you go through?

Augusto Gonzalez: It is both, in the sense that ESA is the implementing agency for Europe, so the EU has an incremental place whereby ESA delivers some services. ESA delivers where it needs to be delivered in order for our programmes to be implemented. ESA is a technical, research and development and specialised space organisation, which the EU is not, so in that respect it is the first. At the same time, ESA has activities that go beyond our programmes and therefore it is necessary that, in pursuing space policy, we also deal with ESA as a partner. We have to make sure that whatever we and ESA do is aligned. We don't live in a vacuum; the EU lives in a socioeconomic context in which our programmes and ESA's activities are a part. Whatever is done in the space domain can contribute a great deal to achieve the objectives of the European Union's growth and jobs strategy. It is not just important to look at what the EU is doing there; it is also very important to look at what ESA and member states are doing on their own. This is where partnership comes in. It is very important to ensure that we work hand in hand with the European Space Agency and member states in the space domain to ensure there is an alignment of initiatives to achieve the overall goal of competitiveness and growth that the EU heads of states and governments have identified for us.

Q75 Stephen Metcalfe: And the resolution of conflicts when there are disagreements?

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Augusto Gonzalez: Conflicts do arise in the context of implementation of our programmes—this is a fact of life—in the sense that there may be a difference of opinion between people working on these programmes on the Commission side, which is responsible for these programmes, and the other side. These conflicts are resolved in the usual way, through dialogue, discussion and so forth. In the end, it has to be underlined that, as far as new programmes are concerned, there is clearly an overall responsibility on the Commission side. The Commission has to be in a listening mode and take into account the opinions of those who take part in discussions but, at the same time, it has to take on some responsibility for deciding what needs to be done in the end, because, after all, it is the Commission that is responsible for those programmes. I do not think there is, at a political level, a conflict of any sort beyond the day-to-day issues that may arise in the context of implementing programmes. The EU has its views; ESA has its views on possible policy developments. I don't think there is a conflict at that level in any way. It is more a question of making sure that we talk to each other and that our views are aligned. I think that throughout this is the case, so I do not see any conflict.

Q76 Pamela Nash: To continue with that theme, do you think it is still important that the EU and ESA remain very much separate? Do you agree that they have two very separate roles?

Augusto Gonzalez: I am sorry; I did not quite understand the question.

Q77 Pamela Nash: Continuing the questioning by Mr Metcalfe, you were discussing the role of the EU and its relationship with the European Space Agency. Do you agree that they still have very distinct roles and should remain separate?

Augusto Gonzalez: The EU has a reason for being, and so does ESA. ESA is what the member states of ESA want it to be. The Commission has outlined its view regarding the future of ESA, which states that ultimately the goal is that both organisations come closer to each other. However, it clearly states also that some of the existing successful features of ESA should remain. We are talking here about the long-term prospects. We are talking about the Commission stating this as a long-term objective. In a way, the Commission is clearly saying that there are distinct features of ESA that should remain, while at the same time ultimately seeking a rapprochement between the two organisations. I suppose the answer to your question is that we see that some of the features of ESA are worth retaining.

Q78 Pamela Nash: You mentioned in your previous answer the five structural obstacles in the communication of November last year. Could you tell us about those issues in a bit more detail?

Augusto Gonzalez: I hope that the Commission paper is clear. To rephrase a little what we said, when I talked about the financial rules this has to do with the fact that ESA is organised to implement due return, which is not something the EU does. Whenever we bring our programmes to ESA and these programmes

involve the management of funds, we find difficulty in the fact that these are structured in a certain way for a certain purpose, and all of a sudden there is another way of doing things. These are difficulties. How can I put it? We have to live with them, and we can continue to live with them, but we also believe that, if we make an effort, we can perhaps make things work a little better and eliminate these obstacles, and there are ways in which we could do this. This was what I said earlier about the options for change. Making decisions is also an issue. As we state in the communication, ESA has to put any decision to its decision-making bodies, which normally for us is the European Union. We find that perhaps it is disproportionate that member states who are not members of the European Union can cast a vote and influence a decision-making process on fundamental matters in EU programmes.

On security and defence matters, both GMES and Copernicus have a security dimension. When it comes to security issues, we must remember that we have the treaty on the functioning of the EU and the treaty on the European Union where security issues are dealt with, and very often we have to work within the context that the treaty of the European Union provides for, and non-membership of the EU is really an issue. We need to find a formula that allows for the fact that ESA and the EU have different membership.

At a more general level of this aspect of policy co-ordination, as I said earlier, we live in a certain context, and let us not forget that the vast majority of ESA member states are EU member states. We have an overall strategy, and the investment that member states make in space, be it through the EU or ESA, is very important. It is a very important instrument in the overall EU strategy. We believe it is very important to put in places methods of co-ordination to make sure that investment made on one side and on the other is geared to achieve the same goals and objectives, which are again set out in the EU heads of government statement. We think there is something we can do about that.

Finally, by bringing ESA closer to the EU, we can add a layer of political accountability. Any new policy or EU action has to be accountable to the European Parliament and European citizens directly, and we believe there is also a potential benefit that we can achieve through reassessment of EU and ESA relations.

Q79 Pamela Nash: Thank you. That is really helpful. You sound very confident that all of these issues can be addressed and ironed out. Has there been any progress since this was published last November?

Augusto Gonzalez: I am confident that we can definitely do the work of analysing, and looking for solutions to, these issues, but agreeing and implementing them might be slightly more complicated. As far as our work is concerned, yes, there has been progress. We have an external contractor looking into the cost-benefit of potential options. It must be underlined that ESA is undertaking a similar exercise on its side, stemming from the Council of Ministers' letter of November 2012, ESA has also taken the initiative to assess the way in which

it can work most efficiently with the EU. ESA is conducting a parallel process, which the ESA executive discusses regularly with the Commission in order to make sure that both bodies are aligned.

On the Commission side, we think that we will be able to come out with a public paper at the end of 2013, where we will summarise what we have done so far. On the basis of that paper, there will be discussion that will take place within the EU Council. At the same time, ESA is working on a paper that will outline the various options for evolution, as they call it. I think it is aiming to table such a paper in early 2014, so it is pretty much around the same time, the idea being that, after that first discussion, on the basis of the initial ideas, we will move forward to more concrete steps and formal proposals.

Pamela Nash: Thank you very much.

Q80 Stephen Mosley: Earlier this year, the Commission published a communication on space industrial policy. I believe it was Com (2013) 108. Could you quickly describe the purpose of that communication?

Augusto Gonzalez: This is a sector of communication in which the Commission looks at the space sector in general and identifies a number of objectives that it has already discussed with member states and industry. It suggests a number of measures to continue those objectives. The objectives can be summarised as ensuring balanced development of the space industrial sector, with particular emphasis on granting access of small and medium-sized enterprises to this space sector, ensuring that the European space industry is well positioned to compete in the global market—because space is by definition a global market—and that we have the skills we need to achieve the balanced development of the industry. Particular emphasis is placed on innovation and the role that we can play to ensure innovation. Stress is also placed on non-dependence, so the European space industrial sector can develop without undue dependence on technology produced outside Europe.

Q81 Stephen Mosley: I noticed that you used the word “balanced” a couple of times in your response. When you are talking about balance, are you talking about technology or balance in terms of geography across member states? Is there any Commission policy to try to ensure balance across the EU?

Augusto Gonzalez: That is a good point: the notion of balance. The Commission wants to encourage a situation where there is no artificial duplication of capacity—that would not be conducive to a competitive European industry. When the Commission refers to balance, it is the balance between the big and the small; it is a balance between integration, which has taken place in Europe, but also ensuring that smaller companies that want to enter this sector can do so, as there has to be room for these companies as well. Those are the main ideas behind the notion of balanced development.

Q82 Stephen Mosley: Have you made any assessment of the current global competitiveness of the European space industry?

Augusto Gonzalez: Yes. We have figures that come from the industry itself. We know for a fact that the European space industry is doing extremely well in the global market. For a number of reasons, European industry is selling very well across the globe, but this situation is changing. In the US, where there is a space industry that is even more developed than ours, we are beginning to see a reduction in the defence budget that the space industry has access to. It is often said that the most important space agency in the world is the Department of Defense in the US. Industry that traditionally worked almost exclusively for US institutions and the Department of Defense is now beginning to be a lot more active internationally. We need to make sure that our industry is prepared to compete with that, or continues to compete just as well as it has done up until now.

We also have a number of emerging nations, with strong emerging space industry—I am talking about China and India. We need to make sure that our industry, which has done extremely well in this sector, remains competitive. I think that answers your question.

Q83 Stephen Mosley: How does the Commission’s space industrial policy fit alongside that of the ESA?

Augusto Gonzalez: ESA has an industrial policy, in that whatever it does has an industrial objective in mind, and due return is an instrument of ESA’s industrial policy. Its instrument to intervene vis-à-vis industry is procurement. It procures things from the industry for their missions. The Commission has that too, because we have Galileo up and running; we have Copernicus, and we now have plans through the research programme, but there are other issues that the Commission is looking into, so it is a bit broader. For example, the Commission needs to look into whether the framework conditions for industry are adequate; whether there are perhaps other initiatives that may undertaken, and we are open as to whether we need them or not. We are looking into that. There is the domain that I just mentioned, where the EU has exclusive competence: trade. Whenever we talk about the ability of our industry to compete in international markets we need to be aware, and we need to make our trade colleagues aware, of the specificities of the sector to make sure that they are taken into account when they negotiate with countries outside the European Union. It is in this context that both the EU and ESA have commonalities. ESA has industrial policies, but the European Union is broader and covers areas where ESA does not have competence or a role.

Q84 David Tredinnick: You have referred several times in your presentation to the Copernicus programme. Could you set out its main aims?

Augusto Gonzalez: Copernicus is an Earth observation programme. The EU is in support of the setting up of a space infrastructure coupled with ground infrastructure, which will provide data that are then used for services. We have a series of services: land, marine, atmosphere and emergency services. Those services will use the data collected through our space infrastructure, and also through the in situ

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infrastructure to operate and basically serve the user needs. Copernicus is the final solution requirement of the programme. The Commission works very closely with the users of those services that I have just outlined to see how, through our space infrastructure, we can provide the data needed for the delivery of those services for users' use, not the Commission's use.

Q85 David Tredinnick: How do you see the co-operation between the European Union and the European Space Agency as part of this programme developing in the future?

Augusto Gonzalez: Co-operation has been very close. Let's not forget that GMES was a programme co-funded by ESA and the European Union, so it was a programme born from an initiative of the European Space Agency, and was taken over by the European Union, so the collaboration remains very close, in that there are parts that are still funded by ESA and parts funded by the European Union, and will continue to be so in the future. Therefore, we are bound to continue to co-operate very closely as we have this programme.

Q86 David Tredinnick: Do you think the European Union is what we might call an intelligent customer of the European Space Agency's services? If so, are there any areas that could be improved?

Augusto Gonzalez: You say "an intelligent customer."

David Tredinnick: Yes. It is my phrase.

Augusto Gonzalez: I think the European Union relays the needs that are out there and develops initiatives. It has put in place Copernicus, together with ESA, and relies on ESA to serve the user community. It is more than a customer. The EU is making policy based on evidence and is getting assistance from ESA in implementing this policy, whose ultimate goal is to serve the public interest.

David Tredinnick: Thank you very much.

Q87 Pamela Nash: The Committee has been reading about the Horizon 2020 programme. How do you think this is going to be able to support research in the space sector?

Augusto Gonzalez: The framework programme for research has been in operation for many years, and there has been a space component for a number of years now. We have seen the role that the seventh framework programme has played in space, in particular with GMES, which has now become Copernicus. The investment through this programme has been instrumental in bringing these benefits, and it has been effective in supporting initiatives coming from industry, research institutions and academia to develop space research initiatives. We will continue to see that under Horizon 2020. Horizon 2020 has not yet been adopted, but there are indications that there will be a space research component to it. The fact is that Copernicus has now become a programme on its own with its own budget allocation under the MFF. There will be more funding of Horizon 2020 for activities other than GMES than was the case in the past—GMES was 8% of the MFF budget. So there will be more funds to continue to support space

initiatives from industry, research institutions and academia, serving the overall goal of the programme, which is to support innovation with the ultimate goal of supporting competitiveness within the European Union.

Q88 Pamela Nash: Will the money that space research receives be around the same share of the research funds in Horizon 2020 as the previous programmes?

Augusto Gonzalez: Yes; it is roughly in the same range as the previous programme.

Q89 Pamela Nash: The Committee has received some evidence from organisations expressing concern that Horizon 2020 may not be completely compatible with ESA. Is that something that you are aware of? Do you have any concerns that you may not be able to co-ordinate?

Augusto Gonzalez: "Concern" is not the word I would use. ESA supports research—that is quite clear—in a way that is somehow different from the way in which the framework programme and the Horizon 2020 programme will work, but this works in a complementary way. ESA research can be defined in terms of mission driven; it is research whose objective is to serve SMEs fundamentally. Horizon 2020 has a more non-prescriptive approach, where the initiative lies more with proponents: people who are interested in space research come up with initiatives. Obviously, there is a framework for that; there are orientations for that. It is not as if everything is open-ended, so there is clear guidance as to what we seek to achieve through the support of the research, be it the support of Galileo applications, or Copernicus applications, or more generally the development of space technologies that industry needs for their business. So, although it is not open-ended, the approach is more portable than the ESA approach.

We have very close co-operation with ESA in implementing the seventh framework programme, and we will continue to have such collaboration with ESA in the future. ESA provides expert advice in evaluating products. They also tell us whether there is any potential duplication of activities funded through the ESA research programmes, so we are quite confident that both approaches are complementary. There is a certain degree of what we call calculable. I think there is nothing wrong in the fact that sometimes we cover the same areas, even though they do so in complementary ways. Duplication is what we seek to avoid. We are doing this quite well at the present time with ESA, and we are confident that that will continue in the future. The voices that we hear are encouraging us to keep the system working as it is at the moment.

Q90 Pamela Nash: On the implementation of Horizon 2020, have you or anyone else in the Commission had any discussions with the UK Space Agency about its implementation?

Augusto Gonzalez: All the programmes—Galileo, Copernicus and Horizon 2020—involve discussions with member states. There is a programme committee on which representatives of member states sit, and very often we find people working with space

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agencies, so, almost by definition, in all those programmes there is regular formal contact with member states and their space agencies, because member states often relay the opinions of the experts in the space industry. More than that, there is also informal discussion with member states, including their space agencies. We have had a series of workshops to help us prepare the draft work programme for Horizon 2020 in which the space agencies, including the UK Space Agency, have been very active.

Q91 Pamela Nash: Do you think the UK Space Agency should be more active in these discussions, or do we have it just about right?

Augusto Gonzalez: I think they have a very satisfactory level of involvement in our process.

Pamela Nash: Thank you.

Chair: That is a very nice note on which to finish. Mr Gonzalez and colleagues, can I thank you very much for joining us this morning? It has been a very interesting session.

Examination of Witness

Witness: Jean-Jacques Dordain, Director General, European Space Agency gave evidence.

Q92 Chair: Good morning and welcome. I would be grateful if you would, briefly, introduce yourself for the record.

Jean-Jacques Dordain: I am the director general of the European Space Agency, and have been since July 2003, so 10 years ago. Before that, I was director of launching at the European Space Agency for three years. It was during that time that I introduced Soyuz and Vega, the two launchers which are now flying and fully operational. Before that, I was director of strategy. I initiated the relationship between ESA and the EU at that time, working on the framework agreement. Before being at ESA, I was with ONERA, which is a research organisation for aerospace, depending on the Ministry of Defence. I came from the Ministry of Defence before being at ESA.

Q93 Chair: And your two colleagues, for the record?

Jean-Jacques Dordain: I can introduce Magali Vaissière, who is the director of telecommunications and integrated applications, but now is head of the Harwell Business Incubation Centre at Oxford. Alan Cooper is my colleague in charge of the Brussels office.

Q94 Chair: Thank you very much. Let me start off with a general question. What do you see as the role of the European Space Agency? What should its strategic priorities be over the next four or five years?

Jean-Jacques Dordain: First and foremost, to explain what the European Space Agency delivers is the best way that I can define what we are doing at ESA. We deliver science and knowledge, technologies and competitiveness to European industry, and we deliver services to the citizens. Those are the three pillars of our objectives. To do that, the science part is related to the universe, to planet Earth. So we are looking at the origins of the universe, the solar system and planet Earth. This is not only for scientists but because understanding the universe and the solar system is the best way to understand planet Earth, and that is our goal. We are spending a lot of effort on understanding planet Earth's environment and climate change. That is for the knowledge part.

On the competitiveness and technology part, we are looking at how we can make European industry competitive on the world market. This is mostly telecommunications, which is the commercial field of space activities. We also launch services and generate technologies. We do everything we can to develop new technologies and the competitiveness of European industry.

Services to its citizens include meteorology, environment and security, operational services and navigation services. Now, with Galileo, there are a lot of different services that we can provide to our citizens. That is what we are doing. What is the perspective in front of us? It is to develop that with more and more partners. Even if I take the last 10 years, ESA has evolved a lot in the way that it is working more and more with other actors, such as national agencies and industrial operators. We have more and more private-public partnership with industry and operators, with international partners, with the EU, meaning that ESA has now an importance that goes much beyond the borders of ESA because of that partnership. In my view, in the next years we have to see under which conditions we can continue to develop this partnership, because that is leverage. It means that any euro invested in ESA is much more important thanks to the partnership. This is certainly the challenge of the next years.

Q95 Chair: So how does that partnership between ESA and the national space agencies actually work in a practical sense?

Jean-Jacques Dordain: It works beautifully. Let us take the science programme. The science programme is a partnership between ESA and the national agencies. It can look strange because, at the same time, these national agencies are contributing to the ESA part, but they are providing their national part. All science missions of ESA are based on this partnership, meaning that ESA is providing the common part of all the science missions and the national agencies are providing the instruments. Let us take one of the most fantastic science missions. All science missions of ESA are fantastic, but let us

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take the last one—Planck. We disclosed the data results of Planck on 21 March. This is the origin of the universe. You can look at it yourself by looking at this picture because we are all coming from there. This is the origin of the universe and our origin. I am very proud that we could do that. Nobody will do that again for several decades. Planck is a mission that has been financed through ESA for the platform technology, while the instruments of Planck—the two major detectors—have been provided by Italy and France. ESA has provided the technology breakthrough because the breakthrough to get this scientific data required a lot of technological improvement. That technological improvement has been provided by ESA. It is because we could cool down detectors at 0.1 degree kelvin that we could provide to the scientists this type of data. This is the first part of the relationship of co-operation between ESA and national agencies. All science programmes follow that model.

On telecommunications, for example, we have a lot of partnerships with the national agencies. The next launch of ESA will be Alphasat, the biggest telecommunication satellite developed in Europe, with several partnerships. This case is interesting because we have the partnership between ESA and the French national agency, CNES, to develop the platform of that satellite; the partnership between Telez and Nacion, which is not usual, but sometimes they can be partners; and the partnership between ESA and MASAD, which is a virtuous partnership because the member states of ESA are taking the risk to develop new technologies. The operator in MASAD is taking the risk to use these technologies to open up a new market. It is a virtuous public-private partnership. That is another example of our co-operation with national agencies, too. I can continue the list, but this is just to give you two very different examples, one on science and one on telecommunications, which, again, is industry and sciences.

Q96 Chair: Certainly in our visits to Frascati and Harwell, we have seen some world-class science. There is no doubt about that. Just looking forward a little, what do you see as the main challenges facing ESA?

Jean-Jacques Dordain: I shall start by giving my usual answer. ESA is European and space at the same time. So it already has two challenges. To be European is a challenge. To work in space is a challenge. To be European: we have 20 member states and getting 20 member states to work together is a challenge, I can tell you, for the director general of ESA. Each meeting of the Council with the representatives of 20 Governments is always interesting. It works beautifully, but it is a challenge. The evolution of Europe is putting that challenge on a continuous basis because we have more and more member states at ESA. We have our relationship with the European Union. All that is a challenge. To be European is a challenge. To work in space is a challenge because it is difficult to work in space. It is risky, even. We are taking risks to work in space, not because we like the risk but because this is the only way to make progress. It is a risky business. At each

ESA launch, I know all the reasons for its mission not to work, but it works. It works because of the expertise of our industry, the expertise of ESA, because we know how to manage the risk. Those are the two generic challenges.

The other challenge is to give back to member states what they are giving us. I am attracting money at ESA on the basis of delivering value and jobs. Obviously, I have to give back that value and jobs. This is what we are trying to do. Okay, yes. This is our challenge.

Chair: It sounds like you have had a career change from being a great scientist to a great diplomat.

Q97 David Tredinnick: Bonjour, monsieur. You have just mentioned value, which moves me neatly on to an area that I want to ask you about. Do you think that the UK gets value for its investments in the European Space Agency compared with other member states?

Jean-Jacques Dordain: First of all, yes, you get value. I shall try to tell you what value you can draw out of ESA. After that, I shall try to compare you with other member states. Let me speak, first, in absolute terms. After that I shall come to relative terms. In absolute terms, the value that you draw from the contribution to ESA is on several aspects. First of all, industry: all euros put in ESA put euros back to industry. As I say, in many of my speeches, I hear the word "re-industrialisation" in Europe. In space, you do not have to re-industrialise because there is no delocalisation of industry. All industry is now in the member states. That is the first value. It is industrial activities. Beyond industrial activities, there are the industrial skills and the industrial process, which can be used in fields other than space. That means that the return is not just the return on the ESA programmes. This industrial return has much more value than just the pure geographical return on ESA programmes. All capabilities that you are developing through ESA programmes can be used on the commercial market, production, downstream services and so on. That is the industrial value.

Q98 David Tredinnick: One of the points that have come up in our visits is the difference between investing in the mandatory programme and the more optional programmes. Do you think that the UK would get a better return on its investment in the European Space Agency if it invested less in the mandatory programme and more in the optional programmes?

Jean-Jacques Dordain: You think that the mandatory programme is the smallest part of ESA. One interesting aspect of ESA is that it is a very flexible structure of co-operation. We have one mandatory programme but 60 optional programmes. In terms of budget, the total of optional programmes is more than 80% of the total budget of ESA. That means that the optional part is much more important than the mandatory part.

Q99 David Tredinnick: So it is a size issue, then?

Jean-Jacques Dordain: That is number one. Our countries have no choice in the mandatory programme. They have to contribute according to

their GNP. The rule is very simple. The richer you are, the bigger your contribution is. That is the principle of the mandatory programmes. As to the big contributors—France, Germany and Italy—they are contributing more than their GNP percentage to the optional programmes. The mandatory programme is mostly science. Behind science comes technology, which is necessary to make scientific progress. I would not like to give the impression that it is only for the scientists. It is a lot of technology. Behind this technology is, again, industry and industrial value.

On the optional programmes, this is where the big contributors are getting the best leverage because the optional programmes are more related to the business and the economy. This is the reason why. ESA is a very interesting agency because 55% of the budget of ESA comes from two countries, and 80% of the budget comes from four countries. This means that, whatever number of member states I have, the core of ESA is made from six countries, which are France, Germany, Italy, UK, Belgium and Spain. That is the core of ESA. Since I became director general, I have got six member states more. It is more member states, not more money, if I can be straight, because the money is coming from the big contributors.

Q100 David Tredinnick: You would take a very positive view of the increase in the British space budget, would you?

Jean-Jacques Dordain: Yes. It is very good news.

Q101 David Tredinnick: You think that is significant. It is not for me to put words into your mouth, as a politician.

Jean-Jacques Dordain: I have said that at a press conference. I have started a press conference 10 minutes after the Council at ministerial level, by saying, "I shall speak in English because the most important news of the Council at ministerial level is the increase of the UK investment in the ESA programmes." I am taking that as a very important signal. I am not saying this because you are British, but in the UK there is a spirit of entrepreneurship that does not exist in the other countries. The most important public-private partnership that we have started to develop in telecommunications was with a UK entrepreneur. The first real one was Ilas 1, which was with Avanti, developed by Mr David Williams. I always quote Mr David Williams because he has made the best compliment about ESA that I have ever heard. He said in one of his speeches that by using the name of ESA he can raise money on the stock market. That is the value of ESA. This is the originality of the UK. This is the entrepreneurial spirit that ESA can take benefit from the UK.

For me, the increase in the contribution of the UK in ESA is very good news because it brings a different culture at ESA. I hope that it is good for the UK but I am convinced that it is good for ESA. This is always the way. I hope that it will continue like that because, thanks to that, we have in the UK a very competitive industry. We have very competitive operators. We have world-class scientists, and this is because you are also investing. You don't get that for granted. You get that because you are investing—I am sorry to say

it—in the right place, and ESA is providing back to the UK a lot of value, which, after that, can be used in other fields, either the commercial market or non-space fields. You are right to increase your investment in ESA and I hope I shall give back to the UK what you are hoping for.

David Tredinnick: Je ne parle rien Français. Merci beaucoup.

Jean-Jacques Dordain: Merci beaucoup.

Q102 Stephen Metcalfe: Good morning. How would you describe your relationship with the EU? There has been talk about a "rapprochement of ESA towards the European Union." Do you think that that is necessary?

Jean-Jacques Dordain: I think that the relationship between ESA and the EU is necessary—difficult but necessary. As I told you, before being director general of ESA and the director of launching, I was director of strategy. I was the first person in the history of ESA to have written a joint document—with the European Commission, in 2000 or something like that—with a colleague. We wrote 15 pages together in a paper that we called "The European Space Strategy." It was the first joint document ever written with the European Commission. I am a strong believer in the relationship between ESA and the EU and the necessity of that.

Why is it so important? It is because by doing that we connect the space world with the world of citizens. I consider that the EU is the world of the European citizen, while ESA is the space world. I am not expecting, let me put it this way, the Commission to explain to me how we make a satellite. We know how to make a satellite. What I am expecting from the European Commission is for it to tell me which of the European policies can benefit from space infrastructure. There is a lot, starting with—I am French—the agricultural policy, but also the environment, security and development policies can all benefit from space infrastructure. I need the European Commission. I need a guide. I am not a specialist in agriculture or security. This is what I am expecting from the EU.

Again, I am not expecting from it satellites—we know how to make satellites—but I am expecting from it to describe the demand of European policies that can benefit from space infrastructure. This is the origin of my belief in the relationship between ESA and the EU. That, for me, is the driving force in this relationship. It is not to get more money. It is to connect citizens and the space world. That is, for me, the important factor.

It is not easy to work with the EU and especially the European Commission. It is a cultural shock. We are a world of engineers and scientists. We are project-oriented. We are interested in making the best satellites in the world and the best launchers in the world. We are project-oriented. We are, again, scientists and engineers. The EU world is very different. I am not saying that it is bad, but it is a different world, and mixing two different worlds, working together, takes time. It takes some pain and effort, but it is necessary, and this is the reason why. Let's face it, I have colleagues on the Commission and they are friends. It is nothing personal. Sometimes I am tired of trying to solve problems between ESA

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and the European Union, but this is necessary, and even essential, because this is good for European citizens. This is the reason why I am a strong believer in that relationship.

In the current relationship, there is room for improvement. Our relationship is not the most efficient that I can dream of. This is very clear. On the other hand, we have started to work with them on Galileo and GMES. Yes, we have problems of efficiency, but it is not a reason to give up, because that would be bad. This is the reason why I am still working to make the best possible relationship between ESA and the EU. I, myself, am not keen for an institutional change. I think that ESA is one of the best space agencies in the world. Okay, I can dare to say the best space agency in the world. I would not like our relationship with the EU to change that. I value ESA too much to take the risk of causing detriment by what we are doing to our relationship with the EU, but it is as a complement.

I can even be more precise. What I am expecting from them is, again, the demand of the European policies that can benefit from space infrastructure. There is still a lot of effort to be made on their side. It is not on my side but on their side. I would not say that I am more interested in the commissioners in charge of environment, security and agriculture than I am in the commissioner in charge of space because I am looking at the European policies, the European-sectoral policies. That is what I am expecting from them.

The one thing I am expecting from them is for them to organise a European institutional market. What we are missing in Europe is a European institutional market on which European industry can be based. I will take a clear example, and Magali can give even more details if you wish: open sky. We are working together with the Commission to see how telecommunications satellite can help the navigation of aircraft in an open sky. That would be the breakthrough in the way that the traffic management would be organised. Today, what is the obstacle? It is because there are telecommunication regulations at national level, not at the European level, which means that we cannot cross the border. It is very strange to have an open sky and to have borders in telecommunication regulations. ESA cannot do something on that. I cannot go myself and say, "I wish to change the telecom regulations." I have no voice on that. That I am expecting also from the European Commission, too. I have a lot of expectations from the European Commission, but I would prefer it if it leaves us to make the Galileo satellites as we want, rather than tell us how to make a Galileo satellite.

Q103 Stephen Metcalfe: You captured your view on the relationship between ESA and the EU in your very first word, which was "necessary," but you do accept that there is room for improvement. If you were to improve that relationship, what are the tangible benefits? Would it be quicker to get changes in relation so that your open sky project would work? Is that one of the kinds of benefits if there was an improvement?

Jean-Jacques Dordain: Absolutely. I am sure that we could design our satellites according to their demand.

The worst is to have the engineers inventing a satellite for environment and security without having someone to define the needs. It is not for us to define the needs. For me the best model of relationship is ESA-EUMETSAT. What is the relationship between ESA and EUMETSAT? It is very simple. EUMETSAT are the masters of meteorology. We don't know a clue about meteorology. They know. They are defining what their needs are in 10 years from now on meteorology satellites. They are giving us their needs. Our engineers from these requirements are inventing the best satellite that they could to answer to these requirements. The member states financed the development of the first satellite. After that, EUMETSAT is financing the recurrent satellites. They are financing the exploitation of the infrastructure and they are delivering the services. If I could do that with the European Commission, that would be fantastic. Our relationship with EUMETSAT is based on 30 years of experience. It is very successful and efficient. The meteorology service in Europe is the best in the world. Let's do that for environment, let's do that for security, and let's do that for transport. Let's do that for everything, and it will work.

So, Copernicus's genius is based on most of that because the member states financed the development of the first satellites. Now, the Commission is taking over the recurrent of the satellites and services. It works.

Galileo, unfortunately, for historical reasons, is not built on that model because this is the European Commission financing the development of the satellites.

Chair: We will come on to Galileo in a moment.

Jean-Jacques Dordain: Again, I expect a lot from the European Commission.

Stephen Metcalfe: Good. Thank you.

Q104 Pamela Nash: Because of the excitement of the video link, I didn't declare an interest earlier. I am a member of the Parliamentary Space Committee here and of the European Interparliamentary Space Conference. There are details about that and of my visits on my register of interest.

On Mr Metcalfe's question earlier, we heard about the five structural obstacles that the Commission set out in November of last year. I wanted to ask if you recognise those five structural obstacles. ESA's position is that they agree that those obstacles exist.

Jean-Jacques Dordain: I do not remember the five obstacles, but I remember that I have read that. I remember that I do not consider those as obstacles, frankly speaking. I remember, for example, the asymmetry of member states. This is not an obstacle. Yes, we have Switzerland and Norway, but they are two good countries. I do not think that there is any secret problem in having Switzerland and Norway in ESA, frankly speaking. I am not taking that as a handicap for ESA. In the same way, the new member states that are not yet members of ESA are all co-operating with ESA. We have launched the first Hungarian satellite. We have launched the first Estonian satellite, and they are very glad. I can tell you that we have had thanks from all politicians of Estonia because we launched the first Estonian

satellite on 7 May of this year. So there is, frankly speaking, no problem.

I remember that another obstacle was the financial regulations. We have totally changed the financial system at ESA. I can tell you that I prefer to make a satellite than to make a financial reform. It was a heavy burden for ESA. We are just coming out from this change. We have made that financial reform to be consistent with the European start-ups. This is not an obstacle.

Security and defence: ESA is for peaceful purposes. It is written nowhere that ESA cannot work for defence. As long as the defence policy is for a peaceful purpose, ESA can work for a defence policy. By the way, "peaceful purpose" is the wording in the Outer Space Treaty. All the signatories of the Outer Space Treaty have to be in space for peaceful purposes. ESA is not prevented from working for security and defence. I do not think that there are obstacles, and this is the reason why. Again, I see that we have to work with the EU. I am more than ready to make all the efforts to work with the EU but provided it is based on roles which are well defined, and ESA has the space role. I think that we are a good space agency. I said that ESA is the best space agency. We do not need the European Commission to tell us how to make satellites but to give us, as I said, things that we cannot do by ourselves.

Q105 Pamela Nash: This is very important because it is slightly different from the evidence that we took earlier this morning from the Commission representative. He indicated that his understanding was that ESA was working to remedy the five obstacles at its regular meetings. What is the process of that?

Jean-Jacques Dordain: As I said, we have made financial reform. Yes, I am ready to make ESA evolve, to be according to European standards, but I shall not kick out Switzerland and Norway, because, frankly speaking, we need Switzerland and Norway. I do not think that these obstacles are real obstacles that would prevent ESA from working with the European Union. We have to work with it—I have no reservation whatsoever about that—but what I want is to work more efficiently with it.

Q106 Stephen Mosley: Could I focus in on one particular project, which is the Space Situational Awareness project? How successful has that been?

Jean-Jacques Dordain: The Space Situational Awareness project has three different subjects, which can be embedded in threats. The only common part is threats, but they are totally different subjects. The first object is tracking of debris. I shall come back to that. The second subject is space weather, the solar flares. The third subject is near-Earth objects. As I said, the common part is threats. The debris is a threat for the space operational systems. Whether you have a navigational system or a GPS delivering your operational systems, you had better protect these operational systems vis-à-vis the threats coming from debris. Those are the threats to space infrastructure coming from debris.

Space weather causes threats to infrastructures, not only in space but also on the ground in the supply of electronic system. So space weather is a different type of threat. We have to take care of that. Near-Earth objects are threats to planet Earth. When you have a small piece coming into Russia, for example, like the experience we had a couple of months ago, that raises the problem of the threats coming from space. There are three different types of threat. We have embedded that into what we have called Space Situational Awareness. The problems are not the same. With tracking, the problem is that we need to detect and monitor the debris. This is not the whole of ESA. We are accustomed to that. What we need is to protect our space infrastructures.

I have said many times that I don't think that that is part of the core role of ESA, but, on the other hand, since nobody was doing anything on that, I took the initiative to put that on the table. It was more to raise an awareness of that problem than to do that at ESA. I am coming from the Ministry of Defence. I can tell you that I was at the origin of the first French system of detection, which was called Graves. I know, unfortunately, that when you are tracking debris, you are also tracking other objects that I don't know now—I knew them when I was in the Ministry of Defence, but I have forgotten them for ever. One of the problems of tracking is how you can make two channels from what you see: the channel that is protection of your space infrastructure and the channel going to the different guys who want to know what is going around. That is a difficulty. That difficulty is not yet solved. This is the reason why the French have a lot of reservations vis-à-vis ESA or even the European Commission taking some part of that. As long as the problem of separation of the data—the one interested in debris and the other interested in other things—is not solved, they will have the reservations. So this is a problem of tracking, but we need that.

We can look for ever to develop the operational space infrastructure. I am not aiming to have such a system in Europe.

In relation to space weather, first, we have to make a lot of progress in understanding the physics. It is good to speak about early warnings. I know it is a threat and there was an historical event where solar flares, even in the 19th century, disturbed the oldest telegraph in the world. So it is a threat, because when everything is automatic on planet Earth, when the power supply is automatically driven and so on, if a solar flare destroys all that, that is a problem. Today, we are not yet at a point where we have fully understood the physics. First comes scientific research. We are doing that at ESA, especially all the activities that we are making on the interaction between the magnetic field, solar flares and the Sun-Earth interaction. There is a lot of science on that, and we are doing that.

Near-Earth objects is a big question mark. The detection is one part but the action is much more important, because on the day that we know there is an asteroid of several tonnes, which will come on planet Earth, either you pray or try to take action. Taking action will require significant effort. There is this famous mission initiated by the United States of going to an asteroid that can look like exploring our

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solar system but may be the starting point on whether we can act on an asteroid. Can we deviate the trajectory of an asteroid? That, today, is an initiative of the United States. We are working with them on that but it is a very long-term activity.

Q107 Stephen Mosley: That was very detailed. I have just two questions. The first question is how you interact with the member states, and particularly the UK, in delivering this project. The second question is how you co-operate with non-EU organisations. You mentioned the US and other organisations. Looking internally, first, how do you work, particularly, with the UK?

Jean-Jacques Dordain: We are working with the member states on two sides. First of all, we work with the member states who are contributing to the ESA part of that programme. The UK is contributing to that programme, but that is normal business. It is an ESA programme. They are the programmes of the participating states. We are also interacting with the member states about their national concerns. We do not want to develop capabilities if they are existing on a national basis. This is the reason why. There are facilities existing in France, which I know very well, because I come from there, in Germany and in the UK. We are trying to complement that with a facility in Spain. With that, we could start to have a network that could be useful for having a space situational awareness global system. Those are the two types of interaction. With the UK, we are working with the facilities that I visited here.

We have some connection ourselves with the United States, but the connection is more with the European Commission to see how we can have an agreement, as we have with Galileo and GPS, to try and avoid making things that would be against co-operation between the United States and Europe, and especially for the different aspects. It is clear that what is behind all that are the different aspects, but we are discussing with them.

By the way, as long as we don't have any system in Europe, we are using data coming from the United States. The problem is that they are giving us data on short notice, unfortunately. I can give you an example of that. It was Christmas four years ago. I was told during the night of Christmas, "Oh, by the way, debris may cross the path of our satellite two days from now so you had better check." I would have preferred to have got that information much earlier.

Q108 Stephen Mosley: So what do you in a situation where you know that debris is crossing the path?

Jean-Jacques Dordain: When we are warned by the Americans, we can use the facilities existing in France, Germany and the UK. What we are missing in Europe is a system that is giving us the full space situational awareness. When we know that there is a corner of space where there is something, we have radars that can monitor that, but the problem is that we have no early warning. This is the problem.

Q109 Pamela Nash: I want to ask about Galileo. The evidence that we have taken from Telespazio indicated that it thought the procurement process with Galileo

had problems with political interventions that may have led to some delay. Is that correct? Do you agree with that?

Jean-Jacques Dordain: I shall make a difference between the normal problem of a space programme and the Galileo space programme. When you are developing new technologies and exploring the unknown, as we are doing, yes, we have some technical problems, because Galileo is a new technological system. We are not duplicating GPS. The atomic clock is at the front. The signal generator is different. These are new technologies. This is going into the unknown. That is the general problem of space programmes.

Galileo has had a lot of specific problems, but most of them are behind us. Yes, there were delays on Galileo. First, it was at the start. I am putting that at the door of the member states. It was the first part of the In-Orbit Validation system, which was financed 50% by the member states of ESA and 50% by the European Commission. It was a choice made at that time. Unfortunately, the member states of ESA were so fond of Galileo that they contributed much more than we wanted at that time. There was a big debate among the member states that took two years to see how they could agree on who would contribute to that. They came up with the worst decision that they could have taken. I am saying that because this is history. They said, "Okay, France, Germany, UK and Italy will finance in equal contributions of 17% each." Unfortunately, this was the worst decision because that was preventing us from using competition to select the primary industrial contractor. That meant it forced us to create the worst infrastructure that you could have invented, which was Galileo Industries, which was a cartel of four industrial companies, leading to a monopoly of the development of Galileo. It took another two years to kill Galileo Industries and to come back to a more reasonable structure. That was the first. That is behind us. It was the In-Orbit Validation Programme. The four satellites are in orbit. This is a significant part of the delays.

The second part of the delays came from the dream of the European Commission to make Galileo under a public-private partnership. It took three years to realise that it could not work because there were no real private investors ready to put money on Galileo. The only private investors who they found were just three. It was not because they were not interested to pay for a system but they were more interested by the fact that they could make the satellites. But it is not a public-private partnership. It took three years to move to a public-funded development programme. But that is over.

The third problem was the procurement system within the Commission. After that it was 100% funded by the Commission. They invented a six-part package, but one preventing any European company being the winner of more than two packages, which has introduced a lot of controls in the system and which was more distributional activities than real competition. That also took some time. I dare to say that all of these problems are behind us. We have now four satellites in orbit—the four IOV—which are working fantastically. The first localisation, which was

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made in March of this year, with these four satellites, shows a localisation that nobody in the world is making. That is good news. We are working to launch the next satellites, which are the FOCs, which will be launched by the end of this year. I am committed to have the first operational services by the end of next year. We are working on that. There are some problems of efficiency because of the relationship between ESA and the European Commission, but it is a lack of efficiency and is not insurmountable.

Q110 Pamela Nash: In relation to the next big project, are you confident that the major issues with funding and procurement will not happen again?

Jean-Jacques Dordain: As I said before, the best model to work with the European Commission would be to have the member states of ESA financing the development of the first of a new generation of satellites because the way we are, procuring the first of any new generation of satellites, is well experienced. We are organising the competition. The most important competition that has ever been organised in Europe on satellites was for meteorology satellites. The ESA system works very well to make a good mixture of competition and industrial return. For me, the future should be that ESA member states finance this first satellite of any new generation and the European Commission finances the procurement of the recurrent satellites, the exploitation and the services. That would not pose any problem because this is a model that we know very well in our relationship between ESA and the EUMETSAT. It works well.

If it could be made that way, I don't see any problem. If it is made with the European Commission paying for the development of the first satellite, we shall have to see. I have spent a lot of time on this. My biggest fear is that the rules of the European Commission are opening the call for proposals beyond the borders of Europe. The European Commission cannot restrict the invitation to tender to the European industry. It was a big debate on Galileo. It is only because I myself went to the European Parliament and said, "I am the director general of ESA but I am speaking as a European citizen. If I am asked to make Galileo by purchasing parts in China, a satellite platform in India and the payload in the United States, I have a much cheaper way to make Galileo, which is to use the GPS that are for free, because, if this is to finance non-European industry, it is totally useless." It took some time to convince the Commission to restrict the invitation to tender to European industry. I said that sometimes the Commission is complaining about the geographical return of ESA, but I said that, before complaining about the geographical return of ESA, they should look at the European return, because that is a subject of discussion. The United States is the most liberal country in the world, but they will never issue any ITT of any procurement programme to any non-US industry. Take notice of that: but I am not in charge of that.

Chair: We have a couple more quick questions.

Q111 David Tredinnick: Why does the United Kingdom not have a director at the European Space Agency?

Jean-Jacques Dordain: Why do we want to have a director? Okay. First of all, we need candidates. We have candidates, it is true, but, since I was expecting that question, I have looked at the number of candidates at the last round of selection, and I can tell you that 8% of the total of candidates were British candidates. If I compare that figure to the French, Italian and German candidates, it is less than two times, and even, for what concerned the Italians, it was three times less Italian than French and German candidates. That is number one. So it is the number of candidates.

Secondly, it was not easy to attract the director that I would have liked to have at ESA. I can tell you that my dream was to get one from the UK for such an important post, because I wanted that person to introduce a new culture. As I said, the UK is bringing a new culture to ESA. My dream was to have that person coming to ESA to bring a new technical culture, but it was not possible. So, it happened that there is no UK director today.

Your next chance, and you have a good chance, is next year. The member states will have to select a new director general. It will be a good opportunity to have the proper candidates, maybe not for the DG, but when there is a selection of the new DG there is always a lot of discussion on the management. This is your next opportunity.

I would not like to have given the impression that to have a British director is the most important condition to have an influence at ESA. Frankly speaking, the influence of UK at the time when Professor Goldsmith or Professor Southwood were in the management team was not much bigger than today. I would say that it was less than today. The influence of a country is more related to the contribution of that country. The more you contribute, the more influence you have. We have more and more weighted votes at ESA. The influence is much more to have a competitive industry because they are making the proposals, and to have competitive scientists. Your influence is also to have investors, like in Masad and Avanti. I can tell you that UK is driving totally the telecommunication programme. Madame Vaissière, a French national, is in charge of the telecommunications programme. I can tell you that the UK is much more important than the nationality of the director, because of the contributions of Avanti and Masad, who are putting in a lot of money.

Last but not least, the decision-making body in ESA is the Council. The role of the minister and the delegate is also more important than the role of a British director. I am not telling you that it is good not to have a director. I hope, and I am ready to help, to have a British director, but this is not the solution.

Q112 David Tredinnick: You explained it very well. The impression I get, and I referred to it earlier on, is that by increasing our contribution, we have now become what is in football terms called "top of the second division" after France and Germany—

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Jean-Jacques Dordain: No, no, no. You have been the sub-contributor at the last Council of Ministers.

Q113 David Tredinnick: I would like you to comment on this point. I think that the impact has been disproportionately to our advantage. The fact that we have put in this new investment has brought a whole lot of benefits in attitude, even to the language that might be spoken at a meeting, which you referred to, which is significant. Is it right that we have had a disproportionate advantage and that the investment has brought a greater return than just the money? I am suggesting to you that the increased British investment in the programme has brought a better benefit to this country. I do not think I am being very clear.

Jean-Jacques Dordain: I do not know how to answer your question or comment. Again, yes, it is a fact that there is no British director.

Q114 David Tredinnick: I am not worried about that. I am saying that we have done very well by increasing the investment. It has helped this country a lot.

Jean-Jacques Dordain: Yes. Absolutely. Let's face it, the increase of your contribution has put your industry, your scientists and your operators at a much different level than they were before. There is also Harwell. Harwell is also a part of your contribution to ESA.

Chair: We are just going to go on to that. The final question is about Harwell.

Q115 Stephen Metcalfe: We visited Harwell last week. It was a very informative visit. One of the things that is taking place there is the business incubation centre. How successful is that being at nurturing small businesses, and where would you see the centre in five years' time?

Jean-Jacques Dordain: Harwell is more than the business incubation centre. Harwell, for me, is not only a new centre of ESA in the UK but it is a new type of ESA centre. For me it is a pilot for what I would like to have as ESA centres in the future, which are open centres, and not any more ESA centres with a wall around, a fence. The beauty of Harwell is that we are putting ESA facilities in a compass where there is already a lot of competence and expertise. That makes a difference. That is Harwell. Innovation is coming from connecting different expertise. Innovation does not come from a closed circuit. It is only by collecting different expertise that you raise innovation. At Harwell, I am sure we will raise innovation by connecting expertise from ESA and expertise that is currently in Harwell.

Coming to the business incubation centre, I am sure you have read that already 26 start-ups have been nurtured from this business incubation centre. The business incubation centre is a very powerful instrument to create value and jobs. We have created eight of these business incubation centres in Europe. The first one was in Bavaria. I can tell you that the objective for any ESA business incubation centre is to create 15 start-ups per year. This is the minimum objective that we are giving to each business

incubation centre. In Bavaria, in four-and-a-half years, we have created more than 120 start-ups and 1,000 jobs. In April of this year, I celebrated with the Minister of Bavaria the fact that 1,000 jobs had been created by the business incubation centre in Bavaria. Two weeks ago, I signed in Le Bourget the eighth business incubation centre, which will be located in Toulouse, and I shall sign the ninth one in Barcelona in September. Again, all these business incubation centres are very successful for the very simple reason that they connect resources. It is not only connecting money, because we have money from ESA and the STFC in Harwell. We also have private investors. In most of our business incubation centres, we even have banks putting money there. As I said, when a banker is investing it is good news because they are people who are taking the least risk in the world, so I think it is good news. We are connecting the money and the expertise. By doing that, we are creating innovation. Good ideas are always coming from there, which means that we are creating value. I am convinced that the business incubation centre at Harwell will be as successful, and may even be more successful, because of the environment of Harwell. There is a lot of science and technology there. I am convinced that the ground is very fertile and, yes, it will be successful.

Q116 Stephen Metcalfe: When judging how successful the incubation centres are, do you look at the amount of exports that have been generated, particularly exports that are outside of Europe, so where we are able to sell product or services to countries outside of our traditional funding base?

Jean-Jacques Dordain: We have several criteria. Basically, there are two criteria. This is what I am doing, by the way, with all industrial companies with which we are working. I am now asking them to say what share of their commercial business is generated by ESA versus non-ESA business. I am afraid of industrial companies relying upon only ESA business. We have ups and downs in our programmes, and when they rely only on ESA business, we have to take care of them, whereas if they are not only on ESA business but on commercial business, we have more chance to maintain the capabilities, even if we have some decrease on the ESA side. This is now systematic for each company, be it big or small. I wish to have a share between commercial business generated by ESA and ESA business. That will apply, obviously, to the business incubation centre. The number of sustainable jobs is also very important. Again, when we signed for the business incubation centre in Bavaria, four years ago we decided that we were so confident that we said to the Minister that we shall meet when we have created 1,000 jobs from ESA business, and we have done that. It was last April. I am ready to take the 1,000 jobs at Harwell and to celebrate that with the Ministers.

Stephen Metcalfe: We look forward to our invitations. Thank you, Chair.

Chair: Professor Dordain and your colleagues, thank you very much for your attendance this morning and for your very full answers. It has been extremely interesting. Thank you very much.

Wednesday 10 July 2013

Members present:

Andrew Miller (Chair)

Jim Dowd
Stephen Metcalfe
Stephen Mosley
Pamela Nash

Sarah Newton
David Tredinnick
Roger Williams

Examination of Witnesses

Witnesses: **David Parker**, Chief Executive, UK Space Agency, **Catherine Mealing-Jones**, Director Growth, Applications & EU Programmes, UK Space Agency, and **Rob Douglas**, Chair, UK Space Agency Steering Board, gave evidence.

Q117 Chair: Can I welcome you to this hearing? This is the last morning of evidence in this inquiry. We are particularly grateful to you for coming this morning. It would be helpful if you could start by introducing yourselves.

David Parker: My name is David Parker, and I am chief executive of the UK Space Agency. My background is about 25 years in research in the space sector, working in industry and also the public sector.

Catherine Mealing-Jones: My name is Catherine Mealing-Jones. I am a director at the UK Space Agency responsible for growth, applications and EU programmes. I am on loan to the agency from the Home Office.

Rob Douglas: My name is Rob Douglas. I am a non-executive chairman of the steering board of the UK Space Agency.

Q118 Chair: First, can I ask you your views about the agency's main achievements since it was established, and what you see as the main challenges over, say, the next five years?

David Parker: Just to recall how the agency was created, it has been in existence for only a couple of years. It came out of the 2010 space innovation and growth strategy, which set out a number of proposals in order to develop the UK space sector. The agency was created to do three things: bring coherence and leadership to space activities in the UK from the government side; promote growth and opportunities in the sector itself to stimulate its development; and, because of the excitement of space, to use space as a tool to inspire and excite people. Therefore, we have been advancing in the past few years in all of those areas. We are delivering policy advice to Ministers, delivering programmes and also undertaking regulatory responsibilities. To take an example on the policy side, last year, the key thing was the issuing of the UK civil space strategy, which set out the long-term vision for the space sector, and a major piece of work to develop and prepare for the European Space Agency ministerial that happened last year.

On the programme side, there are a couple of examples. We have undertaken the national space technology programme, a new programme to stimulate commercial technologies for space. On the scientific side, we delivered the first instrument for NASA's James Webb space telescope, the largest

mission NASA has ever undertaken, and a lot of regulatory work as well.

Looking forward, what are we doing? It is about taking the policy and strategy thinking and turning it into delivery, taking forward the goals to expand the space sector and, hopefully, get to a much bigger sector in a few years' time, so it is delivering tangible benefits for science, economic growth and the citizen.

Rob Douglas: One of the challenges over the next five years is to develop our leadership capability of the sector, given that the economic growth and the results we are looking for are going to be delivered largely from the private sector. Our role is to nudge, cajole, influence and do a bit of pump-priming, and developing that skill, which we have worked on in the last two years, will be a key part of it.

Q119 Chair: Do you see your responsibility as helping to develop those skills in, say, the SME sector as well?

David Parker: Yes, certainly. The SME sector is particularly significant. We will probably talk about the upstream and downstream in the space sector in minutes to come. Manufacturing is mainly about large companies but also equipment manufacturers. A lot of the downstream growth is likely to come from SMEs who are going to take space data and start to use it, so some of our programmes are aimed at SMEs and some of the activities of the European Space Agency are reserved for SMEs, so they are an important part of the story.

Q120 Chair: How do you think we should look at value for money when one considers the funds allocated through the national space technology programme? What metrics ought we to be looking at to determine whether you are spending public money wisely?

David Parker: The national space technology programme was another of the recommendations of the space IGS. It recognised that, in order both to stimulate commercial activities in space and prepare effectively for ESA programmes, there was a need for pump-priming on the UK side. For the first phase of the NSTP, we secured £10 million of new funding. We have already achieved some metrics out of that. The £10 million has become a programme of about £27 million of activity because of matching with industry money and working with other government

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organisations: research councils, the Technology Strategy Board and the Defence Science and Technology Laboratory. One metric is the size of the programme that has been created. Another is the potential benefits that will come out of the technology developed. It is not a monolithic programme; there are different scales of activity, but there is a flagship programme devoted to the next generation of telecommunication satellites. That was designed to prepare industry for participating in the European part of that programme, so £2 million there is going to turn into sales of telecommunication satellites in a few years' time of maybe £500 million a year, so potentially there are quite large multiplier effects. We are going to do some review work on the first phase of the NSTP to see how effective it was before we go on to the next phases.

Q121 Chair: When is that work going to be completed?

David Parker: The plan is to do it this financial year, so at present we are writing the terms of reference for that.

Q122 Roger Williams: We have heard about some of the things that the UK Space Agency is doing. It is nevertheless small compared with other European countries, particularly Germany, Italy and France. What do you think we miss out on by not having a more substantial financial contribution to the UK Space Agency?

David Parker: I am not sure that we are missing out a great deal. If you look at the activities in space that we are doing, it is now pretty broad ranging. The national space technology programme has grown significantly in the past few years. NSTP is one element which did not exist before, so it is completely new. We have also been able to invest in the NovaSAR programme, which is a new type of satellite for the export market, so it is growing quickly. The national programme has grown. We have made substantial investments in the European Space Agency programme. We are now a growing and much more prominent player in ESA as a result of decisions at the ministerial meeting last year. The Government have been making investments in things like the catapult centre at Harwell. That money may not be coming through the UK Space Agency, but it is nevertheless fresh investment. It is pretty joined up at the national level.

The one area where maybe we could do more is the international stage, working in bilateral relationships with space agencies across the world. We have a couple of ongoing programmes with NASA and the Japanese space agency. There is perhaps more we could do there, but, even where we do not have financial investments, we can do an awful lot. Take the example of signing MOUs with countries like Kazakhstan. We signed an MOU in March and a UK company secured a contract with that country last week, so we can do a lot at the agency-to-agency level.

Q123 Roger Williams: You have covered the ground, but it has been suggested to us that we do not

have so much ability to enter into bilateral arrangements because of lack of funds. You have pointed out the clever way in which you do that, but could it not be done more easily and directly if more funds were available?

David Parker: You can always do more with more money but, even with the resources we have had, we have been able to identify a couple of opportunities to work with NASA. We have funded two new projects in the past year. There is a very exciting mission to measure seismic activity on Mars. We are working with NASA on that. There is another space weather mission. We are funding a couple of universities to provide instruments for a mission called Sunjammer. We have to be very smart with the resources we have and develop international relationships.

Q124 Roger Williams: Could the agency do more to engage with EU stakeholders? Is the agency a recognised major player in Brussels?

David Parker: We do a lot of work with European Union programmes. We are doing three things, basically, with the EU. We are negotiating hard on behalf of the UK when the so-called regulations or legal basis of EU space programmes are being put together. We are often pushing for transparency, and on the security agenda. We are supporting industry and going for the commercial opportunities that come out of it. If you look at the numbers, UK industry has done pretty well out of the Galileo programme. Every single navigation payload under the EU Galileo programme was built in the UK. The third thing is to prepare for the use of all of this EU-funded space infrastructure back in the UK. There are some national investments, of which catapult is a part. There are investments in preparing to use some of the PRS signal from Galileo nationally. I am going to Brussels. We have eyes and ears over there with permanent representation in the Commission by way of UKREP, and lots of informal meetings and discussions go on. There are literally dozens of trips to Brussels every year made by my team and myself. I think we are pretty engaged with the Commission.

Catherine Mealing-Jones: They recognise that, in order to make their programmes successful, they have to hit users in Europe and beyond, and they look to us for a lead in that. They have seen what we are doing at Harwell with the establishment of the facilities there. They partnered with us back in December of last year with the first European space solutions conference, which was about exploiting European programmes. The UK was able for the first time to get a European conference focused on real user communities, rather than a more traditional style of conference where they talk just about progress with satellite building, and so on. This was a breakthrough and a model that they then have taken forward. We are seen as leaders in that sort of thing. They look to us for programme management expertise, our focus on value for money in programmes and so on. We do punch above our weight in European programmes generally.

Q125 Stephen Metcalfe: The UK space sector has set the objective of capturing 10% of the global space

market by 2020. That is worth about £40 billion, as opposed to £10 billion in 2010–11. That is quite an ambitious target. Are we on track to deliver on that target?

David Parker: I think the answer is: so far, so good. The trends are positive. As hinted at earlier, this is very much a partnership between the public and private sectors. Most of that turnover is not going to be public sector funds going through the system; it is about commercial activity. The innovation and growth strategy was a starting point in setting out a whole set of recommendations about actions where industry felt, if government did this, it would be able to deliver. If you look back at those actions, the vast majority have now been implemented on the government side. Therefore, in the partnership view, it is turning to industry delivery. We need industry to step up in engagement in export opportunities. Some are really good at that, but we need more of them to do that.

Most of the growth is going to come in the downstream sector. The manufacturing of satellites will certainly grow, but the big growth has got to come from the use of space data in everyday life. It is happening now. The Met Office say that already 70% of the accuracy of weather forecasts comes from satellite data. That is a public service. Therefore, it is satellite information going into weather forecasts, but weather forecast data are used by, for example, supermarkets to determine their stock. If it is a sunny day, you eat ice cream; you don't want ice cream when it is raining. That can help the economy and increase supermarkets' profits, for example, but there are many new applications of space data that have not even been thought of today that will become possible, and that is the particular emphasis on the UK strategy to invest in things like the catapult at Harwell, to focus on that downstream sector. That partnership has to go forward and start to deliver in the future.

Rob Douglas: This takes us back to your comment about SMEs and their role in this. While we have a number of big players who will drive a lot of that growth and engagement with the SME community, it is important that those local enterprise partnerships that have space activities in their area, of which there about 11, bring those out and we try to promote, steer and help those LEPs develop their strategies around space. We had one meeting, about a year ago, with the LEPs which had a space interest. Trying to maintain that momentum is important.

David Parker: One of the other elements at Harwell is the business incubator, which is a joint activity between STFC and the European Space Agency. It has already created a couple of dozen businesses: micro-businesses at the moment, but hopefully they will grow in the future. That is a great model and it works, but if we are to create the number of businesses we want, we need perhaps to think about space business incubators spread around the country in Northern Ireland, Scotland, Wales, Cornwall, or wherever, linked back to Harwell to use the facilities and know-how created there, but we want the businesses all round the country.

Q126 Stephen Metcalfe: You said industry needed to step up, which makes it sound as if perhaps it is

not quite doing that at the moment. The other thing that came out of what you said was that the majority will come from downstream and it will be use of the data. How do you make it known to potential businesses that that data is available? It may not be the traditional industries that can find a use for this. I think you are saying that people outside the space industry might think, "I know what I can do with that data; I can do this or that application," and they would then come into the space sector. How do you make it known to the wider business community that these data are available and they can use them?

David Parker: You are absolutely right, because the worst thing is to go in and say, "We are a space company and we are going to help solve your problem." It is going into those communities and reaching out, getting into the environment where the energy industry, maritime sector, fisheries, agriculture, or wherever, meet and engaging with them through that route. That is very much what the International Space Innovation Centre, which has become the catapult, is setting out to do. The agency does not have the resources to do that itself as far as the broader economy is concerned.

Where we are particularly trying to do that is by way of government within government. If you think about the use of space data in government—the smarter government growth path that we have in our strategy—we are working on something called the national space applications programme to reach out across government sideways and engage in conversation with users. We already work with Defra because they are the policy lead in the use of GMES Copernicus data. They are already driving the requirements and thinking about how to use Copernicus. We have invested in satellites for broadband internet from space, so the availability of satellite broadband is there today as a result of investment on the agency side. We have got to work with all the right groups and other Departments to ensure that is understood and that the opportunity to use satellite broadband is taken up, because it is there now.

Q127 Chair: You talked about Departments in your response. Does that apply equally to the whole spectrum of research councils?

David Parker: We already have a very close relationship with research councils. I come from a research council background: the STFC. We have colleagues who were formerly with NERC as well. With the research councils, we have a formalised relationship, so-called service level agreements in some cases for the delivery of activities, and also MOUs to work together. As to STFC and NERC, we see the heads of the research councils regularly and work very closely with them. It works. For decision making on scientific programmes, we have a so-called dual-key mechanism whereby, if we are thinking about investing in a satellite, or science instrument, we seek advice from the research councils as to whether it is a scientific priority before going ahead. We don't want to get into a situation where we have invested in an instrument that is not a scientific priority.

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Rob Douglas: Catherine mentioned the EU solutions conference. That was a very good example of new people involving space data being there. There was a fascinating session about the insurance sector. One particular insurance company and broker was really using this. Several other insurance companies who were there said they did not realise that. You are getting the involvement of new sectors and then it goes by word of mouth. There is always somebody who leads it, and then it spreads.

Catherine Mealing-Jones: There is the satellite applications catapult, but because it is part of a network of catapults you have a ready access point to people trying to do similar things in different sectors, whether it is advanced manufacturing, offshore renewable energy and so on, all of which have satellite applications. They can help put those links together.

The other big piece of work going on is a series of consultations over the summer. We call it, for shorthand, a restack of the innovation and growth strategy. That is part of industry stepping up. It is a recognition that, if phase one was about putting the fundamental infrastructure in place—the foundation of the agency and the other recommendations—this is much more about getting to grips in a quite forensic way with what the markets are, what the ecosystems that support those markets are, what the supply chains are, how we can bring supply chains into the UK, and fundamentally how we start to talk to these sectors, which we don't talk to at the moment. We all recognise, and industry recognises, that we cannot stay in the community we are in; we have to reach out to the broader marketplace. There is almost a paradigm shift taking place at the moment.

Q128 Stephen Metcalfe: That is quite important, because we have no idea where the next big thing could come from. It could be being developed right now in a bedroom across town, and suddenly it is another Facebook but using space data. Obviously, we have to keep an eye on that. How would you measure progress in getting this message out and getting towards the £40 billion figure? What metrics do you look at?

David Parker: The ultimate metrics are the turnover numbers, so we do a so-called size and health survey every couple of years on the space sector. That has revealed a gentle growth in the manufacturing sector and a strong growth in the downstream sector. Then it will be the number of new businesses coming out of the incubators, and the impact when you talk to the maritime and energy sectors and see them using the space data. When missions, particularly those like the Copernicus programme, come on stream, there will be huge amounts of new data available for use. I can give you a metric already. One of the investments the agency has made already at Harwell is in a cloud computing facility called CEMS. It does not matter what it stands for, but from a standing start its capacity has already been fully used by users of the data that have been made available. We are now having to think about how we invest further to expand capacity. That is a kind of marker that tells you something is happening.

Q129 Stephen Metcalfe: How dependent is all of this on continuing and future government support beyond the usual four to five-year window?

David Parker: Space is long term, and there is no question but that one has to be in this game for a long period. You can do short-term investments and see short-term returns, but some of the real growth is going to come, for example, from translating fundamental science, let's say climate science or understanding the sun, into a climate or space weather service. Yes, you have to be in it for the long term. You see returns coming from scientific activities undertaken many years ago in commercial value now. People have forgotten how that technology was created. Consistency of support for fundamental science is absolutely valuable, but the message that has been transmitted is that the UK has a long-term vision. We have heard from the managing director of a company abroad looking to set up in the UK who said, "Look, the UK has set out this long-term vision. We haven't heard this anywhere else in Europe." I think that is an excellent message.

Rob Douglas: It did benefit the space agency and the sector hugely that there was continuity of policy at the change of administration. That gave the sort of message David is describing. As a non-executive chairman, I would say that having that continuity going forward will be very important because it is such a long-term game.

Q130 Pamela Nash: Catherine, you mentioned working with the catapult and other catapults. Is there a formal structure there? Have you seen evidence yet of the catapults working together? We have a UK space conference in Glasgow next week, which is fantastic. Is there a relationship with the other Assemblies and Governments within the UK? Is that a good relationship, and are they supportive of the space agency?

Catherine Mealing-Jones: The catapults were formally launched in April of this year, so they are quite new. It is a very exciting process. The agency was closely involved in the setting up of the catapults in shadow form the year before. There is evidence of them working together. The catapults view themselves very much in a collegiate structure. The chair people are very close; they have regular get-togethers and so on. Although these catapults are independent, the TSB fosters close working relationships. At the moment, they are working on what their success metrics are going to be, and almost certainly they will build something in which is about a success metric being operating with other catapults to come up with solutions.

All the catapults have an advisory group structure beneath the main board. We have a representative on that advisory group. Based on the priorities in the catapults—security, transport, an internet of things and energy and climate change—they are actively looking to get somebody who is a representative of the catapult with the closest link to that. I think they are looking at offshore renewable energy as the main link. I am confident that they will make those links and will thrive as a network of centres.

Rob Douglas: A concrete example of the initiatives is the future cities catapult. By the very nature of what future cities may need to draw on, that will bring in the satellite applications and also the digital information catapult. They are almost bound to work together because they are so interwoven in the disciplines and skills that they have.

Catherine Mealing-Jones: The chair of the connected digital economy catapult is Andy Green, president of UK Space, so there is healthy collaboration going on there.

David Parker: To take the point about the different parts of the UK, we already have a good relationship with Scotland. I take the example of the UKube satellite, which went through its first flight acceptance review a couple of weeks ago. That is the first spacecraft built in Scotland. That has been partially funded by the UK Space Agency, yes, but also by Scottish Enterprise folks, as a joint effort. We are talking to Invest Northern Ireland about some opportunities there. There are exciting possibilities of specific developments around the propulsion part of the space sector in Northern Ireland. We have been talking to them about that, and so on.

Q131 Stephen Mosley: I would like to talk about the European Commission's paper COM(2012)671 which suggests bringing the ESA essentially under the wing of the EU. Do you think that is a good idea?

David Parker: The Commission communication on the subject was a very interesting document and put forward a number of arguments for why this was necessary. How do I view this? From a philosophical point of view, ESA works with a number of different communities, basically three. It is to some extent a science-driven organisation, so it works with the science community to deliver, and that is all about peer-reviewed excellence. It is just like CERN, the European Southern Observatory or any of these other organisations, and that relationship between the science community and ESA is well understood and works well, so I don't think there is anything that fundamentally needs addressing there. ESA has a relationship with the industrial community, so it is co-funding on commercial technologies and activities with the commercial sector. Is there anything fundamental that needs addressing there? I don't see it.

You then address the third community, which is ESA as an agent delivering space technology for operational users, for example in the area of weather forecasting. EUMETSAT, the European met satellite organisation, is a customer of ESA's ability to develop spacecraft.

What does the European Union do in space? It now has competence in space policy, but that is alongside national governments. National governments choose to pool that through the European Space Agency. The European Commission has decided that it has a need for space infrastructure in the case of GMES delivering long-term earth observation data. In that case, it needs to set the requirements. Why and what are the requirements of that system? It then needs to hand those to an R and D organisation that is able to develop space hardware, which is ESA.

Does all of that add up to transferring ESA into the European Union? Our judgment from the UK side is no, because the issues that need to be addressed about the relationship between ESA and the EU are more at the bureaucratic level and whose rules you are using. Are you using the just retour rules of ESA? Are you using straightforward open competition rules in the EU? Those can be sorted, but that does not lead to transferring ESA under the EU. The European Space Agency was set up and managed by Ministers through the Council of Ministers of ESA, which meets every few years and only Ministers can eventually decide the future fate of ESA.

Q132 Stephen Mosley: At one point you said, "Does this add up to transferring it to the EU?" By that do you mean what has been proposed is actually transferring it to the EU, or that it shows a need for it?

David Parker: I am saying that the Commission put forward a number of options, some of which are changes in the relationship between ESA and the EU, but one of the options is to absorb ESA as an agency of the European Union. That is one of the suggestions they have made, and in the view of the UK that is not justified.

Q133 Stephen Mosley: In terms of the UK, how would it affect our interests in space if they went ahead with this?

David Parker: The point I am making is that, because the European Space Agency is an intergovernmental organisation and belongs to member states, it is not in the power of the European Union simply to acquire it. Unless member states choose to do this, the issue does not arise.

Q134 Stephen Mosley: I can see that, but we have a choice. The Commission has put forward proposals. Do we as a nation state go along with them? A choice has to be made there. What choice should we make?

David Parker: Exactly. I am saying that we have not seen the rationale for why there would be any benefits in transferring the European Space Agency lock, stock and barrel to the European Union. ESA has a very effective relationship with the science community; it works, so there is nothing particularly to be improved there. It has an effective working relationship with industry in developing commercial technology, so we don't see there is anything to be gained. Where the European Union can really make a contribution is at the high political and policy level of supporting relationships in space activities between Europe and, for example, free trade discussions, perhaps with the United States, and also investing in space infrastructure where they support European Union policies. Those are the directions in which we would like to see the European Union's involvement in space head off.

Q135 Chair: There could be some confusion. Essentially, are you saying you see the EU as having competence in things like telecom regulations, and you would like some harmonisation around that, but when it comes to the science, you and the science

community are better placed to do that than the machine in Brussels?

David Parker: I am saying that there are high-level political, policy and regulatory issues where doing things at the European Union level can be tremendously helpful, but the level of the interaction between ESA and the science community works very effectively. The science community understands how to work with ESA. Demonstrably, world-class science is delivered through the European Space Agency.

Q136 Chair: One point you did not raise is that ESA has members and associate members who are not members of the EU.

David Parker: One of the issues raised by the Commission is the asymmetry of membership. Norway and Switzerland are members of the European Space Agency. If you look at Norway, for EU space programmes like Galileo and Copernicus, it put in additional money to contribute to those programmes, alongside EU member states.

Q137 David Tredinnick: What is your vision for Harwell over the next 10 years? Where is it going, and what is that going to do for the UK space industry?

David Parker: Harwell is one of the new weapons in our armoury to try to develop the UK space sector. It is not the only one, but it is an exciting new one that has attracted attention across Europe. It is about creating a visible internationally competitive and relevant hub of space activity by combining existing capability, particularly the Rutherford Appleton Laboratory space science group: RAL Space. They have been involved in hundreds of missions over 50 years and have fantastic ability in science and technology in space. I mentioned earlier the business incubator, which is trying to suck out know-how from the space sector and turn it into new businesses.

The third element has been the catapult, which has focused on the downstream sector, and finally something in which I have been involved for five years: the involvement of the European Space Agency at Harwell. Having the European Space Agency on UK soil for the first time anchors the UK in ESA and ESA in the UK. It gives access to the know-how and capability of ESA, and ESA is able to take advantage of everything that is already happening in the campus at Harwell.

What is the vision? The vision is for this capability to grow. Maybe there will be 500 people in a few years' time and 1,000 by the end of the decade, but the number of people at Harwell is not really the point; it is what Harwell can do for the rest of the space sector by being a centre of know-how and capability, skills and facilities that everyone else can use. If you are an SME, where do you get cloud computing facilities? You cannot afford it yourself, but it is there. Where do you find somebody who knows how to use data from Galileo? You don't know, but there are people there, so it is creating that hub of capability.

Q138 David Tredinnick: That is how it would work with SMEs. What about the EU space programme? How do you see that interface? You talked a bit about it earlier. As we move forward, what mechanisms

have you got in place to make sure the innovation from Harwell reaches the European Union space programme?

David Parker: Quite directly. One of the investments we have made is a terminal sitting on the roundabout at Harwell which will directly receive data from the Copernicus satellites via the new European data relay satellites. The data will come straight down from the European satellites into Harwell and will be made available, for example in the cloud computing facility I was talking about. It is our aspiration potentially to offer the capabilities of Harwell to EU space programmes. We need to encourage the European Commission to think harder about the downstream applications of all the infrastructure that has been built that it is paying for, and we have something to offer there. Perhaps alongside ESA that is now there we can see an involvement by the European Commission in the future.

Q139 David Tredinnick: Do you think it is fair to say that the Government effectively bought the ESA presence at Harwell, and it is as good an illustration as any that money talks?

David Parker: It is a demonstration of a really stronger engagement with the European Space Agency setting out what we wanted to achieve, and that we have a space policy focused on practical and real-world applications of space rather than, for example, investment in launcher technology. By transmitting the message that we want to step up in the area of telecommunications and applications in space, we were able to negotiate hard to secure the growth of ESA in Harwell. It is an example of the much stronger influence that the UK now has in the European space community, and that message of stronger influence has gone out globally and is causing international space companies to call us up and say, "Can we come and talk about a stronger presence in the UK?"

Q140 David Tredinnick: In one of your earlier remarks, you focused on the fact that a contract had been won in Kazakhstan. Is that linked in any way to an aspiration to get closer to the Baikonur cosmodrome?

David Parker: The Baikonur cosmodrome is in Kazakhstan and is run by the Russian space agency, so there is no particular or direct linkage there. We use the Russian launch capability for some of our satellites, but there is no direct link I can think of.

Q141 David Tredinnick: In response to Stephen Metcalfe's earlier question, you talked about hopefully having business incubators round the country. How on earth is that going to be funded? Is there not a resistance the further you get away from London to setting up centres as alternatives to somewhere like Harwell, because those of us who represent the midlands and beyond do not like the length of travel up the country, as it were?

David Parker: I don't think there is resistance; it is more enthusiasm to get involved in the growth of the space sector. There is already a business incubator in GRACE in the east midlands. The incubator at

Harwell is already working with the incubator in the east midlands. We have to establish appropriate funding routes, but we have several in mind that could take us forward on that side. We have to find a way, if we are to achieve these growth targets. We have an ambition and we will have to find solutions to achieve it.

Rob Douglas: We are talking perhaps about formal incubators here, but there are other clusters of activity that link into space, like Daresbury in the north-west or round Guildford where you have Surrey Satellite Technology and the Surrey Space Centre. They are already encouraging businesses round them that we look to for the SME type of growth.

David Parker: As to that model, for a space incubator to be successful it needs to be embedded in fertile ground, by which I mean maybe a top-class university, an area with an industrial capability or a business enterprise capability that is there and can be taken advantage of as a natural hub that will grow strongly. We can foresee several of those.

Q142 Chair: Stemming from that, one of the enthusiastic presentations we had at Harwell was by Miguel Bello Mora, who explained why his first investment outside the Iberian peninsula was in the UK. Do you think that has got more to do with the cluster, the broad strategy or the UK's approach to science?

David Parker: The answer is: probably a bit of all of those. The clear long-term vision and commitment is the first thing. As that gentleman said, it was the fact that the Minister was standing up and saying the UK had a long-term space policy, the fact that it has built on the space policy of previous Administrations, so the continuity and time it takes to develop space is important. It is something about the entrepreneurial spirit of the UK perhaps being noticeably different from the more top-down, government-driven space approaches of some other European countries. Clearly, if someone like that is looking where to locate, Harwell is the first fertile place to come and see.

Q143 Jim Dowd: Most of these questions seem to be going to you, Mr Parker. Mine are no different. I want to go back, hopefully not over ground you have already covered, to the EU and ESA. How much time, effort and resource does the agency devote to EU-facing issues, and how does that compare with the amount of funding you derive from the EU?

David Parker: A lot of resource is devoted to the EU, hence Catherine and her team are pretty significant in this. Several new staff who have joined in the past year are devoted to EU space activities. If you look at the financial investment going from the Treasury to the EU, and into space programme, it is not as much as through ESA but it is getting to the same order of magnitude. One of the things we are doing in the agency is step back and say we do not think about there being a national programme, an ESA programme and EU programme; rather we have an overall space endeavour and we are doing things in technology, and some of that happens through all three routes. As to navigation, some of that is through ESA, some through the European Union and some of it

nationally. Rather than think about it in terms of the categories of ESA, EU and nationally, we think about it more in terms of what we are trying to achieve in telecoms, earth observation and so forth.

Catherine Mealing-Jones: We certainly put resource into things as they have come up. The EU came forward with a space industrial policy, which we saw as a significant development, so we recruited a resource to deal with that.

We are a small agency, but we do use expertise all around government. We work very closely with colleagues in the MOD, FCO and more technical colleagues in DSTL and others who come to meetings with us. Either they partner with us so we have a policy person and a technical expert or they go to the more technical meetings on our behalf. We have some very strong co-ordination mechanisms across government to make sure we get the right presence.

The number of meetings in the EU is very significant. We spend a lot of time in Brussels. As David has already said, we also rely on our colleagues in UKREP who have built a very strong space expertise to represent us as well. You could put a lot more resource into European work, but we have beefed up what we are doing over the last 18 months or so as the EU itself has stepped forward with new proposals on space.

Q144 Jim Dowd: I am astonished to learn that there are an awful lot of meetings in Brussels—it's a revelation. Mr Parker, you mentioned earlier that ESA with its presence at Harwell—whether it is because of the incentives or bribes David mentioned earlier, which I'll put to one side—had anchored the relationship between ESA and the UK. Would that not be further strengthened if there was a UK director at ESA?

David Parker: There are a dozen directors in ESA. We have had UK directors in the past but we do not at present. I would argue, separately, that our involvement, strength and influence in ESA is strong at the moment, so there is not necessarily a direct correlation between the two pieces of information. My predecessor chief executive of the agency was chair of ESA's governing council, which is the key interface between the executive of ESA and the delegates; a very influential place to have been in for the past few years. I have just been elected as vice-chair of the council which will put me in some of the same meetings and discussions. We are very influential at that level. This year, my team and I will attend 64 different programme board meetings of the European Space Agency where we are influencing and all the time battling for the UK position.

In terms of directors, the process is a short list. We have to have good candidates coming from the UK. Those candidates ideally should combine an industrial background and experience of working in government. The candidates are interviewed by the chair of council before they are recommended to the director general, so the process is an open one. It is advertised and people should apply. ESA have pointed out that it gets fewer candidates from the UK than from other member states. Maybe we have to do more work on the UK side to get good candidates going

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forward. There will be opportunities when the next round happens in a couple of years' time, but do we need to have a director just to have influence? No. Would it be a good thing? Yes, of course.

Q145 Jim Dowd: You say that the council is an alternative avenue of influence.

David Parker: Very much so.

Q146 Jim Dowd: Telespazio Vega has said that one of the reasons there is no UK director is that the quality of candidates from the UK is inferior to that of others.

David Parker: The candidates generally come from industry, so we have to work more strongly with industry to develop its ability to go for those interviews and be successful. The opportunities are certainly there.

Q147 Jim Dowd: How does the agency ensure that ESA's programme matches, as far as it can, the priorities for the UK, and how does that compare with, say, other members of ESA?

David Parker: I think we are very effective. The mechanics of it, if you like, are the different programme boards. We send a couple of people to each of these boards—science, earth observation and telecoms—and they take along priorities which have been established not simply out of their own heads but through a consultation process with the UK community. We have an advisory committee for telecoms and navigation, science and earth observation. You will find around the table people from industry and the science community gathering information and feeding it to the delegates, our delegates who go off to those meetings. There is the formal process and an awful lot of informal stuff that goes on as well with e-mails and conversations going backward and forwards all the time.

Does it work? Yes. If you look at just the earth observation science programme, UK scientists are leading three of those missions, which is above the fair share. If you look at the space science programme, we are principal investigators on many different instruments and scientific activities. Overall, looking purely from an industrial point of view, we get back our fair share of contracts. Our so-called geo return is near enough one, which is a better situation than it was a few years ago. Engagement with ESA is very strong. It starts with the very positive relationship between our Minister and the head of ESA and works downwards.

Q148 Sarah Newton: In the last few remaining moments, I would like to take us back from the EU to the UK and look at the UK's civil space strategy. Six pathways were identified to help growth of the sector in the UK. Which ones do you think were the most and least successful pathways?

David Parker: I would like to answer that in two ways. First, they are all important. They are an indivisible set of activities that support each another. I do not believe you can take one away and still be successful. Secondly, as an engineer would say, the time function of these different pathways varies. What

do I mean? If you invest in a commercially oriented programme, whether that be through ESA or nationally, you can see a return quite quickly. We have invested in an all-weather satellite programme called NovaSAR at national level that is happening now. I would expect to see export orders within the next year or two. Likewise, with some of the ESA programmes we invested in at the ministerial last November, I would expect to see contracts coming out of that this year and next year, and that opening up the growth opportunities that flow from it quite quickly, whereas investment in science is necessarily longer term. You are investing in the science and knowledge that you gain, which might turn earth science into an understanding of climate in five or 10 years' time, but that may deliver services on the back of that.

The science programme also trains young people, so postgrads and postdocs, who will become leaders in the space sector in a few years' time, but you need always to be investing in the future. Sometimes in the science programme, you can get a return very quickly. I can think of examples coming out of a Mars programme. What is the relevance of that to the everyday economy? There is technology flowing already into the oil industry, manufacturing and medical science. As to the time function of that, you get the benefits even before you have launched the mission to Mars because the technology is created.

The really long-term stuff is inspiration. If you think about Tim Peake's flight to the space station in a couple of years' time, hopefully that will have an Olympic effect in inspiring people to think, "I could get involved in science and technology. Maybe I won't become an astronaut, but maybe I will be inspired." That may influence those people's career choices in five years' time and they will join the industry in 10 years' time. The influence of these different pathways will be over different periods of time, but you need to do all of it in a joined-up way.

Q149 Sarah Newton: Can we talk a bit about the idea of incubators once you get outside of London or Harwell? Representing Cornwall, with Goonhilly, I have an obvious interest in this area. It has been talked about for some time. Other members of the Committee represent other remote rural areas. Could you talk us through how you see this happening? You said you were enthusiastic about the possibility of spreading incubators all around the UK. Practically, how do you see that happening, and over what period of time?

David Parker: We have just started to think about it, so it is not going to happen tomorrow. The roots are to understand what makes the existing space business incubator successful. As I hinted earlier, it is about a particular model that the European Space Agency has, of being able to put a little investment directly into the hands of the entrepreneur, combined with a fertile environment of business advice and connection to finance. There is something called the London Satellite Finance Network, in which Catherine has been involved. That is building up an expertise in the financial community that understands space and is open to investment in space, as you need the finance alongside funding for the entrepreneur. Then you need

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access to the space know-how. In the ESA environment that is clear, so the question is: how do we replicate that round the regions so that somebody sitting in Cornwall, for example in an incubator at Goonhilly, can access the know-how of ESA? The answer is: a lot easier now that they are in the UK and not somewhere on the continent.

We also have to think about communications links. Is it putting in a fibre connection between the two? Can we use satellite broadband to connect? Fantastic downlink capabilities at the Goonhilly centre are starting to be used for satellite communications. Maybe that is an existing piece of infrastructure that could be built on for an incubator. Then it will need funding to make it happen. Perhaps regional funding from the EU might be accessible. That involves working with the LEPs to explain why this might be an opportunity. The LEPs have to see this as an opportunity and put it on their shopping list of priorities for EU regional funds. Those are the kinds of admittedly nascent ideas we are thinking about.

Rob Douglas: The LEPs are critical in this. They are just developing their strategies during the course of this year. We need to try to influence those that have some space activity, or a university which is interested in space, and plug in these thoughts. There are already lots of types of incubators and high-tech incubators, and this is just a version of that.

David Parker: It is a flavour.

Rob Douglas: It is not something brand new, conceptually.

Q150 Sarah Newton: You are just starting work on it.

David Parker: Exactly.

Sarah Newton: So it will be in a couple of years' time.

David Parker: Yes.

Q151 Chair: I want to explore a little further the work you do with SMEs. Does that include, for example, helping them through some of the bureaucratic morass of how to get licences and so on?

David Parker: Are you talking about space licensing?

Chair: Yes.

David Parker: Yes, indeed. The regulatory environment and role of the agency is very important because it has a responsibility to implement obligations that the UK has taken on under the Outer Space Treaty. That means our obligations are implemented through the so-called Outer Space Act

1986. We take that very seriously in terms of issuing licences for operators and people who are going to launch things and use things in space. The dangers of a failure of a space system are very great with potential damage to the space environment. We take the regulatory responsibilities very seriously and assess all people who are looking to put things into space. Where there are start-up organisations—I will not name names—we take companies through the process and help them, because it comes as a surprise that they need to provide technical information but also financial evidence of their strength before I sign the licence on behalf of the Secretary of State. The required commitments are all very serious in that sense.

In the ESA environment, SMEs are supported quite actively. Under the bidding process of the European Space Agency, there are certain types of activities reserved for SMEs, and there are some where SMEs are given preference. The industrial policy of ESA has a conscious effort to encourage SMEs. There is no doubt that, if you have not bid to ESA before, the processes are quite complicated, again because ESA has to be very careful. It is spending public money and does not want to give money to an organisation that is not financially secure or does not have a strong technical background. Those processes are there, but through our industrial policy committee delegate we work with ESA to try to improve that over time.

Q152 Chair: Space licences clearly are a special category, but at a basic level, many SMEs in my own area find it very difficult to work their way through just export licence arrangements. Do you help at that level?

David Parker: Yes. We can often intervene to help with export licences and act as an interlocutor between the space community and the export licensing folks, who are in another department of government. Quite often, the export people may be unfamiliar with the specific nature of space technology. Of course, for some aspects we have to consider the security implications, and there are also links into the domain of the MOD in terms of defence exports. It is a necessarily complicated process, but you only have to look at the success of companies like Surrey Satellites, which is selling spacecraft all round the world to know that it can be done.

Chair: Can I thank you all very much for your attendance this morning? It has been a very enlightening session.

Examination of Witnesses

Witnesses: Rt Hon David Willetts MP, Minister of State for Universities and Science, Department for Business, Innovation and Skills, and David Parker, Chief Executive, UK Space Agency, gave evidence.

Q153 Chair: Good morning, Minister, thank you for coming to join us, and welcome again, Mr Parker. Minister, when we were visiting Harwell, I was asked a question to which I did not know the answer. I said I would ask the Minister because he would know. What is the postcode of the international space station?

Mr Willetts: I don't know the postcode of the international space station. I saw these e-mails. What is the answer, David?

David Parker: It was a joke; it was a sarcastic comment from an organisation that perhaps had struggled with the export licensing organisation. Nevertheless, we were able to unblock that through the good offices of the Department.

Q154 Chair: The point being made, inside a light-hearted remark, was that sometimes—we have just touched on this with the previous panel—small companies find it really difficult to deal with the bureaucracy of things like export licences. As Mr Parker says, this particular case has been resolved, but—allegedly—bureaucracy was saying, “You haven't filled in the section for the postcode.” That may be an apocryphal story, but you and I would agree it is vitally important that we make it easier for SMEs to get into this sector, and other advanced sectors. Can you have a close look at the bureaucratic processes and make sure your Department understands the needs of SMEs?

Mr Willetts: That is a very fair point, which I accept, and it is a reasonable request. Now we are on track. You threw me with your question about the space station postcode. Often, these products are very high-tech and there are legitimate security questions, but we need to give clearer and more authoritative guidance. Certainly, the system for approvals needs to work more smoothly, so I am happy to undertake to look at that.

Q155 Chair: You identified space and satellites as one of your eight great technologies. Are we a world leader in satellites, or the analysis of satellite data? How far are we from being a world leader?

Mr Willetts: We have some distinctive strengths, obviously small satellites and the ability almost to sprinkle satellites either over an area which has had a natural disaster or perhaps an area of conflict. That is going to be increasingly seen in the future. We make 40% of the world's small satellites at Guildford at Surrey Satellites. That is something of which we can be very proud. There are also companies like CloudSpace in Glasgow, which I have visited several times. We do have a world lead.

When it comes to analysing data, we have distinctive strengths. We are trying at the catapult centre to build up a British position as a place where satellite data can be analysed, but one of our jobs, which is not yet finished, is to raise the level of awareness, both in the commercial sector and across government, of the value of satellite data for completely standard, day-to-day activities which people might not have previously

thought of as depending on space: agricultural uses or disaster monitoring. Both the commercial and the public sector could do more of that.

Q156 Chair: I think you are enthusiastically pursuing your commitment to the space sector and developing what you inherited. How are you going to ensure that there is a continuing legacy so there is a long-term commitment to space in the UK?

Mr Willetts: We have invested in some technologies whose significance will become apparent only in years to come. I would identify several. For example, NovoSAR was a £21 million investment with the aim of us being the world leaders in synthetic aperture radar. I hope to see significant export orders from that. Most recently, there was the announcement of the backing of reaction engines. We have been able to back some very significant technologies that, regardless of the outcome of the next election, will I hope be generating revenues for Britain for years to come.

Q157 Chair: Going back to your comment “regardless of the outcome of the next election”, when neither of us may be in our current seats, do you think there is a sufficiently strong buy-in within Parliament and government and across parties to convince the outside world that Britain is a place in which to invest?

Mr Willetts: When I arrived in office in May 2010, the previous Labour Government, in its final years, had set up the Space Leadership Council, which I have found a very useful body, and had commissioned work on an innovation and growth strategy for space. That was also very useful to inherit and draw upon. I make no bones about the fact that the last thing I wanted to do was arrive, tear up everything and start again. We did not do that. We built on what was there when we arrived, and I think we have added to it in various ways. It is for other parties to comment, but I hope that, if there were a change of government, this is not a matter of massive party-political disagreement and other parties in government would have a similar approach in 2015, if there were any change.

Q158 Chair: We are talking about an industry that is targeting a £40 billion value by 2030. Is that achievable? What do you see as the main challenges in getting there?

Mr Willetts: It is quite an ambitious target. It is a double target based on the model that shows the industry growing a lot globally and the UK getting a 10% share of it. It is tough but achievable. It is very early days, but so far we believe that the growth of the sector means we are on track to achieve the target. To achieve it, we have to be absolutely clear that we need very substantial private investment alongside public investment. As you implied in your earlier questions, we need a very strong sense that there is cross-party support for the space sector, which I think is the case; and we need to carry on making difficult but important choices when technologies come along,

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to back them. We will sometimes make mistakes. We have to accept that in a world of rapidly moving technology there may be particular technology programmes or initiatives we back which in 10 years' time have not necessarily delivered what was promised. People have to accept that we are working here with imperfect information in an imperfect world; there must be some understanding of that as well.

Q159 Pamela Nash: I have to apologise to the previous panel. I should have declared my interest as being part of the space committee and European inter-parliamentary space conference. There are more details of that on the register. The other place where government can really make a difference is encouraging skills for the sectors we are trying to grow. Whenever I meet people from all over the space industry—I am sure you have had the same experience—I am depressed when they tell me they cannot fill the skilled jobs with British people, particularly in a country where most toddlers have drawn a picture of themselves as an astronaut at some point. Can you tell me what the Government are doing to try to fix that, and whether there are conversations with the devolved Administrations as well?

Mr Willets: You are completely right that that is one of the big challenges. The good news is that applications for university courses in the crucial disciplines and physical sciences are rising. There are universities growing their departments in response to student demand, because part of our reforms is that funding goes with the students and university, so we are making progress. I hope that the Tim Peake mission will help a lot as well. In America, people still talk about the Apollo effect. I hope that the sheer excitement around that mission will interest lots of kids to study science at school and college and go on to do it at university.

Q160 Stephen Metcalfe: I think that at the recent ministerial council you increased the amount of funding we were giving to ESA. Can you tell us, first, how much that increase was, and, secondly, where the money is coming from?

Mr Willets: We increased our contribution. It is extra funding, not out of the science budget, and is about £160 million a year.

David Parker: It is about a 20% increase, depending on what you take as the starting point, but basically it is an average of £240 million a year for five years.

Mr Willets: A lot of the spending is in years for which there is no overall budget. The Treasury was very good. We explained that this was a four or five-year negotiation, so we had to go beyond what was then a public spending profile that did not extend beyond 2014–15. It was extra money, in the sense it goes out beyond the normal public expenditure horizon.

As to why we did it, there were several reasons. One is the fact that a lot of European space activity happens via the European Space Agency, and the

industrial case for it is that if you put more in up front in a kind of prototype, so you have a big role in making the first satellite of a series—the ESA development stage—you are very likely to earn a significant industrial return as more versions of that satellite are produced commercially. I bought the argument that there was an important industrial return for Britain. Secondly, a lot of space science cannot be done on your own; it is a collaborative activity, and there are worthwhile research projects in space that we can do via ESA. Thirdly—this was partly dependent on how the negotiations panned out—we were able, through our membership of ESA, to get a role in the international space station, hence the value of Tim Peake's flight, setting aside all the scientific and technical benefits, in signalling to younger people the excitement of science. We got that for a very modest contribution via ESA of €20 million, or £16 million, into a \$100 billion space facility. I think it has worked out to Britain's advantage.

Q161 Stephen Metcalfe: For clarity, you said £240 million a year, so that is £1.2 billion over the five-year window.

Mr Willets: Yes.

Stephen Metcalfe: That is a significant increase in investment. I think you said right at the beginning of your remarks that that was new money and was not taken out of any other science budget. Is that correct?

Mr Willets: We had a ring-fenced science budget of £4.6 billion—again, David Parker might be able to explain this in more detail—which, at the time of the last autumn ministerial, extended only as far as 2014–15. There were no public expenditure figures later than 2014–15.

David Parker: To clarify a point, the increase was not £240 million; the total is £240 million a year.

Q162 Stephen Metcalfe: What was the increase?

David Parker: It was about 25%, so this year we would have been spending about £190 million; it is now £240 million.

Mr Willets: Of that £1.2 billion, which is the first year of that budget?

David Parker: The financial year just started.

Mr Willets: The bulk of that £1.2 billion is being spent in years later than 2014–15, so it runs out over five years, covering 2013–14, 2014–15 and three subsequent years. The Treasury provided me with two things: first, a modest amount of extra funding on top of the ring-fenced science budget in the two years for which there was already a budget; and, secondly, we explained that there was an international negotiation going five years ahead that needed funding that went beyond the current public spending envelope. We also had the negotiating flexibility for those three extra years. Because they do not like Departments making commitments beyond the public expenditure round, that was equally valuable.

Stephen Metcalfe: I think that would be considered a successful outcome.

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Q163 Chair: If I may move off that particular point to the relevance of this inquiry which is all about work, you mentioned the ring-fence arrangement. Can you confirm that the ring fence is as defined in the previous spending round and nothing has been allowed to slide out of it, or, indeed, is there anything coming into it?

Mr Willets: There are sometimes very fine points around the edges, but basically we are trying to roll forward the ring fence for one more year. The reason I am being cautious is that there are always specific issues about the National Measurement Office, or the exactly which bits of the UK Space Agency, but the basic concept rolling forward is the same.

Q164 Stephen Metcalfe: That must be considered a success because it is new money that will add to that. Anyone who suggests that other parts of the science budget would miss out would be misleading us.

Mr Willets: Yes. We have not done this at the expense of other parts of science. The Chancellor has been very good in understanding the value of science in general and space in particular. This was extra funding, extending further ahead. Some of what is done is very useful science; it is genuinely worthwhile and very innovative science work that is done partly with this.

Q165 Stephen Metcalfe: The UK does not have a director of ESA. First, is that important? Does it matter that we don't? Secondly, why do you think we don't?

Mr Willets: I would rather we did have a director. It is hard to judge exactly how important it is, and we try to have an influence in ESA. David and his team attend lots of the official meetings, but I would prefer us to have one of the senior directors there. In the past, we were seen perhaps as semi-detached from ESA and that probably had an effect on our influence. The fact that in the negotiations last autumn we showed we were heavily engaged with it has increased our clout and ability, and I hope we will get a director in the future. In Westminster terms, the next reshuffle in ESA will be when the director, Jean-Jacques Dordain, retires in 2015. That is when the new overall head may look around for a new team around him or her, and I hope we will be able to take that opportunity to get a director.

Q166 David Tredinnick: How much influence do you think the UK has in ESA?

Mr Willets: David might like to comment. He is involved with it on almost a week-by-week basis in a way I am not. I try to have a good working relationship with Jean-Jacques Dordain, and I find him someone with whom one can deal. He will be with me at our big space conference in Glasgow next week. We have secured successes like ESA moving over 100 of their technical staff dealing with telecommunications to Harwell. I think we do have a good relationship.

David Parker: I commented on this earlier. Our influence has ramped up over the past few years because of the positive messages and actions we have taken towards ESA. We were the chair of the

governing council, which is a key place. I am now vice-chair of the governing council. I chair one of the programme boards where one of the main programmes is managed, so it is quite a strong influence.

Q167 David Tredinnick: How do we persuade ESA to take on projects that we think are particularly in our national interest? Can we do that?

David Parker: Yes, indeed. The mechanism in preparing for an ESA ministerial is that possible ideas are put on the table by ESA and there is a process of discussion backward and forwards when member states say, "We are really interested in this one and we would like to lead it." Leadership means taking a major stake, usually above your nominal geographical return share. There is a programme called integrated applications. That is one of the real downstream-driven programmes where the UK is by far the largest contributor. As a consequence, that programme is driven by UK thinking and ideals that go into that. Likewise, on the Mars exploration programme, we are the second largest contributor. We have a major influence in designing how that programme goes forward and ensuring that we get the kind of technological work and scientific work, whatever it is, that we want. ESA is a genius because it has a small mandatory programme to which you have to contribute, but the vast majority are optional programmes and, depending on where you put your money, you have influence.

Q168 David Tredinnick: I understand that. I was going to ask you a question about the two types of programmes in a minute. Minister, looking at our funding commitment to ESA, you described it as strong but select. What exactly is the focus? What are we trying to do here?

Mr Willets: "Select" means not doing launches, and a significant part of the ESA budget is concerned with that.

Q169 David Tredinnick: Ariane.

Mr Willets: Yes. After that, based on expert advice, the UK Space Agency and the wider community, our aim is to participate in the programmes where we can make a really good scientific contribution, our scientific researchers are interested in it, or there is a great commercial opportunity for our industry.

The negotiation last autumn was an extraordinary event. I had not quite seen ministerial negotiation in this form before. It is almost a matter of passing round the cap. They identify a programme, go round the table and every country says how much they will put into it. There has been some preparation, but it goes round and €1 million, €10 million and €20 million is offered, and, at the end of the day, they find out if they have enough money for it to go ahead, and also what the relative weights are; that is, how the British contribution is relative to the French or German. Sometimes, it does not quite add up and you go round a second time; at other times it does. Then they work out which are the programmes, but it is a genuinely intergovernmental scheme. If we all put in enough money to make a programme viable, it happens.

Unlike the EU principles, it is on a kind of *juste retour* basis, so, if you have ended up making a 25% contribution, you are likely to get 25% of the work coming to your country, and that is just for the prototype. It is not an EU institution but an intergovernmental one functioning in that way, so those are the criteria we use.

Q170 David Tredinnick: When you are at the table in the bidding process what happens if, when you get to the last country, there is not 100%? Do you go round again and try to get more money, or do you say, "We don't want to do this project. We'll move to the next one to see if anybody wants to back that"?

Mr Willets: Obviously, at the ministerial it is only the tricky issues that come up. A lot of preparation has been done, but absolutely. David will correct me if I am wrong, but if there is not enough support and people are not putting in sufficient money from their pockets to support a particular programme, it does not happen.

David Parker: The ministerial is the final stage of it, but I can tell you that council meetings happen at the delegate level beforehand. Literally, just before the ministerial ESA realised there were one, two or three programmes that people were not going to support and they withdrew them, so they never went in front of Ministers.

Q171 David Tredinnick: On the balance between mandatory and optional programmes, someone wrote somewhere that, if you just do the mandatory and do not take up a lot of the optional projects, it is like joining a club and not playing on the pitch, turf or wherever it is. Is that right?

Mr Willets: Yes. The image is one where you are able to afford the membership fee of the club but not a round of drinks at the bar. It has been like that. There were times when Britain just about maintained mandatory membership but we were not joining in the round of drinks. It is at the point where you join in the round of drinks that you start to get the benefits. You leverage up beyond the mandatory programmes, and you strategically choose. We had discussions in the space leadership council and other areas, and there was a consultation exercise through much of last year when we asked scientists, "Which are the areas where you think there is a really interesting science programme you want to join in?" and the business community, "What satellites do you want to be building or participating in?" That was the optional stuff, where the real value arises.

Q172 Roger Williams: On the mandatory and optional payments, David Parker said that it is a small mandatory payment, but that is in proportion to the size of the nation state, is it not? We make quite a large mandatory payment. What is the ratio between mandatory and optional at the moment?

David Parker: It is roughly 50:50. You are quite correct that we are the second largest contributor to the mandatory programme in percentage terms. From memory, it is about 60%. That buys us the space science programme; basic technology and infrastructure; the education programmes of ESA; and

communications work. On top of that, we are in the optional programmes. As a result of the decisions taken in Naples, we are now the largest contributor to the telecoms programme; the second largest contributor to the technology programme for navigation satellites; and in several others we are a major player now. We are still not contributing to the launches programme, which is a very large part of ESA's activities, and we are a very small part of the space station programme, which is colossal, if you're German. There is a very large investment on the German side, for example.

Q173 Jim Dowd: It's not something I've ever done—joining a golf club—but I'm led to believe that some people do it solely to use the bar. There is a degree of tension, as you will be aware, Minister, between the EU and ESA at the moment. Can you give us a broad outline of where you think the balance of UK's interests is between the national programme, what ESA should do and what the EU should do? Do you think effort should be put into attempting a reconciliation of some kind between EU and ESA?

Mr Willets: Your analysis is correct. Sadly, there is some tension at the moment, which I regret. I think it can be resolved; I see a way forward. By and large, ESA is a well-run intergovernmental organisation. We have just been discussing how it functions. I think it functions not perfectly but pretty well. Separately, the EU in the Lisbon treaty got a competence in space which it had not really had before. The EU can use ESA to deliver EU programmes and be a downstream customer, building up the use of ESA technology. There may be agricultural applications of services developed from ESA which the CAP could help fund. That is speculative. We do not want to see the EU in some sense taking over ESA. It is not necessary; it has its own treaty and intergovernmental structure; and it includes people who are not full members of the EU, like Norway and Switzerland. We just need a sensible way in which they interconnect. There is a significant amount of ESA activity which is done as a result of bids from members of ESA that does not have an EU angle. Some of the criticisms and anxieties about accountability and such like which the EU Commission put in one of their papers about ESA were misplaced. I think they were trying to invent problems that were not there.

Q174 Jim Dowd: That leads neatly to my next question. Do you think any of those criticisms are valid?

Mr Willets: By and large, not. If it ain't broke, don't fix it. We recognise that the EU has now got its own treaty framework in which it has competence in space and has money that it spends. When the EU is looking at how to spend its money on its space projects, the obvious thing to do is to procure them from ESA and use ESA as its arm. Therefore, one body, the EU, using a different body, ESA, to deliver its programmes requires a memorandum of understanding and framework, and that can be clarified and improved.

David Parker: I agree. We have not spotted one of their obstacles that is really fundamental. We think they are over-egged red herrings.

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Q175 Jim Dowd: If the EU Commission were determined to subjugate ESA under the provisions of the Treaty of Lisbon, is there anything to be done to prevent that?

Mr Willets: One argument might be considered, which it is only fair to bring to the surface. ESA is a *juste retour* structure. The EU, at least officially, does not operate on a *juste retour* basis. One seductive argument that people sometimes put to me is, "Hang on. If you have EU contracting rules, not ESA contracting rules, and you are so confident about the great qualities of British space technology, you might do better than *juste retour* on EU rules." That argument is around. That is why, on some of the procurement for Galileo—David will correct me if I am wrong—we have done better under the EU rules because we have ended up with a British role in building all those satellites so far because it has been an EU procurement.

But now the framework for going forward is that we agreed at the ESA ministerial that ESA would work constructively on how it saw the relationship with the EU. That may be one of the items on the agenda for the next ESA ministerial; and in the competitiveness council of the EU, we have had discussions of how, wearing that hat, we should deal better with ESA. We are making progress in trying to get negotiations with our wearing these two different hats.

Q176 Jim Dowd: You mentioned Galileo in passing and how well this country comparatively has done out of it. What role, if any, do you have in ensuring the efficiency and value for money of projects like Galileo, or Copernicus?

David Parker: The answer is: through negotiating hard on the regulation, leads and structure of these programmes and, at each decision point, pushing the Commission to be efficient and take the right management decisions. A lot of it is about the bureaucracy between ESA and the EU, getting in place the right decision making process. When I said there were no fundamental obstacles between the two, the practical stuff is about clearly defining who is responsible for what. If you are a customer with an industrial company trying to negotiate scheduling costs and technical issues, you need to be able to do that together, not have to check with the paymasters whether they agree with the decision you have just taken and go back to the industry and change it again. Getting those interfaces sorted is what really needs to be done on programmes like Galileo and Copernicus.

Q177 Sarah Newton: I would like to come closer to home. We understand from written evidence that, later this year, a policy document on UK space strategy is going to be published which aims to bring together civil and national space security policy. Are you expecting any significant changes to our national space policy as a result of the publication of this document?

Mr Willets: We have a civil space policy out there, which is the crucial thing. We are going to put alongside it the space security policy which is focusing on particular issues affecting this important part of our national infrastructure, for example vulnerability to space debris or space weather, or indeed—it has to be part of it—circumstances where there is a hostile attack on the capabilities of your satellites. We hope to produce that document very soon.

On top of it, there is an overall document which will be relatively straightforward and simple, and will refer to the two other documents, both of which will be in existence. The combination of what we have done at ESA at the ministerial and what we have produced in the civil strategy is the bulk of our space strategy.

David Parker: The capping document is intended to clarify roles and responsibilities across government.

Q178 Sarah Newton: It is not a real change of policy; it just gives an overarching narrative and policy that links various parts together.

Mr Willets: It has taken longer than we would have hoped. The areas we have been thinking about a bit are, for example, in space security, how vulnerable our satellites are to space weather and increases in solar activity every 11 or 12 years. We have had detailed conversations with the industry about that. As to the space debris problem, which is currently monitored by the Americans and us at Fylingdales, which is also very closely linked to the US, do we need to do more to monitor it? That is now quite a significant cost, using fuel to move satellites around because you are warned that they might encounter space debris. Those are the kinds of angles we are covering, but I would not expect a massive change in our overall strategy.

Q179 Chair: Is there a mechanism inside government for liaison between you and your opposite numbers in the Ministry of Defence where there is an overlap in interest between space weather, increasing concerns about EMP weapons and so on?

Mr Willets: We have had a small Cabinet committee on space security, which I chaired but which also had Ministers from the MOD and Foreign Office. That has been supervising the work on space security policy. In Whitehall terms, when the policy is in place, the ultimate custodians would be the Cabinet Office, because they are in the lead on the critical national infrastructure. In many ways, the space security policy is about treating space as part of the infrastructure and showing that the responsible Departments are discharging that responsibility. It is on a long list from the Cabinet Office, so they can say, "Right, so you've got in place a plan for this bit of national infrastructure."

Q180 Chair: When we see space weather given an extremely high priority on the risk register, we can assume that there is a co-ordinated approach to that across Government Departments. I appreciate that some of this cannot be published.

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Mr Willets: Yes. The ultimate custodian will be the Cabinet Office, which will be responsible for checking that space weather as a threat to our national infrastructure is properly covered. The immediate operational body monitoring and reporting on it will be the Met Office, and between that some ministerial responsibility might well come through the UK Space Agency and myself.

Q181 Sarah Newton: I was going to pursue that line as well. In the comprehensive spending review, there was an additional uplift for things in the MOD around cyber. We heard from David on the previous panel about satellite internet. You can see quite a lot of crossover, so it is reassuring that there is going to be co-ordination at Cabinet level. Sticking with policy, we have heard a lot of very good evidence about the success of Harwell. A lot of that has been because of funding coming from ESA. In the policy going forward, will we be looking at other ways of attracting funding to Harwell and other incubators based around the UK, or will we see the future growth of Harwell and other such centres being dependent on increased contributions to ESA?

Mr Willets: You are right to make the case that it is not just Harwell. Harwell has its distinctive role, but there are a lot of other great centres like Portsmouth, Guildford and elsewhere. With the decisions we have already taken—the implementation of the space strategy and contributions to ESA—one thing I find very encouraging is the number of internationally mobile businesses that now say they want to be active in the UK. A string of people come to see me and David Parker and say they want to locate some of their space technology work in the UK as a result. For them, what we have already done is reason enough for locating here. The more we can keep on ratcheting it up, the better we will do, but they assure me that they are not just into the tourism business of trying to get some of the ESA budgets. They have taken the view that Britain is now a good place to locate space technology activities, and Harwell is one of the places they want to come to but elsewhere in the UK as well.

Q182 Sarah Newton: Do you think that is as much to do with the deal you managed to strike with the Treasury, the certainty of funding, the future direction and the clear commitment, as it is with the absolute sums of money?

Mr Willets: You are absolutely right; and the fact we have been working steadily through a strategy. Continuity and long termism is something they do value, and they are right to do so.

Q183 Roger Williams: I think we would all agree that space is a very good example of how cutting edge research can be translated into technology. Recently, extra money has been secured for the small business research initiative. Will some of that money be dedicated to developing space technology SMEs at Harwell?

David Parker: In terms of the SBRI, not necessarily specifically at Harwell, but we are using an SBRI mechanism for some technology work, particularly the Galileo spacecraft system where we are going to

provide new signals. One of the really exciting commercial opportunities is related to the high dependability and high security signal. We are working with the Technology Strategy Board on an SBRI model to develop technologies to exploit that in the UK.

Q184 Roger Williams: Minister, have you encouraged Government Departments to make use of research that might come out of the business incubation centre at Harwell?

Mr Willets: Yes. I push to the limit my colleagues' tolerance of my saying to them, "Have you thought about a space application to help with your problem?" reminding them that you can get broadband services in remote areas via satellite and use satellites to get information about the performance of agriculture literally field by field. The space applications centre at Harwell, what is now the catapult centre, is a great place to get lay people from Whitehall and business, who don't think of themselves as being involved in space at all, to come along and see at first hand how data from space could help them run their businesses or departments. I believe this Committee has seen it; if not, I suggest it does so. As a layman, it is a great way of seeing how satellite data can help.

Q185 Roger Williams: We have been told that the facilities there will enable research to be accessed by businesses. Will Harwell be reaching out to all parts of the UK, or will the businesses have to migrate there? You can understand that for some of us who live on the periphery of the United Kingdom it is important to maintain our economic activity there as well as having access to technology.

Chair: Can you deliver Roger his broadband?

Mr Willets: It is a very fair point. You can argue that we have a range of centres stretching from the Clyde to Goonhilly, so it cannot all be concentrated on Harwell.

Q186 Roger Williams: Have you made any assessment about what you anticipate to be the return or economic growth from the investment at Harwell in the satellite applications catapult?

Mr Willets: In general, all the assessments—I think there was a big economic assessment by London Economics in 2010—showed very good rates of return of five or six to one from investment in space technologies. I don't know whether we can offer any more detail than that.

David Parker: I am sure the catapult has specific business targets. I am afraid I don't know offhand what they are. I am happy to provide a note.

Roger Williams: Perhaps you could let us have that.

Q187 David Tredinnick: I just want to probe a security matter. We have talked about weather, and whether we are prepared for severe space weather events. You touched on a Cabinet sub-committee. Which is the lead Department for space security policies? Did you touch on that? I am not sure you gave us that answer. You said the MOD and Foreign Office were there.

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Mr Willets: If you think of it as critical national infrastructure, I would say the Cabinet Office are the overall custodians with responsibility for ensuring that we have arrangements in place, so they are ultimately responsible.

Chair: Minister and Mr Parker, thank you very much indeed.

Written evidence

Written evidence submitted by Professor David Southwood (ESA002)

1. I submit evidence as an individual. I am present retired from the European Space Agency. I was previously Director of Science and Robotic Exploration there and before that worked in Earth Observation as Head of Strategy. I serve at present on the Steering Board of the UK Space Agency and am also President of the Royal Astronomical Society. I am also a fellow of the Royal Aeronautical Society and a senior research investigator at Imperial College London. The views expressed here are my own and not intended to be institutional.

Q1. *What are the strengths (S) and weaknesses (W) of the funding, organisation, and work of the European Space Agency?*

2. S: A modern developed society cannot ignore space for communications, environmental monitoring, navigation and a host of linked uses. Membership of ESA gives UK access to scientific and technology development programmes and space facilities that could not be maintained nationally. It thus allows UK industry and academia to remain globally competitive.

3. S: In contrast with bilateral arrangements, there is no dominant partner within ESA. Moreover the agency functions so that countries choose to opt in to the majority of programmes. This à la carte system means that UK can balance its expenditure to match its priorities and at the same time exert influence in ESA by choosing where it invests its contribution.

4. S: The ESA science programmes in astronomy, solar system exploration and Earth science are broad based and second only ever to the US and often superior. There is no way that the UK science could function in these fields outside ESA.

5. W: ESA's scope of activity is limited in the political sphere and, in particular, omits most aspects of defence use. Effective means have to be found to exploit dual use aspects of the technology developed. However, that does not mean transfer of responsibility to EU. The same comments would also apply to EU, as long as Defence remains a prime national responsibility. This latter fact seems sometimes ignored in documents like COM 2012 671, see eg para 2.2.

6. W: Inevitably, management in an international organisation like ESA is complex and can often become political. Not all member states have the same priorities and the interests of the larger member states can often be in conflict with the smaller in that the larger. For example, several large states have national capabilities that they do not want to see duplicated. This likely to become increasingly evident as ESA membership expands to include the full EU membership.

Q2. *In light of the European Commission's recent Communication on relations between ESA and the EU (COM 2012 671), what relationship between ESA, the EU and the UK would provide the most effective governance regime? Why?*

7. ESA is an R&D organisation and so operational entities like GSA necessarily fall outside its remit and it is natural for EU to be primarily responsible. Clearly in some areas, such as regulation, EU should hold sway. However in areas like international cooperation or defence, although cross-European coordination is appropriate, it is less obvious that national authority should be devolved to EU. In terms of governance, the 40-yr-old ESA convention has shown itself remarkably resilient in accommodating the different national scientific and technical priorities of individual member states without conflicting with national political priorities. The solutions proposed in COM 2012 671 seem rather "one size fits all". At present, it is not clear that the ESA combination of à la carte and *juste retour* for science and technology development programmes is yet played out whilst it is clear that space regulatory and operational bodies are not best served through ESA because of its nature as an R&D organisation.

8. Perhaps from a British point of view the biggest distinction between an EU unified approach and the à la carte approach of ESA is exemplified in launcher policy. COM 2012 671 makes no reference to launchers however there is a more recent communication, COM 2013 108, concerning establishing a European industrial policy. In that communication, the notion of preserving European access to space introduces the idea of the EU and Member States explicitly favouring European launchers. UK has little direct industrial interest in the present ESA launcher programme. However, with an industry which has successful sectors producing small satellites which have hitherto found launches through the open market, UK has a special interest. UK interests could be at variance with those countries deeply involved in developing launchers. At present, it would not seem in the national interest to be bound by policies that might preclude UK institutions seeking the most cost-effective launch solutions possible.

9. COM 2012 671 makes clear that ESA at present does not directly respond to EU, except where it has development responsibility for EU programmes. However it is not explained that ESA does respond to Member State governments directly through its Council and constituent bodies. When the communication states Para 2.4 "There is no formal mechanism at policy level to ensure that initiatives taken within ESA are consistent

with EU policies" it seems to assume that actions of Member States are somehow antithetical to or inconsistent with what EU undertakes on those states behalf.

10. COM 2012 671 seems to make no reference to the working relationship between ESA and EUMETSAT (European Organisation for the Exploitation of Meteorological Satellites). ESA has a well-defined role in R&D and development of new systems for EUMETSAT which then is responsible for maintaining operations and data to national weather agencies. This division of responsibility (which even includes differing industrial procurement policies in the two organisations) seems to work well.

11. Technical development and scientific research ideally should be close to the Member States institutions (space agencies, research councils, research institutions, etc) as long as this is where the largest share of public research investment originates nationally. Thus an organisation like ESA needs to remain directly responsive to national governments. However as the needs for transnational regulation and operational systems increase, so the EU should have a larger and larger role. Governance arrangements in each case should reflect the balance of investment.

Q3. How effective is the EU's support for research and innovation in the space sector? What effect have changes to the Multi-Annual Financial Framework had on ESA and support for the space sector from the Horizon 2020 programme?

12. The most significant role of the EU in space has been to provide the frame for independent navigation and surveillance space systems: EGNOS, Galileo and GMES. Initially these funds had to come from budgets that were designed for R&D and not suited for development of space systems. The result was much delay while funding was sorted out. If the Multi-Annual Financial Framework contains these operational items and allows the European Commission to act as a customer for system and service delivery, it is an important step.

13. The Horizon 2020 programme will still use the approach of the Framework R&D programmes, for example forcing forming of consortia for geographic spread rather than encouraging competition. ESA's equivalent R&D programme has been more commercially oriented where member states have wanted it to be so. Moreover, ESA has long had long-term planning. Space programmes take a long time to be designed and developed. Coherence is required over similar periods to make investment and expenditure most effective.

14. The structure and function of the space science part of ESA was inherited from ESRO (European Space Research Organisation) and modelled originally on the particle physics organisation, CERN. It has been a very successful model allowing development of large space telescopes and many other space probes. The Horizon 2020 system of support is not appropriate for this kind of programme.

Q4. How effective has the UK Space Agency been and what improvements could be made? Is the UK effectively exploiting opportunities for growth in the space sector or could more be done?

15. The UK Space Agency has been a big step towards re-establishing UK as a space-oriented nation. The cross-discipline authority vested in the Minister at the November 2012 Council of Ministers gave him a better platform to negotiate UK's part in the future programmes that were decided.

16. The existence of the UK Space Agency allows a coherent national approach to space policy that ideally should bring together institutional, defence and commercial space interest together and allow setting national priorities and goals. Investment in ESA and national facilities (such as the Harwell Satellite Applications Catapult Centre) can then be exploited more coherently.

17. The relationship with the Research Council where has changed and needs to be monitored as the new Agency is not going to work to the same rules. Nonetheless it needs to make sure that the scientific demands and goals of the Research Councils are effectively followed.

18. The existence of UKSA allows the possibility of greater flexibility in developing bilateral cooperation with the agencies of other spacefaring nations. The agency can now negotiate bilateral programmes over the full range of national space interests and use its flexibility to improve the overall benefit.

Q5. Does the UK get good value for money from its membership of ESA? How does its return on investment compare to other countries?

19. The UK gets good value for money from our membership of ESA. We participate in space programmes of a scale that we could not afford by ourselves at a cost that is a fraction of what it would cost us otherwise. The overhead associated with the need to contribute to and to monitor a complicated and diverse international organisation is more than offset by such gains.

20. It is nonetheless important that, after many years, ESA has been prevailed upon to set up a British base on the Harwell campus. UK space companies and British approaches to feeding skills form science to technology and new industry have been amongst the most innovative in recent years. One should look to ESA Harwell and the allied UK investment there to ensure that this innovation is fed into future European space programmes.

Q6. *How resilient is the UK's space-based infrastructure? Are threats from space debris or solar activity being appropriately mitigated? What role do, or should, ESA and the UK Space Agency play in addressing these issues?*

21. ESA has started an optional programme in space situational awareness which is assessing both the means and need for monitoring space debris and threats from electromagnetic disturbances of solar origin. At present, Europe is dependent on the US for information and warnings. Space debris responsibility lies with the countries launching problem emanating from ESA programmes. As Europe becomes more and more independent in space capability so there is a need for ensuring independent ability to assess threats.

22. At the national level there is technical capability in space debris, space weather and near-Earth objects (which might pose a threat of collision) in the science community but there seems no clear institutional responsibility for delivery of monitoring service or warnings.

April 2013

Written evidence submitted by the Space Action Network (ESA004)

The Space Action Network (SPAN) comprises university group and institute heads across the fields of Earth Observation, Space Engineering and Space Science. Our joint response to the above consultation is as follows:

1. *What are the strengths and weaknesses of the funding, organisation, and work of the European Space Agency?*

1.1 The ESA programme is generally very successful with excellent underpinning technological development. It is implemented in such a way as to provide continuity and commitment. Following a thorough assessment and selection process space missions generally go on to provide a world class in-space capability. This continuity is in contrast to that of NASA where political interference and changes of high level policy cause much disruption, delay and cost increase. Moreover, the selection process involves significant community participation and balances science value with technical/programmatic risk and opportunity. A weakness of this assessment and selection process is that it is slow and elaborate with much nugatory work taking place at the expense of the nations.

1.2 The mechanism of *Juste retour*, in which individual nations receive a large return of their subscription in terms of industrial contracts has been generally effective. While it can sometime lead to an element of compromise, or lack of optimization, it ensures continued support from participating nations. The increasing size of ESA places additional pressures on the *Juste retour* mechanism.

1.3 ESA is technically highly competent and so makes an intelligent customer for the prime contractors and is able to make informed decisions regarding strategic technological developments. However, ESA's programme is small compared with the overall European space programme which gives prime contractors a great deal of power. As a result ESA often defers to the primes position at the expense of nationally funded instrument providers to avoid contract cost increases.

1.4 ESA's policy to cover all technical aspects associated with space has led to the creation of its "Centres" (ESOC, ESRIN, ESTEC, ESAC, "Harwell",...). While these are effective they provide services to space missions in a non-competitive environment and so are perceived to be expensive and elaborate.

2. *In light of the European Commission's recent Communication on relations between ESA and the EU (COM 2012 671), what relationship between ESA, the EU and the UK would provide the most effective governance regime? Why?*

2.1 It will be important to align ESA's space programme with that of the EU, especially in terms of technology and capability development (rather than major space missions which should remain the province of ESA). It would be very detrimental in further politicize ESA and so to introduce to it many of NASA's weaknesses. However, better cooperation in terms of technological development would avoid duplication and funding gaps. Non-EU nations (Switzerland and Norway in particular) play an important role in ESA and might be excluded were there to be common governance.

3. *How effective is the EU's support for research and innovation in the space sector? What effect have changes to the Multi-Annual Financial Framework had on ESA and support for the space sector from the Horizon 2020 programme?*

3.1 The EU has probably much more to learn from ESA in terms of the implementation of a European space programme than ESA has to learn from the EU.

3.2 ESA has the best perspective on the needs of the space sector. An independently EU strategy makes little sense—see 2 above. Nevertheless, the EU does provide useful support in this area especially with the more focused ERC schemes. However, EU funding is to bureaucratically managed.

4. How effective has the UK Space Agency been and what improvements could be made? Is the UK effectively exploiting opportunities for growth in the space sector or could more be done?

4.1 UKSA's awareness of the particular needs and constraints of the space sector in general and ESA in particular are evident in a more nimble and informed decision making process (eg compared with STFC). It only weakly supports early technological development (ie non-mission specific) which is currently the responsibility of other research councils (STFC, EPSRC and NERC). Its relationship with these bodies will need to evolve so that a more joined-up approach can be established. It should be noted that because of EPSRC's reluctance to fund space engineering, UK universities are forced to turn to ESA and the EU for support in this area.

4.2 So far UKSA has been a success.

5. Does the UK get good value for money from its membership of ESA? How does its return on investment compare to other countries?

5.1 The UK science community benefits very significantly from the ESA space programme. Its missions have made a great contribution to our understanding of processes that shape our Earth and the Universe. European space technology is world class.

6. How resilient is the UK's space-based infrastructure? Are threats from space debris or solar activity being appropriately mitigated? What role do, or should, ESA and the UK Space Agency play in addressing these issues?

6.1 Space debris and solar activity represent a real threat to the UK's space-based infrastructure. While the probability of a major incident is low, its potential impact is very high and could be very expensive. The UK should have a clear strategy for reduction and mitigation of these risks and should engage with ESA, the EU and others to maximize the benefits of its national contribution in this area.

April 2013

Written evidence submitted by Mullard Space Science Laboratory, University College London (ESA005)

DECLARATION OF INTERESTS

University College London's Mullard Space Science Laboratory undertakes a programme of space science experimentation and research which includes projects funded by the UK Space Agency, UK research councils, ESA and the EU. We are also contractors to ESA and European space prime contractors.

MSSL is the largest university-based space science institute in the UK and has flown ~40 instruments on international spacecraft. It has provided instrumentation to many of the leading space observatories and probes and is engaged with the majority of ESA's future space science programme.

1. What are the strengths and weaknesses of the funding, organisation, and work of the European Space Agency?

1.1 ESA is an effective and successful organisation. From the point of view of the mandatory Science Programme, which is our main experience, the agency has seen the development of a sequence of highly successful missions, almost always meeting their initial specifications, and with a record of excellent reliability. These highly demanding technological projects provide a platform of European space instrumentation development that feeds the growth of the European industrial sector. European space science and space astronomy is at the front rank internationally.

1.2 The cost-effectiveness of ESA's missions is probably better than NASA—the benchmark. Nevertheless, there remains room for improvement and it is important that innovative approaches to cost reduction continue to be introduced, albeit not at the cost of reliability. It is reassuring to see the introduction of ESA's Small (S) class missions which provide an opportunity for such innovation although disappointing that the UK Space Agency has not been able to contribute significantly to this initiative to date.

1.3 One important advantage over the NASA programme is that long-term financial decisions can be made which allows ESA to manage a coherent programme of science research without numerous costly and ineffective funding reviews. This continuity is absolutely fundamental in programmes which typically last over 20 years from selection to the end of operations. However, ESA's current mission selection process is certainly protracted and liable to delay, alteration and lack of visibility. Nevertheless, their current mission portfolio is well-balanced and internationally very well respected. The European and UK science community is well represented in the selection process.

1.4 Space science and exploration has often provided opportunities for international collaboration and ESA's science programme is a very good example of this. By exploiting and valuing national perspectives, priorities and characteristics, ESA is able to achieve much more that might be done by individual European nations or

small, ad hoc European collaborations. It combines industry, agency and some of Europe's finest scientific institutions and universities.

1.5 ESA has shown recent progress in controlling internal costs and we would welcome a continuation of this programme to allow the maximum resources to be deployed on ESA missions. However, ESA needs to maintain a core of technical staff to manage the large industrial contracts that are the major part of their external activities.

1.6 The weaknesses of ESA's funding and organisation are related to the multi-national nature of the organisation, which adds to the complexity of governance, and some inefficiencies. The so-called georeturn approach is highly effective in ensuring sufficient benefit is returned to funding nations. However, its implementation can be difficult and constraining. The number of ESA member states has grown significantly which adds to this complexity and stresses its decision making processes. ESA needs to continue to work to sensibly minimise the impact of this complexity.

1.7 In the past 10 years, ESA has run several of its space science programmes entirely through industrial contracts, rather than the Principal Science Investigator/Nationally funded instrument model used on successful missions such as XMM, Herschel and Planck, each with strong UK roles. We recognise the value of industrially-led missions in some situations, but investigator-led missions have developed the science expertise that now exists within Europe and should continue as the major part of ESA's programme.

2. *In light of the European Commission's recent Communication on relations between ESA and the EU (COM 2012 671), what relationship between ESA, the EU and the UK would provide the most effective governance regime? Why?*

2.1 COM 2012 671 identifies several areas where there are mismatches between the EU and ESA (such as membership), and the difficulties arising from the growing EU role in space matters through the Lisbon Treaty. The document suggests a "rapprochement of ESA towards the EU" as the solution, especially in order to promote operational efficiency and democratic accountability. However, this ignores the fact that ESA is responsible to EU member states individually and is hence democratically accountable and legitimate. It would seem unlikely that oversight by the EU would in any way increase operational efficiency. Nor does the document address many of the issues arising from the different membership; are Norway and Switzerland to be somehow removed from ESA? Changes may be necessary, but it seems unlikely that a transfer of responsibility of ESA from oversight by nation states to the control of the EU as suggested by COM 2012 671 is the best solution for ESA, or for UK interests within the space arena.

2.2 The further mismatch regarding security and defence is likely to be difficult to resolve. ESA's non-engagement in defence issues has kept a potentially divisive dimension from disrupting the relatively cooperative environment that ESA has created.

3. *How effective is the EU's support for research and innovation in the space sector? What effect have changes to the Multi-Annual Financial Framework had on ESA and support for the space sector from the Horizon 2020 programme?*

3.1 EU funding is important for the space sector, especially in a context of recent UK research council constraints. We note the growing importance of EU funding but also the need to align strategies between ESA, the EU and national priorities. We note that the technology roadmaps developed by the National Space Technology Strategy Group give a useful backdrop of UK capability but fail to provide a focused strategy.

4. *How effective has the UK Space Agency been and what improvements could be made? Is the UK effectively exploiting opportunities for growth in the space sector or could more be done?*

4.1 In our experience, the UK Space Agency has been effective within the constraints permitted by its resources. These may not be up to the ambitions expressed in the 2010 IGS Report (www.bis.gov.uk/assets/uk-spaceagency/docs/igs/space-igs-exec-summary-and-recomm.pdf) but nevertheless solid progress has been made against a difficult economic backdrop. The UK Space Agency is supportive of the main scientific and technological initiatives within UK space science groups, and provides an appropriate oversight and management framework to promote the securing of major new initiatives important to the UK science and technology base, and ensuring the delivery against current obligations.

5. *Does the UK get good value for money from its membership of ESA? How does its return on investment compare to other countries?*

5.1 It would appear so.¹ This identified that in 2007 the UK has the lowest public space budget among the G7 countries (Figure 5.1), of which ~75% is to ESA. Considering the scale of the UK presence in space, this indicates an excellent return on investment.

¹ www.bis.gov.uk/assets/uk-spaceagency/docs/igs/bis_space_economics_paper-number-3.pdf

5.2 From our perspective, without ESA, UK participation in some of the most important scientific endeavours would not be possible, and nor would the consequent benefits to UK society and the economy (knowledge-based networks, advanced technology development) be realised.

6. *How resilient is the UK's space-based infrastructure? Are threats from space debris or solar activity being appropriately mitigated? What role do, or should, ESA and the UK Space Agency play in addressing these issues?*

6.1 Some progress has been made in recognizing the threats associated with Space Situational Awareness that covers the issues mentioned. It will be important to address all aspects of these issues including the underlying science, monitoring and mitigation—at present the focus appears to be mainly on monitoring and then in only a partial way, for instance there is no present upstream solar wind monitor. For solar activity in particular a better understanding of the chain of interaction between Sun and Earth is necessary and ESA's Solar Orbiter mission will address some of the underlying science related to this. The development and implementation of mitigation strategies including response to incidents seems unsupported within the UK.

April 2013

Written evidence submitted by PHS Space (ESA006)

EXECUTIVE SUMMARY

This memorandum contains written evidence submitted by PHS Space Ltd to the Science and Technology Committee inquiry into the European and UK Space Agencies. Responses are provided to five of the six categories of information requested by the committee. However, the focus of the evidence relates to the space debris problem. Some concerns about the level of funding available in the UK are identified, particularly with regard to the development of innovative debris mitigation/remediation technologies. Budgetary pressures are also observed to be jeopardizing the UK's long-standing participation at important international debris mitigation committees. It is noted that the UK cannot afford to ignore the debris problem if it is serious about growing the space sector to achieve a £40 billion turnover by 2030. Indeed, part of this turnover could come from the development and use of technologies that address the debris problem.

BRIEF INTRODUCTION TO PHS SPACE LTD

PHS Space Ltd is a small UK-based consultancy company whose principal, Dr Hedley Stokes, has worked on various aspects of the space debris problem for nearly 20 years. Founded in 2006, the company provides specialist knowledge and expertise in the following areas:

- Use of an in-house, novel software tool to assess space debris impact risks to spacecraft;
- Design and optimisation of impact protection on spacecraft;
- Development of international space debris mitigation guidelines/standards and their application to space systems;
- Innovative space debris mitigation technologies, one of which is currently being patented.

DECLARATION OF INTERESTS

PHS Space Ltd provides technical advice and support on space debris matters to a variety of customers, including:

- UK Space Agency. PHS Space represents the UKSA at meetings of the Inter Agency Space Debris Coordination Committee (IADC) and the ISO Space Systems and Operations Committee (TC20/SC14).
- European Space Agency. PHS Space is currently undertaking research activities on two space debris-related ESA contracts.
- EU. PHS Space is a participant on two space debris-related projects funded under the Seventh Framework Programme (FP7).

WRITTEN EVIDENCE

1. *What are the strengths and weaknesses of the funding, organisation, and work of the European Space Agency?*

1.1 The greatest strength of ESA is its technical staff, whose breadth and depth of knowledge across the organisation is significant. This expertise, which has brought about many successful space missions, should be developed as much as possible. For example, more opportunities could be provided for the secondment of ESA staff to industry, national space agencies or the EU.

1.2 In terms of organisation, ESA has a rigid hierarchical structure which is similar in many respects to a large civil service department. A flatter organisation with a matrix management system, if implemented correctly, would allow greater flexibility in moving staff both within and outside the organisation. It would

also provide a closer relationship between senior management and the technical staff. This should improve upward communication flow of important advice from technical staff.

1.3 One area requiring attention in ESA is the process that industry has to follow when bidding for relatively low-value competitive tenders, ie those less than 500k euros. At present the process is too costly, time-consuming and complicated. This can act as a barrier to SMEs bidding, since the size of the investment that must be made, and risk taken, may be a substantial proportion of the SME's overall business. Therefore, SMEs are forced to consider bidding only for those ESA contracts that they have a significant chance of winning. By contrast, large organisations can absorb the high bidding costs much more readily, and therefore they can afford to be more speculative when bidding for work. Thus the complexity and cost of the ESA bidding process has an inherent bias in favour of large organisations. This clearly has a couple of (perhaps unintended) consequences. First, the organisation that wins a contract may not necessarily be the best one to undertake the work. Second, the potential for SMEs to grow could be hindered.

1.4 An aspect of the ESA bidding process that remains a cause for concern is "*juste retour*". The existence of a geographical return requirement can force a bid consortium to include some weaker partners in order to spread the geographical loading. Therefore, it seems inevitable that bid consortia will be sub-optimal in their make-up. As a consequence, one must also presume that some of the resulting contract deliverables from a winning consortium will not be of the highest standard achievable.

2. *In light of the European Commission's recent Communication on relations between ESA and the EU (COM 2012 671), what relationship between ESA, the EU and the UK would provide the most effective governance regime? Why?*

2.1 ESA has accomplished much since its inception. There have been notable achievements across all of the space activity domains. However, given its budgetary constraints, and the emergence of EU funding of space-related activities, perhaps now is the time for ESA to focus on certain key areas. There should be a clear demarcation between ESA's activities and those of the EU. The greatest technological risk and challenge comes from science missions, interplanetary missions and human spaceflight. It could be argued that ESA's undoubted technical expertise would be put to best use by concentrating on these particular areas. Where synergies and economies of scale exist, ESA projects should be pursued in collaboration with national space agencies within Europe, such as the UK Space Agency, or agencies outside of Europe.

2.2 To complement this approach, the EU could assume responsibility for unmanned, Earth orbital missions since these provide the most immediate and obvious societal benefits to European citizens. In recent years the EU has demonstrated its commitment to Earth orbital space, both in terms of use (eg GMES) and in terms of preservation of the environment for future generations (eg addressing the space debris problem).

3. *How effective is the EU's support for research and innovation in the space sector? What effect have changes to the Multi-Annual Financial Framework had on ESA and support for the space sector from the Horizon 2020 programme?*

3.1 EU support for research and innovation has provided a significant boost to the European space sector, and has filled in some sizeable funding gaps. This is particularly evident in an area such as space debris research. Over the past three years several large debris projects have been funded within FP7 to address a variety of important needs. These include the development of methods to mitigate the growth in orbital debris and technologies for actively removing debris from the environment. In the light of concerns about the Kessler syndrome taking hold, ie the onset of an irreversible collision cascade in low Earth orbit (LEO), the EU has approached the debris problem with a sense of urgency. This is laudable. EU funding has helped many European companies, especially SMEs, to develop promising ideas and technologies. In so doing, the competitiveness of European industry has also been improved. The upcoming Horizon 2020 programme looks set to continue that trend.

3.2 One problem that the EU currently appears to suffer from is a lack of staff to oversee the space-related research being undertaken. At present the EU has limited in-house technical expertise, and therefore it has to invite outside experts to act as project reviewers. This can work quite well if there is a good match between the aims of a project and the knowledge of the expert. However, experience shows that this is not always the case. Some projects have been reviewed by experts who are not sufficiently qualified to provide meaningful inputs. If the EU is to provide effective oversight of research within Horizon 2020, then it needs to address this problem. One possible solution would be for ESA to provide a number of technical staff to the EU. This could be on a secondment basis or as a permanent transfer.

4. *How effective has the UK Space Agency been and what improvements could be made? Is the UK effectively exploiting opportunities for growth in the space sector or could more be done?*

4.1 The UK Space Agency's National Space Technology Programme (NTSP) has given much-needed assistance to the development of innovative technologies within the UK space sector. However, the level of investment would seem to fall short of that necessary to satisfy the aspiration of creating a £40 billion-turnover space industry within the UK by 2030. In addition, calls for proposals need to be more frequent and regular to ensure that promising new ideas can be developed quickly and retained by the UK.

4.2 The relationship between funding offered by the NTSP and that offered by the Technology Strategy Board (TSB) is unclear. It is presumed that there is coordination between these funding programmes regarding the technical requirements in calls for proposals. However, an outsider to the process can have poor visibility and understanding of this. For example, it is not clear under what circumstances a proposal should be submitted to the NTSP rather than the TSB.

5. How resilient is the UK's space-based infrastructure? Are threats from space debris or solar activity being appropriately mitigated? What role do, or should, ESA and the UK Space Agency play in addressing these issues?

5.1 One of the leading international organisations for addressing the space debris problem is the Inter Agency Space Debris Coordination Committee (IADC). This is an international governmental forum for the worldwide coordination of activities related to the issues of man-made and natural debris in space. Recently IADC has studied the stability of the debris population in low Earth Orbit and found that the population is likely to increase by approximately 30% in the next 200 years. This projection assumes 90% implementation of mitigation measures in the design and operation of spacecraft (which is not currently achieved). In view of this result, the IADC observes that two key elements are required for the long-term sustainability of the future LEO environment. The first defence is to encourage greater compliance with mitigation measures (such as those contained in the IADC's space debris mitigation guidelines or the ISO 24113 standard). Secondly, active debris removal (ADR) should be considered. The IADC study concludes that "the international community should initiate an effort to investigate the benefits of environment remediation, explore various options, and support the development of the most cost-effective technologies in preparation for actions to better preserve the near-Earth environment for future generations".

5.2 Active debris removal brings with it many challenges. Aside from the technical difficulties in safely removing debris, there are also political, legal and financial hurdles to be overcome. The UKSA should make a meaningful contribution towards finding solutions to all of these problems. For example, on the technical side, the UK has significant expertise in a number of areas, including:

- The ability to undertake in-depth studies to investigate the environmental benefits and risks of different ADR solutions;
- The ability to develop more cost-effective (potentially disruptive) technologies/concepts for debris mitigation and remediation than those currently being proposed in the rest of Europe and elsewhere. These include achievable, near-term approaches which focus on adapting to the environment rather than trying to modify it.

5.3 The UKSA should encourage and support the development of promising new debris mitigation/remediation ideas, particularly those emerging from SMEs. Otherwise there is a risk that other countries will benefit from the UK's innovations. At least one such idea is on the verge of being lost from the UK because of a lack of funding opportunities.

5.4 The UK Space Agency also has a long-standing obligation to participate in international forums addressing the space debris problem. It has satisfied this obligation with the help of a small number of experts who have provided the UKSA with technical support and advice on space debris matters for a number of years. As a result the UKSA has been able to take a leading role in the development of international debris mitigation guidelines and standards, such as those published by the IADC, UN and ISO. This work is on-going, and has now been expanded to include recommendations relating to active debris removal (ADR). To ensure the UK can continue to have a positive influence on these activities, and therefore protect the commercial interests of the UK space industry, it is very important that such representation is maintained. However, budgetary pressures within the UKSA in recent years have reduced funding for the expert support to a point where meaningful participation has been jeopardized.

5.5 The UK cannot afford to walk away from its obligations in these international debris mitigation forums if it is serious about growing the space sector to achieve a £40 billion turnover by 2030. Activities such as monitoring and modelling the debris environment, and standardizing spacecraft design and operations to mitigate debris are inseparably bound with this economic aspiration. The UKSA should therefore reaffirm its commitment to international space debris mitigation efforts via the IADC, UN and ISO, and take immediate measures to reverse the decline in funding support for expert participation in these forums.

5.6 ESA's funding of the space debris problem has been variable during the past decade. Approximately 10 years ago, a management decision was made to curtail funding of space debris research. The rationale for the decision is unclear. Since no serious collisions had happened up to that point, perhaps there was a perception that debris was not a significant problem that deserved funding. In contrast, ESA debris experts at that time were predicting that collisions would be likely to start within a few years (based on simulations from long-term debris environment evolution models). As it happened, the first major accidental collision took place in February 2009 and the environment has deteriorated substantially since then. It is worth noting that ESA funding of space debris research has increased noticeably in the past couple of years. This is a welcome development. However, given the level of concern about the debris problem now, perhaps there is scope for further improvement.

5.7 Finally, within ESA, technical experts are currently studying options for actively removing the Envisat satellite from orbit. Envisat, one of the largest spacecraft to be launched, orbits in a very popular and populous region of low Earth orbit. After 10 years of operation it suffered a sudden and irrecoverable failure last year and, as a result, became one of the most hazardous debris objects in LEO. Unfortunately, Envisat will now remain in orbit for well over a century unless ESA can find some method to remove it safely. Space debris experts in the UK are also considering possible solutions to this problem.

April 2013

Supplementary written evidence submitted by PHS Space Ltd (ESA006a)

With reference to the questions asked by committee members on 12 June 2013, PHS Space Ltd wishes to expand upon some of the information supplied. In particular:

Q30. What have been the main achievements of the UK Space Agency since its establishment? Where do you see room for improvement?

1. The creation of a National Space Technology Programme (NSTP) has been a very welcome development for the UK space industry. However, there are two important ways in which the NSTP could be improved. Firstly, given that the programme currently has a relatively modest budget, then there is a strong argument that the available funding should be targeted much more towards SMEs. This source of funding is likely to have greater benefit to SMEs, particularly those who may be struggling to develop innovative space technologies and establish their businesses. Secondly, the NSTP must invite calls for proposals on a more frequent and regular basis. This will help promising new ideas to be explored and developed at the earliest opportunity.

Q59. In the written evidence it states that there is a good chance of loss of innovation to this country. Can you expand on that? Is there a remedy to it?

2. In addition to the oral response given to this question, the answer to Q30 (above) is also relevant. From personal experience, an SME seeking to develop a new technology cannot necessarily afford to wait for the next round of NSTP funding to materialise. Therefore, other avenues have to be explored either within Europe or even further afield. Inevitably, this may mean that the technology is developed in partnership with non-UK companies who will stand to benefit from the revenues generated in the long-term. Thus, the importance of the NSTP as a vehicle for encouraging and retaining novel UK technologies cannot be understated. More frequent and regular calls for proposals are essential.

Q60. To change the subject back to the discussion we had at the end of the last session about space weather and space debris, how well do you think that is being managed? How could the management of those risks be improved?

3. One of the primary ways to manage the space debris problem is to ensure that spacecraft designers and operators comply with international debris mitigation guidelines and standards. The UK Space Agency performs a valuable role in this regard by requiring and checking that any new UK spacecraft complies with the guidelines/standards before granting it a licence to launch. This is one of the most important functions that the Agency performs. For example, there is considerable evidence that the proper disposal of spacecraft at end-of-mission significantly reduces the risks from space debris. In geostationary orbit, in particular, compliance also has the benefit of ensuring that valuable slots are freed for future use.

4. However, it is not clear how thoroughly the UK Space Agency evaluates compliance before issuing a licence. There may be scope for improvement in this regard. It is worth noting that in France a stricter regime of compliance and enforcement now exists, whereby designers and operators are required by law to implement specific debris mitigation measures in their spacecraft.

Whilst this might not be an appropriate route for the UK to take, it nevertheless underlines the importance that some countries attach to the space debris problem. Consequently, it might be advisable for the UK Space Agency to demonstrate the robustness of its licence evaluation process by submitting it to independent scrutiny.

5. It is also important to recognise that the UK Space Agency's role as a launch licensing authority may be at odds with its other role as a supplier of funding to assist in the development of new UK spacecraft. In fact, there is the potential here for a conflict of interest. On the one hand the Agency could be promoting the development of a new spacecraft, whilst on the other hand it may be required to deny that same spacecraft a launch licence if a compliance failure should subsequently emerge during the evaluation process. In this circumstance the Agency could find itself in an awkward and embarrassing situation. There is therefore an argument that the licensing authority role should transfer to another body, ie one that is independent of the UK Space Agency.

Q62. *In the previous evidence session we heard doubts about how practical it was to hoover up space debris. Do you think that is a fair assessment? Do you believe we could hoover it up, and how can clearing up this debris be encouraged?*

6. For technical, political, legal and financial reasons, it is by no means clear that the active removal of large debris objects is a viable proposition. One of the largest uncertainties concerns the actual benefit of an Active Debris Removal (ADR) system versus the costs and risks. For example, one might conceive of an ADR system which removes the 50 largest debris objects from low Earth orbit over a ten-year period. However, it could well be that none of those debris objects would have been involved in a catastrophic collision with another space object during their orbital lifetime. In which case, the 50 debris objects would have been removed at great cost for no benefit at all. Furthermore, the presence of the ADR system in orbit would be adding to the collision risk.

7. This simple example serves to illustrate one of the fundamental problems with ADR—which objects to remove? The answer to this and many other questions requires a careful study of the benefits of the various ADR concepts versus the costs and risks. In this regard, the UK has world-leading analytical capabilities. The concern is that these analyses will be overlooked as industry around the world pushes governments for substantial amounts of money to develop ADR concepts, whilst at the same time failing to meet the costs associated with fully implementing debris mitigation measures in their spacecraft.

8. For example, since 2002—the year of publication of the IADC space debris mitigation guidelines—the majority of spacecraft launched into low Earth orbit will not be able to deorbit within 25 years of the end-of-mission. This lack of observance of one of the most fundamental debris mitigation guidelines cannot be allowed to continue. Pressure must be brought to bear on those who fail to comply. International organisations, such as the IADC, ISO and UNCOPUOS are currently the best routes to apply that pressure. However, the UK's expert participation at these forums is now being jeopardized as a result of budgetary constraints within the UK Space Agency.

July 2013

Written evidence submitted by UKspace (ESA007)

UKspace is the trade association of the UK space industry, with a mission to promote the best commercial, political and public environment for the UK space industry. UKspace is sponsored jointly by ADS and Intellect encapsulating both the upstream and downstream nature of the space sector.²

0. SUMMARY

0.1 The UK has a dynamic space industry that has been influenced by successive UK Governments. Britain's investment in European Space Agency (ESA) programmes is a key driver in this success story and continued UK involvement will continue to support the sector's export and growth ambitions.

0.2 The formation of the UK Space Agency (UKSA) has helped to drive a more ambitious, growth-oriented space policy, yet more needs to be done to strengthen the Agency and focus its resources and skills to maximise economic opportunities, including exploiting EU budgets.

0.3 Industry welcomes the arrival of the EU into space policy and, in particular, into operational infrastructure. EU space spend, at around €2 billion per year, represents one of the biggest overseas market opportunities for UK industry, and should be prioritised and resourced by both UKSA and the Catapult accordingly.

0.4 Much progress has been made in recent years to maximise UK value from (and influence in) ESA, through strategic investment in ESA operational programmes and in developing the ESA Harwell facility. However, continued and growing success in Europe requires a significantly larger UK national space programme, as in France and Germany. Industry welcomes the refinancing of the National Space Technology Programme in November 2012, but calls for a step change in funding, supported by a visionary and ambitious National Space Policy, and more aggregated procurement across Whitehall, in Earth Observation and secure satellite communications services.

0.5 Industry urges the EU to avoid imposing modifications on the successful ESA model which has delivered the high level of technical competence and outstanding reputation Europe has built up since 1964. Industry believes that there are and should remain distinct roles for the EU and ESA.

0.6 ESA is membership driven, and not Treaty driven. As such, there exist ample opportunities for the UK Government, as a leading ESA member state, to shape its agenda. In particular, industry welcomes the development of ESA's Harwell facility and its remit focussed on the growth prospects of interest to UK industry. However, the UK could play a more assertive role in ESA itself, for example in pushing for UK Directors at ESA, an issue acknowledged by the Science minister in a recent parliamentary debate.

² www.ukspace.org

1. *What are the strengths and weaknesses of the funding, organisation, and work of the European Space Agency?*

1.1 The UK's thriving space sector contributes £9.1 billion a year to the UK economy and directly employs 28,900, with an average annual growth rate of almost 7.5% over the last decade. This strength has been shaped over time by support from successive UK Governments and in particular through the UK's involvement in ESA.

1.2 ESA has played a crucial role in building a competitive and innovative space industry in Europe. ESA's procurement principles ensure that investment by Member States helps to shape ESA programmes and they ensure that this investment is channelled back proportionately into national priority areas. *Juste retour* has provided a reliable—and accountable—mechanism for guaranteeing return on investment by ESA member states. UKspace wants to see these principles retained. Nevertheless, it should be noted that the UK has won a greater share of EU space research grants and infrastructure and service contracts thus far than it has invested by virtue of its membership of the EU, suggesting that the UK fares well out of both ESA's and the EU's procurement processes.

1.3 At the 2012 ESA Ministerial Council, the UK Government announced investment of £1.2 billion into some of Europe's most significant space projects through the UK Space Agency, a 25% increase in UK investment in ESA. Through leverage effects this should enable £1 billion of private investment into the UK space sector; and help the industry achieve the ambitious goals of growing to a £40 billion industry by 2030 and generating an extra 100,000 jobs.

1.4 ESA has changed considerably over the last decade. ESA has developed world-class skills and competences that must be retained and utilised. It has broadened its horizons from a scientific R&D organisation into one that also has a strong focus on supporting industrial R&D. For example, through its ARTES telecommunications programmes, it is helping industry develop/retain world-leading expertise and service offerings to the large, and growing commercial market. It has also begun to create the space infrastructure for navigation and earth observation that will allow industry to exploit these growing downstream services markets.

1.5 ESA and specifically the European Space Operations Centre in Germany (ESOC), has helped the UK develop European leadership in satellite ground segment and operations at a low cost to the UK (as the return is partially allocated to Germany). The flexibility of the Optional Programmes has allowed the UK to develop leading technologies in the more commercial Space sectors.

1.6 ESA has a long history of managing complex high technology-risk programmes. In most cases these have been successful and delivered on time and to budget. However, the Galileo procurement processes of both the European Commission and ESA proved susceptible to political intervention, leading to cost overruns and delays, underlining the need for strong UK political engagement in both organisations.

2. *In light of the European Commission's recent Communication on relations between ESA and the EU (COM 2012 671), what relationship between ESA, the EU and the UK would provide the most effective governance regime? Why?*

2.1 We welcome the arrival of the EU into space policy. Space is increasingly vital for delivering public policy at local, regional, national and supra-national levels, and has a key role in reaching Lisbon Treaty objectives of a smart, sustainable and inclusive economy by creating high-skilled jobs, commercial opportunities, boosting innovation and improving citizens' well-being and security. For example, Copernicus (formerly GMES) is a vital tool for the EU in environmental protection.

2.2 UKspace recognises the five areas of concern raised by the Commission and in particular acknowledges the need for closer cooperation in order to avoid duplication and to maximise public benefits. We believe that ESA and the EU can work well together, with distinct and complementary roles, with ESA as the design and implementation authority and the Commission as the policy maker helping to define public user requirements and stimulating and funding the operation and exploitation of space infrastructure for the benefit of European economies.

2.3 The EU interest in space is recent and rapidly evolving. The EU and the UK public sector face the same challenge, to become a smart customer and informed user of satellite-enabled services, in areas from precision agriculture to cleaner air, from smarter, safer transport systems to satellite broadband.

2.4 Given ESA's success, industry shares the UK Government's concern about any overly hasty move to bring ESA under the wing of the EU, and supports the Government's cautious approach to moving the two institutions closer together. To align the need for coordination with the importance of maintaining distinct roles, the Commission's proposal for ESA to set up a specific ESA directorate in charge of implementing EU programmes, under EU rules, should be evaluated.

2.5 Industry strongly supports an EU role as space policy lead and sponsor for downstream services dedicated to socio-economic applications. Industry would like to see this EU role, promoting space exploitation, better reflected and co-ordinated in Horizon 2020.

2.6 The Commission pointed to a "democratic deficit" in ESA's accountability. Industry believes ESA offers good accountability to ESA member states, including the ability to target investment against national interests.

2.7 The level of influence that the UK has in ESA is already strong. UK scrutiny could be enhanced further by an annual Parliamentary debate on space policy, as the Committee recommended in its 1999–2000 inquiry, and as the shadow science minister advocated in a recent debate. The UK should be more assertive in its efforts to secure UK nationals in senior positions in ESA, especially among its Directors.

2.8 Overall UK advocacy in EU space areas remains under-resourced and under-structured, partly reflecting the fast evolving nature of the EU's space landscape. Industry is currently reviewing its own representation, as a major strand of the on-going Space Innovation and Growth Strategy, and we encourage UKSA to review and strengthen its own resourcing in relation to EU space matters, including, for instance, promotion of more UK nationals in the EU's growing space policy community.

3. How effective is the EU's support for research and innovation in the space sector? What effect have changes to the Multi-Annual Financial Framework had on ESA and support for the space sector from the Horizon 2020 programme?

3.1 R&D is an important enabler of economic growth and underpins the competitiveness of the space industry. The innovation component of the EU's next seven-year budget is an opportunity to build a platform for growth and competitiveness. Asia, for example, currently reinvests 3.5% of total GDP in R&D, whilst Europe commits just 2%. Placing Horizon 2020 at the centre of Europe's economic plans would send a very clear message that the EU and its Member States are committed to fostering innovation and economic growth.

3.2 The long-term nature of R&D cycles in the space sector means that stable funding is especially important for businesses. EU funding should focus on the very early stages of technology development in order to mitigate the risks for companies, universities and individuals investing in experimental technology and in operationalising new satellite-enabled service capabilities.

3.3 The space sector uses a NASA-based Technology Readiness Level scheme to mark the progress of ongoing research and development. These range from "Basic Technology Research" (TRL1) through to demonstrated, ready-for-market systems (TRL9). As a general principle, research and innovation funding should target projects between TRL1 and TRL6, which for the space sector should extend up to and include in-orbit demonstration and service demonstration for downstream applications. This is where public assistance is most valuable to industry.

3.4 The Commission has promised a "strengthened steering, monitoring and evaluation" of Horizon 2020, with progress tracked through a set of indicators every two years. We recognise the need to ensure coherent implementation across the programme, especially of SME participation and international co-operation, but some of the particular reporting required can necessitate substantial expenditure on auditors. Whilst recognising that expenditure of public money must be properly scrutinised, some of this expenditure could be reduced through simplification of the reimbursement mechanisms and put to better use in the research programmes being undertaken.

3.5 A specific weakness of the EC's FP7 research programme has been lack of funding for satellite communications and satellite navigation applications. DG ENTR's space research programme largely ignores telecommunications, despite the contribution of satellite communications to growth and public policy, eg in the EU Digital Agenda targets for 2020 for deployment of high-speed broadband to all European citizens. Funding for developing satellite navigation applications has also been lacking in recent years, despite the progress made on the launch of the Galileo satellites. It is essential that these omissions are corrected in Horizon 2020.

4. How effective has the UK Space Agency been and what improvements could be made? Is the UK effectively exploiting opportunities for growth in the space sector or could more be done?

4.1 UKspace strongly welcomed the formation of the UK Space Agency and commends the Coalition Government for upholding and advancing the space policy it inherited. The UK now has an executive space agency with its own space budget, rather than the pooled budget of its predecessor. In addition, we welcome:

- the increased recognition of the value of close partnership between government, academia and industry through the Space Leadership Council;
- a National Space Technology Programme to focus on developing important space capabilities; and
- the creation of the Satellite Applications Catapult to work in partnership with industry in facilitating high growth opportunities in satellite-enabled service markets.

4.2 UKSA has been significantly under-resourced, affecting its relationships with industry, and degrading the perceived transparency of its decision-making. Examples are in dealing with EC communications and in producing the promised National Space Policy.

4.3 Despite the UK's policy leadership in promoting a growth agenda in space, the UK is now almost unique amongst spacefaring nations in lacking a resident, full-time economic or analytical capacity, a capacity which could sit within the agency or the Catapult.

4.4 Industry believes that there are a number of improvements that could be made by UKSA. Many of these recommendations are emerging through the current work on the Space Innovation and Growth Strategy, due for publication in the second half of this year. Emerging issues include the need for UKSA to:

- build stronger relationships with key public space stakeholders such as TSB, Research Councils, BIS and “user departments”, to capture the benefits of the old BNSC partnership model (a model which never effectively engaged with user departments), and to improve coherence across UK stakeholders including academia, the Met Office, NERC and especially MOD where there is much scope for dual-use technologies;
- build stronger relationships with EC space policy-makers and programmes in all the many relevant EC departments;
- support the creation of a forum of public users of space enabled services, and service providers, looking towards EURISY’s work across Europe for best practice, and complementing UKSA’s new National Space Applications Programme;
- work closely with the TSB and the Satellite Applications Catapult to focus industry and academia and lead the Harwell Innovation Cluster leveraging on ESA; and
- establish an industrial strategy focused on market growth, to nurture national space supply chains, an issue complicated by ESA’s *juste retour* procurement, but essential for long-term sustainable growth.

4.5 The failure of the UK to achieve any director in ESA, compared with three each for France, Italy and Germany, is a failure of ambition and influence by UKSA.

4.6 UKSA must work closely with industry to ensure that together they are delivering on growth. The current work on the IGS is vital to reach the target 10% share of the global market by 2030. Growth is driven by the downstream services market so we must target key sectors for growth and work with the other Catapults to fully exploit these markets. UKSA can help unlock barriers to market access and help take science and technology into the marketplace.

4.7 Effective ESA and EC engagement requires complementary national funding to create the conditions in which industry can win greater shares of ESA “noble work” and EU funding. This approach is well recognised and practised by our international competitors. Industry therefore welcomes the establishment of the National Space Technology Programme (a key recommendation of the first Space IGS in 2010) and its refinancing in the Autumn Statement of 2012. However, industry considers a stronger NSTP an essential test of UKSA’s commitment to help maximise UK economic return from EU and ESA space spend. This is also key to risk reduction of new commercial initiatives which can then attract City funding.

5. Does the UK get good value for money from its membership of ESA? How does its return on investment compare to other countries?

5.1 The UK has developed world leadership in both space science and in commercial export markets, partly from targeted investment in ESA programmes with proven scientific and economic potential, notably ARTES. However, a better balance between national and ESA investment is essential if the UK is to fully exploit its ESA (and EU) investments.

5.2 ESA is a vital wealth creation mechanism for the UK space-enabled economy, providing an excellent means for UK-based operators to leverage off leading edge UK technologies, enabling UK exports of high value satellite systems and services.

5.3 *Juste retour* allows for targeted investment by Member States. This was reflected at the 2012 ESA Ministerial, with the UK deciding to target investment into key optional programmes based on the economic or science benefits. Industry welcomes the growth focus of the policy agenda which has shaped the successful ESA Ministerial outcome. Industry pointed to prospects for a 6:1 return on targeted investment at C-MIN.

5.4 Investment at the ESA Ministerial has triggered the announcement by ESA that it will bolster its UK presence by transferring its Telecoms and Integrated Applications Directorate to Harwell. Industry strongly welcomes the moves to strengthen the UK voice in ESA. The satellite communications business is Britain’s biggest commercial space success story, supporting over 70% of the industry’s manufacturing workforce. The ESA decision reinforces Britain’s credentials as the best place in Europe to do the business of space.

5.5 Early decisions on investment in ESA programmes helps create a more strategic and long-term UK agenda in ESA; it helps industry plan ahead, develop technology roadmaps and identify export opportunities. It is vital that the UK invest strongly in the early phases of major programmes, in order to get sufficient control to deliver UK technology priorities and maximise growth opportunities.

5.6 UKspace has demonstrated that there are strong commercial spinoff benefits from earth observation, space science and robotic exploration in terms of technologies, and also in terms of software and services to the global Space market.

5.7 The UK has demonstrated that it achieves a better return on investment than other ESA Member States. This is primarily through its highly developed capacity to take ESA developed technology to the commercial

market. It is also strongly influenced by the UK selection of ESA optional programmes that are better aligned to the global marketplace.

6. How resilient is the UK's space-based infrastructure? Are threats from space debris or solar activity being appropriately mitigated? What role do, or should, ESA and the UK Space Agency play in addressing these issues?

6.1 Government understanding of the resilience of the UK's space-based infrastructure is hampered by the absence of a clear definition of who owns it, what risks have been considered or the efficacy of mitigation measures.

6.2 There should be a clear UK owner or overseer of resilience plans for the satellites and ground-based supporting infrastructures that provide critical UK capabilities and a comprehensive analysis of space systems critical to the UK. This should include an analysis of the level of resilience of space-related capabilities or of mitigation measures in the event of disruption.

6.3 CPNI has decided that space is not part of their scope primarily because of the lack of a Lead Government Department for space security. The EC requires the UK to treat the UK Security Monitoring Centre for the Galileo programme as critical national infrastructure.

6.4 There is no resilience apparent in the provision of satellite communications to Government Departments such as the Foreign Office or the Department for International Development and no analysis of whether these links should be resilient and if so, to what degree.

6.5 The threats from natural events in space are well understood and ESA has an on-going programme to provide monitoring and warnings of Space Weather events.

6.6 The loss of space assets has a similar impact whether from natural events or deliberate actions. The focus must be on things we can control—impact mitigation within the national infrastructure. Government should:

- Publish a National Space Security Policy identifying the lead Government department for space security policies;
- Ensure the Cabinet Office oversees a thorough analysis of the UK's reliance on national and international space-related capabilities;
- Determine UK critical space-based dependencies;
- Determine the degree of resilience of these critical dependencies, the resilience required and the mitigation measures to reach an acceptable level of resilience with common shared "best practice" and clear centres for expertise;
- Develop and circulate a space infrastructure resilience policy.

April 2013

Written evidence submitted by the Royal Astronomical Society (RAS) (ESA011)

DECLARATION OF INTERESTS

This is the official submission from the Royal Astronomical Society to the Select Committee inquiry into the European and UK Space Agencies. The Society itself has no financial relationship with either the European Space Agency or the UK Space Agency. Many of our Fellows however are either employed by these organisations, receive grant funding from them or are involved with them in advisory roles.

INTRODUCTION

1. With more than 3,700 members (fellows), the Royal Astronomical Society is the UK body representing professional astronomers, space scientists and geophysicists. As such we are pleased to respond to this inquiry, as the concerns raised are of direct relevance to all of these communities.

EXECUTIVE SUMMARY

2. The RAS submission includes the following points:

- The European Space Agency (ESA) has enabled European space scientists to carry out work at the same level as their peers in the United States and elsewhere in the world.
- We welcome the involvement in and interest of the EU in space policy. That involvement however should acknowledge the interests of the ESA member states that are not members of and are unlikely to join the EU in the foreseeable future.
- The formation of the UK Space Agency was an important and positive step and welcomed by the space science and astronomy communities.

- Research scientists nonetheless remain concerned that instruments and space missions developed by the UK Space Agency may not be fully exploited, a consequence of resource constraints in the research councils and the Agency itself.
- The explicit reference to space activity and support for scientific research in the Horizon 2020 programme is welcome, but this is not straightforwardly compatible with ESA.
- UK involvement in the ESA Space Situational Awareness (SSA) programme allows British scientists to be part of the effort to protect space (and some ground) based infrastructure from the impact of severe space weather.

What are the strengths and weaknesses of the funding, organisation, and work of the European Space Agency?

3. Since its formation in 1975, the European Space Agency (ESA) has enabled scientists from its member states to develop and exploit the results of world-class scientific missions. ESA missions have covered planetary exploration (from the Giotto mission to Halley's Comet in 1986 to forthcoming spacecraft to Mars and Mercury); observation of the Sun (SOHO, jointly with NASA) and the wider Universe (good examples being the infrared Herschel telescope and Planck satellite). Its satellites have also played and continue to play a key role in Earth observation (including the ice monitoring satellite Cryosat and the SWARM satellite that will study the terrestrial magnetosphere) and have given us a real insight into the processes that shape our planet.

4. ESA appears to be largely effective as an organisation, in that with a total budget of €4.3 billion, less than one third that of NASA, it has delivered world-class space missions for scientific and civil applications. In 2011, the ESA allocation for science was €465 million, whilst €129.4 million was set aside for robotic exploration, €844 million for Earth observation and €410.9 million for human spaceflight. The largely efficient use of these resources has allowed Europe to take the lead in a number of areas, for example in the ESA Euclid mission to explore dark energy, where NASA cancelled its proposed equivalent project but later elected to support the European spacecraft.

5. Unlike bilateral arrangements between states, ESA has no dominant partner and member states are free to opt in (or not) to the majority of programmes. This lets the UK focus its investment on national priorities and then exert influence in those areas.

6. ESA, unlike NASA, has the capability to take longer term financial decisions. UK space scientists see this continuity as being of vital importance for a sector where projects can easily last 20 years from inception to end of operations.

7. The weaknesses that the scientific community perceive in ESA are often a result of funding restrictions that in turn limit the scientific programme. A recent example is the selection of the L1 (large) class mission, where the JUICE probe to Jupiter was selected in competition with the gravitational wave observatory NGO and the X-ray observatory ATHENA. The three proposals related to very different areas of science and yet were tensioned against each other, inevitably leading to some controversy around the final decision.

8. One area that may not be as efficient is the requirement to use ESA facilities to do work such as the processing of data from ESA missions. An example cited by geophysicists is the SWARM mission, where the projected cost is €100 million, a figure that compares unfavourably with other projects. ESA expect member states to find the resources for this work but at least in the UK this is proving difficult to deliver.

9. In the overall context of the inquiry, MPs may also wish to consider the ambitions for space exploration set out in the 2007 Global Exploration Strategy and the 2011 Global Exploration roadmap.³ Both of these policy documents are products of discussions between space organisations from around the world, including ESA and the UK Space Agency.

In light of the European Commission's recent Communication on relations between the ESA and EU (COM 2012 671), what relationship between ESA, the EU and the UK would provide the most effective governance regime? Why?

10. The Communication sets out areas where oversight is poorly aligned, from the differing memberships of the EU and ESA to the ways in which the two organisations are politically accountable. The two full member states of ESA outside of the EU are Norway and Switzerland, neither of which seem likely to accede to EU membership in the near future and the same applies to Canada, the main associate ESA member.

11. Over the 40 years of its existence ESA has been accountable to its member states through its governing Council. That relationship makes it responsive to national interests. With the increase in EU funding of ESA and the importance of the Horizon 2020 programme, there is a case for an enhanced EU governance role, but this should not be at the expense of the interest of the non-EU member states.

³ http://esamultimedia.esa.int/docs/GES_Framework_final.pdf and
http://www.nasa.gov/pdf/591067main_GER_2011_small_single.pdf

How effective is the EU's support for research and innovation in the space sector? What effect have changes to the Multi-Annual Financial Framework had on ESA and support for the space sector from the Horizon 2020 programme?

12. The sheer size of the Horizon 2020 programme (with an agreed budget of almost €70 billion) and the explicit reference to space activity within it represent a major EU commitment to the space sector, as does the contribution of 20% of the ESA budget.

13. As well as funding research, the existing Framework 7 Programme has supported work such as the Europlanet initiative, which brings together more than 100 institutes engaged in Solar system science.⁴

14. The different aspects of Framework Programmes are however not always aligned with the strategies of the scientific and engineering communities, such as the space exploration aspects of the ASTRONET roadmap.⁵

15. Perhaps as a consequence of its administration by the DG Enterprise and Industry rather than the DG Research and Innovation branch of the European Commission, Framework Programme funding also places demands on scientists to acquire two industrial partners. For blue skies projects, this can be a challenge and it sits uneasily alongside the ESA model.

How effective has the UK Space Agency been and what improvements could be made? Is the UK effectively exploiting opportunities for growth in the space sector or could more be done?

16. In the 2007 Committee inquiry into Space Policy, the RAS argued strongly for the creation of a space agency in the UK. We therefore welcomed the formation of the UK Space Agency and continue to see this as a positive step for space science.

17. The 30% increase in the UK contribution to ESA agreed in the 2012 Ministerial Council was a welcome development for space science and demonstrated the renewed commitment to the UK Space Agency. This uplift has also helped to increase UK influence on ESA strategy to a level comparable with other major industrialised nations such as France and Germany.

18. At the time of its establishment the way in which the Agency and the research councils relevant to RAS interests (ie STFC and NERC) would work together were not clear. The implementation of the so-called "dual key" approach, whereby the Space Agency supports the development of scientific missions and the research councils support the exploitation of mission data, is still a matter of concern for some members of the scientific community, particularly in geophysics.

19. These researchers are critical of that relationship, where they are asked to find funding for exploitation from the normal research council grants programme. Taking the example of the SWARM mission, scientists are struggling to become involved with the early processing of data from the spacecraft, meaning that the UK misses out on this aspect of "georeturn" (see the next section). The capital investment in mission development through the UK Space Agency is then not necessarily being realised in access to its scientific output. Rather than being a matter of process, this seems to reflect constrained resources in both the Space Agency and the research councils.

Does the UK get good value for money from its membership of ESA? How does its return on investment compare to other countries?

20. Solely on the basis of the "georeturn" rule, which aims to apportion the value of industrial contracts in each ESA member state in proportion to the contributions of their governments, UK membership is good value for money. According to the UK Space Agency, georeturn stood at 0.99 in 2012 (ie contract values were 99% of the funds available for this purpose), above the target of 0.96 set for 2014. There are some countries which do better than this, notably the Netherlands with a georeturn value of 1.10, but on the whole the UK georeturn is as expected. There is also significant variation between programmes, with the UK receiving a return as low as 0.34 from activities at the Guyana Space Centre and as high as 3.34 for launchers. The UK also has some industrial contracts in areas where it does not make a direct public contribution.⁶

21. Alongside the simple financial return from the subscription is the opportunity for British scientists and engineers to take part in projects that the UK could not support alone. Until recently the UK made one of the smallest contributions to ESA relative to GDP and yet British scientists have been involved in many flagship missions, a clear demonstration that our investment represents excellent value for money.

22. The scientific aspect of this investment has also delivered serendipitous returns to the economy and wider society, with technology spin-offs in a diversity of areas from security and oil exploration to car disc brakes. Space and astronomy are also widely recognised as "STEM attractors" that encourage the study of and pursuit of careers in science, technology, engineering and medicine.

⁴ <http://www.europlanet-eu.org/>

⁵ http://www.astronet-eu.org/IMG/pdf/Astronet-Brochure_light.pdf

⁶ European Space Agency: Industrial Policy Committee: Geographical distribution of contracts (4 March 2013)

How resilient is the UK's space-based infrastructure? Are threats from space debris or solar activity being appropriately mitigated? What role do, or should, ESA and the UK Space Agency play in addressing these issues?

23. The RAS highlighted the threat of severe space weather to UK space-based and ground-based infrastructures in our contribution to the 2010 Science and Technology Select Committee report on Scientific Advice and Evidence in Emergencies. This was recognised through its inclusion in the 2012 National Risk Register.

24. This assessment was reinforced in the severe space weather report published by the Royal Academy of Engineering in February 2013.⁷ This report was the outcome of a year's study by a team of UK experts, both engineers and scientists, and including several RAS Fellows. Their report noted that, whilst our space infrastructure is built and operated to high standards, it would be at risk during a severe space weather event such as those observed in 1859 and 1956,⁸ but not experienced by our planet in recent decades. Such events can produce conditions that exceed the specifications normally used to design spacecraft.

25. Thus there is a need for research to better understand the scale and frequency of severe space weather events, so that satellite designs and operating procedures can be fully prepared for these rare but extreme events. In dealing with such extremes (whether space weather or other natural hazards) it is vital to exploit the long-term view and insight that research can provide. That view transcends individual and organisational memory and can significantly improve resilience against natural hazards.

26. Severe space weather falls firmly in this frame as shown by the recommendations of the Royal Academy for a range of research activities, including better measurements of space weather conditions on the Sun, in interplanetary space and at the Earth, and better modelling of those conditions in order to improve our forecasting capabilities.

27. This is where the role of ESA and the UK Space Agency are crucial. The Agency's recent decision to participate in the ESA space situational awareness (SSA) programme is opening up new opportunities for British scientists to develop space weather services and technologies, exploiting our world-leading skills in space-based and ground-based measurements of space weather conditions and in physics-based models of space weather phenomena.

28. The UK is making the second biggest financial contribution to the SSA programme, so we have the opportunity to influence the programme so that it meets the national needs being identified as part of Government preparation for a space weather emergency and that it supports the research activities of the UK space weather community. The engagement of the UK Space Agency with the ESA SSA programme is a good step forward. It should enable the UK expert community to play a major role in developing space weather services that address national, European and global needs.

April 2013

Written evidence submitted by Telespazio VEGA (ESA014)

0. SUMMARY

0.1 The UK has a dynamic space industry that has been influenced by successive UK Governments. Britain's investment in European Space Agency (ESA) programmes is a key driver in this success story and continued UK involvement will continue to support the sector's export and growth ambitions.

0.2 The formation of the UK Space Agency (UKSA) has helped to drive a more ambitious, growth-oriented space policy, yet more needs to be done to strengthen the Agency and focus its resources and skills to maximise economic opportunities, including exploiting EU budgets and stronger support to the export market.

0.3 Much progress has been made in recent years to maximise UK value from (and influence in) ESA, through strategic investment in ESA operational programmes and in developing the ESA Harwell facility. However, continued and growing success in Europe requires a significantly larger UK national space programme, as in France, Germany and Italy.

0.4 We believe that the UKSA should play a more assertive role in ESA itself, for example in pushing for UK Directors at ESA, and stronger influence on the key decisions made by the Programme Boards.

0.5 Telespazio VEGA played a leading role in producing the UKspace Trade Association input and fully endorses its key messages.

⁷ Space weather: impacts on engineered systems, infrastructure and society, <http://tinyurl.com/burj2xy>

⁸ These events are well-documented in the scientific literature through the efforts of RAS Fellows and other scientists working at the time of those events.

1. What are the strengths and weaknesses of the funding, organisation, and work of the European Space Agency?

1.1 ESA has played a crucial role in building a competitive and innovative space industry in Europe. ESA's procurement principles ensure that investment by Member States helps to shape ESA programmes and they ensure that this investment is channelled back proportionately into national priority areas. *Juste retour* has provided a reliable—and accountable—mechanism for guaranteeing return on investment by ESA member states. We want to see these principles retained. Nevertheless, it should be noted that the UK has won a greater share of EU space research grants and infrastructure and service contracts thus far than it has invested by virtue of its membership of the EU, suggesting that the UK fares well out of both ESA's and the EU's procurement processes.

1.2 ESA has changed considerably over the last decade. ESA has developed world-class skills and competences that must be retained and utilised. It has broadened its horizons from a scientific R&D organisation into one that also has a strong focus on supporting industry. Especially through its ARTES telecommunications programmes, it is helping industry develop/retain world-leading expertise and service offerings to the large, and growing commercial market. It has also begun to create the space infrastructure for navigation and earth observation that will allow industry to exploit these growing downstream services markets.

1.3 For multinationals such as the Telespazio Group, ESA has had a fundamental role in developing competence, competitiveness and trans-national supply chains. This has allowed an overlap of technologies which helps provide core capabilities required on the different National Programmes.

1.4 ESA and specifically the European Space Operations Centre in Germany (ESOC), has helped the UK develop European leadership in satellite ground segment and operations at a low cost to the UK (as the return is partially allocated to Germany).

1.5 The flexibility of the Optional Programmes has allowed the UK to develop leading technologies in the more commercial Space sectors by targeting its investment in ESA in the most appropriate Programmes.

1.6 ESA has a long history of managing complex high technology-risk programmes. In most cases these have been successful and delivered on time and to budget. However, the Galileo procurement processes of both the European Commission and ESA proved susceptible to political intervention, leading to cost overruns and delays, underlining the need for strong UK political engagement in both organisations.

2. In light of the European Commission's recent Communication on relations between ESA and the EU (COM 2012 671), what relationship between ESA, the EU and the UK would provide the most effective governance regime? Why?

2.1 We welcome the arrival of the EU into space policy. Space is increasingly vital for delivering public policy at local, regional, national and supra-national levels, and has a key role in reaching Lisbon Treaty objectives of a smart, sustainable and inclusive economy by creating high-skilled jobs, commercial opportunities, boosting innovation and improving citizens' well-being and security. For example, Copernicus (formerly GMES) is a vital tool for the EU in environmental protection.

2.2 Given ESA's success, we share the UK Government's concern about any overly hasty move to bring ESA under the wing of the EU, and support the Government's cautious approach to moving the two institutions closer together. To align the need for coordination with the importance of maintaining distinct roles, the Commission's proposal for ESA to set up a specific ESA directorate in charge of implementing EU programmes, under EU rules, should be evaluated.

2.3 We strongly support an EU role as space policy lead and sponsor for downstream services dedicated to socio-economic applications. We would like to see this EU role, promoting space exploitation, better reflected and co-ordinated in Horizon 2020.

2.4 Overall UK advocacy in EU space areas remains under-resourced and under-structured, partly reflecting the fast evolving nature of the EU's space landscape. We encourage UKSA to review and strengthen its own resourcing in relation to EU space matters, including, for instance, promotion of more UK nationals in the EU's growing space policy community.

3. How effective is the EU's support for research and innovation in the space sector? What effect have changes to the Multi-Annual Financial Framework had on ESA and support for the space sector from the Horizon 2020 programme?

3.1 R&D is an important enabler of economic growth and underpins the competitiveness of the space industry. The innovation component of the EU's next seven-year budget is an opportunity to build a platform for growth and competitiveness. Asia, for example, currently reinvests 3.5% of total GDP in R&D, whilst Europe commits just 2%. Placing Horizon 2020 at the centre of Europe's economic plans would send a very clear message that the EU and its Member States are committed to fostering innovation and economic growth.

3.2 The long-term nature of R&D cycles in the space sector means that stable funding is especially important for businesses. EU funding should focus on the very early stages of technology development in order to

mitigate the risks for companies, universities and individuals investing in experimental technology and in proving the feasibility of new satellite-enabled service capabilities.

3.3 A specific weakness of the EC's FP7 research programme has been lack of funding for satellite communications and satellite navigation applications. DG ENTR's space research programme largely ignores telecommunications, despite the contribution of satellite communications to growth and public policy, eg in the EU Digital Agenda targets for 2020 for deployment of high-speed broadband to all European citizens. Funding for developing satellite navigation applications has also been lacking in recent years, despite the progress made on the launch of the Galileo satellites. It is essential that these omissions are corrected in Horizon 2020.

4. *How effective has the UK Space Agency been and what improvements could be made? Is the UK effectively exploiting opportunities for growth in the space sector or could more be done?*

4.1 UKSA has been significantly under-resourced, affecting its relationships with industry, and degrading the perceived transparency of its decision-making. Examples are in dealing with EC communications and in producing the promised National Space Policy.

4.2 We believe that there are a number of improvements that could be made by UKSA. These include the need for UKSA to:

- build stronger relationships with key public space stakeholders such as TSB, Research Councils, BIS and "user departments", and to improve coherence across UK stakeholders including academia, the Met Office, NERC and especially MOD where there is much scope for dual-use technologies;
- build stronger relationships with EC space policy-makers and programmes;
- support the creation of a forum of public users of space enabled services, and service providers, looking towards EURISY's work across Europe for best practice, and complementing UKSA's new National Space Applications Programme;
- work closely with the TSB and the Satellite Applications Catapult to focus industry and academia and lead the Harwell Innovation Cluster leveraging on ESA;
- concentrate on better Outreach and Education to bring young people into Space and to ensure that we have the skills to build the academic and industrial base we need; and
- establish an industrial strategy focused on market growth, to nurture national space supply chains, an issue complicated by ESA's *juste retour* procurement, but essential for long-term sustainable growth.

4.3 The failure of the UK to achieve any director in ESA, compared with three each for France, Italy and Germany, is a failure of ambition and influence by UKSA.

4.4 On the European front to maintain momentum with ESA the UKSA must influence their Programmes to meet UK policy objectives. They must try to optimise the return from our ESA subscriptions in terms of noble work which is focused on technologies with real market potential wherever possible.

4.5 UKSA must work closely with industry to ensure that together we are delivering on growth. The current work on the IGS is vital to reach the target 10% share of the global market by 2030. Growth is driven by the downstream services market so we must target key sectors for growth and work with the other Catapults to fully exploit these markets. Working in partnership with other government departments the UKSA can work pro-actively to unlock barriers to market, support access to export markets and thus take science and technology into the global marketplace.

4.6 Effective ESA and EC engagement requires complementary national funding to create the conditions in which industry can win greater shares of ESA noble work and EU funding. This approach is well recognised and practised by our international competitors. We therefore welcome the establishment of the National Space Technology Programme (a key recommendation of the first Space IGS in 2010) and its refinancing in the Autumn Statement of 2012. However, a stronger NSTP is an essential test of UKSA's commitment to help maximise UK economic return from EU and ESA space spend. This is also key to risk reduction of new commercial initiatives which can then attract City funding.

5. *Does the UK get good value for money from its membership of ESA? How does its return on investment compare to other countries?*

5.1 The UK has developed world leadership in both space science and in commercial export markets, partly from targeted investment in ESA programmes with proven scientific and economic potential, notably ARTES. However, a better balance between national and ESA investment is essential if the UK is to fully exploit its ESA (and EU) investments.

5.2 ESA is a vital wealth creation mechanism for the UK space-enabled economy, providing an excellent means for UK-based operators to leverage off leading edge UK technologies, enabling UK exports of high value satellite systems and services.

5.3 Early decisions on investment in ESA programmes helps create a more strategic and long-term UK agenda in ESA; it helps industry plan ahead, develop technology roadmaps and identify export opportunities. It is vital that the UK invest strongly in the early phases of major programmes, in order to get sufficient control to deliver UK technology priorities and maximise growth opportunities.

5.4 Industry has demonstrated that there are strong commercial spinoff benefits from earth observation, space science and robotic exploration in terms of technologies, and also in terms of software and services to the global Space market.

5.5 The UK has demonstrated that it achieves a better return on investment than other ESA Member States. This is primarily through its highly developed capacity to take ESA developed technology to the commercial market. It is also strongly influenced by the UK selection of ESA optional programmes that are better aligned to the global marketplace.

6. How resilient is the UK's space-based infrastructure? Are threats from space debris or solar activity being appropriately mitigated? What role do, or should, ESA and the UK Space Agency play in addressing these issues?

6.1 There should be a clear UK owner or overseer of resilience plans for the satellites and ground-based supporting infrastructures that provide critical UK capabilities and a comprehensive analysis of space systems critical to the UK. This should include an analysis of the level of resilience of space-related capabilities or of mitigation measures in the event of disruption.

6.2 The threats from natural events in space are well understood and ESA has an on-going programme to provide monitoring and warnings of Space Weather events.

6.3. Due to the sensitivities associated with Space Debris and the associated tracking of objects in earth orbit, the UKSA should look to other European nations such as Germany and France to develop ground based national systems to protect critical national space assets outside of ESA programmes.

April 2013

Written evidence submitted by the Director General of the European Space Agency (ESA016)

1. What are the strengths and weaknesses of the funding, organisation, and work of the European Space Agency?

History and status

1.1 The European Space Agency is an intergovernmental organisation. With its predecessors, in which the United Kingdom was a founding Member State, it has almost 50 years of experience. The Agency has grown from 10 Member States in 1975 to currently 20 Member States, of which 18 (the exceptions being Switzerland and Norway) are also Member States of the European Union. Between them, those 18 account for 98% of the EU's GNP. The Agency operates under the Convention which was opened for signature in 1975.

1.2 ESA has cooperation agreements with all current EU Member States not members of ESA, except for Bulgaria, with whom negotiations are in progress. Canada has a long-standing Cooperation Agreement and takes part in several ESA programmes.

Resources and instruments

1.3 The budget for ESA programmes in 2013 is €3.4 billion; programmes managed for other European institutional partners will amount to an additional €0.8 billion. Total expenditure will therefore be €4.2 billion. Appendix 1 shows a breakdown of programme income and institutional partner income according to the source.

1.4 The Agency's programmes are funded in two main ways. Mandatory activities (15%) are funded by all Member States at GNP level. The budgets for Mandatory activities are determined by a decision taken every three to five years on the Level of Resources. This provides a degree of medium term planning and allows decisions to be taken on missions within the Science Programme to allow for a suitable mix of cornerstone missions and those of a more moderate size. This also provides reassurance to all sub-sectors in the scientific community that their needs will be catered for in the programme.

1.5 Optional programmes (85%) are funded on a voluntary basis, programme per programme (currently around 60 different programmes), according to the interest of the Member States (the number of participating States in a programme ranges from one to 20). This system provides substantial flexibility, both in devising programmes and in allowing each Member State to set its own priorities. For example, the UK has historically chosen to focus its investment in primarily in commercial and scientific satellite development. Programme decisions are taken only by the Participating States and Council decided recently to introduce weighted voting according to the level of contribution, for certain types of decision.

1.6 For Optional activities, a financial envelope is agreed at the time of subscription. This commits Participating States to complete the programme, subject to costs remaining within the envelope plus a contingency margin. With some satellite developments taking a decade, followed by an exploitation period of similar duration, such commitments are essential. The Optional programmes also ensure that, from the Member State point of view, the Agency focuses carefully on devising attractive programmes that fully meet Member State needs.

1.7 In the area of telecommunications, almost all programmes now entail partnerships with industry and/or satellite operators, under which Participating States fund and bear the risks of technology development and the operator takes the risk to use these new technologies to open new markets. The complexity which this adds to the programme is more than offset by both the additional resources brought by the third party and the strong commercial focus. In addition, the involvement of an operator in a successful R&D mission provides a strong opportunity for the manufacturing to build a lasting supplier-customer relationship. UK companies such as Astrium, Avanti and Inmarsat have already participated in such public-private partnerships—Hylas launched in 2011 and Alphasat which will be launched in July this year.

1.8 A unique aspect of ESA, and the bedrock of the achievements described later in this evidence, is that Article VII of its Convention requires that it should elaborate and apply an industrial policy designed in particular to:

- “(a) meet the requirements of the European space programme and the coordinated national space programmes in a **cost-effective** manner;
- (b) improve the **world-wide competitiveness** of European industry by maintaining and developing space technology and by encouraging the rationalisation and development of an industrial structure appropriate to market requirements, making use in the first place of the existing industrial potential of all Member States;
- (c) ensure that all **Member States participate in an equitable manner**, having regard to their financial contribution, in implementing the European space programme and in the associated development of space technology; in particular the Agency shall, for the execution of its programmes, grant preference to the fullest extent possible to industry in all Member States (...); and
- (d) exploit the advantages of **free competitive bidding** in all cases, except where this would be incompatible with other defined objectives of industrial policy.”

Organisation and centres

1.9 ESA's technical centres contain expertise which aims to be world leading in their field and is recognised as such. This expertise provides the management capability to support industry in delivering scientific satellites of unparalleled complexity and commercial satellites capable of competing in world markets. ESA is an R&D programme management organisation first and foremost, where most international organisations are administrative by nature. Information on ESA's sites, including Harwell, is given in Appendix 2.

Achievements

1.10 The Agency's achievements derive from its strengths. ESA has designed, tested, launched and operated over 70 satellites. It currently has 17 scientific satellites in operation. Slides 2 and 3 in Appendix 1 show recent examples of the impact which the results of these satellites can have in the general media, worldwide; their impacts in scientific media are too numerous to list.⁹

1.11 Through ESA, the Member States have created and maintained a highly competitive industrial sector. The share of commercial sales and exports in the European total space manufacturing turnover has grown from 28% in 1991 to 45% in 2010. ESA has been responsible for the development of the Ariane 1, Ariane 2/3, Ariane 4, Ariane 5 and Vega launchers. The Ariane family celebrated their 200th launch in February 2011 and are the world reference, taking some 50% of the available global market for commercial satellite launches.

1.12 Europe's share in the worldwide commercial telecom market has grown in the past decade from 19% to 33%. In the geostationary satellite market, Europe has improved its worldwide market share: in satellite platforms from 20% in the 1992–2001 period to 28% in the 2002–11 period; in payloads from 22% to 32% for the same periods. All non-geostationary communication satellite constellations (Iridium NEXT, O3b Networks and Globalstar 2nd Generation) have been captured by European industry which will deliver most of the associated equipment value (2/3 on Globalstar 2, more than 50% on Iridium NEXT). The global satellite industry itself posted average annual growth of 9 % for the period 2006 through 2011, and despite the financial crisis a growth of 5% in both 2010 and 2011.

1.13 Every billion US \$ spent in by the US government gives rise to about 1.5 tonnes of institutional satellites in space and 1.25 tonnes of commercial satellites manufactured in the US. For Europe (ie ESA, EU and national programme expenditure) the corresponding figures are 3.5 tonnes and 4 tonnes respectively.

⁹ Appendix 1 not printed.

Relative weaknesses

1.14 The ESA Council at Ministerial Level meets only when required, normally every three to four years. Their discussions focus on major policy changes within the Agency and major new programmes. Member States are in most cases represented by the minister responsible for research. In the past, this restricted the Agency's ability to embed space systems into the development and delivery of European and national policies which would benefit from utilising space and to influence the development of policies which affect the sector, such as international trade policy and frequency allocation.

1.15 In contrast, the EU addresses a wide range of issues through its Councils, which generally meet several times per year, allowing political momentum to be built. From the mid-1990s onwards, the Agency has therefore sought to cooperate with the EU at all levels. This cooperation has borne fruit in many areas, the most prominent of which are the joint developments in the areas of Global Navigation Satellite Systems—Galileo and EGNOS—and Earth monitoring—GMES/Copernicus, and the decisions of the EU to fund these as operational systems.

2. *In light of the European Commission's recent Communication on relations between ESA and the EU (COM 2012 671), what relationship between ESA, the EU and the UK would provide the most effective governance regime? Why?*

2.1 As noted above, the relationship between the EU and ESA has grown substantially during the past decades, based on a symbiotic relationship between ESA's technical and managerial capacities and the EU's political strengths and requirements for space infrastructure to meet its needs for space services. At a political level, a turning point can be traced back to the "common resolution," similarly worded resolutions passed in both Councils in 1998, initiated by the UK EU Presidency. This was followed up in 2000 by a further common resolution on a European Space Strategy, when the EU Research Council and the ESA Council at Ministerial Level met together in Brussels, under the chairmanship of the UK, chairing the ESA, and France, chairing the EU.

2.2 The first significant cooperation at a programmatic level was in the area of navigation, with EGNOS followed by the Galileo In-Orbit Validation Programme. The latter was approved in the EU Transport Council, signalling the success in convincing ministers of the value of space beyond ESA's research constituency.

2.3 A broader context was given to the cooperation through the Framework Agreement between the EU and ESA, which came into force in May 2004 and has twice been extended, most recently to 2016. Among other things, that Agreement has given rise to the European Space Policy and to political orientations and resolutions in the eight meetings of the Space Council to date.

2.4 However, there has been a marked change in the partnership since the Treaty on the Functioning of the European Union came into force in December 2009. The EU's space-related activities over the next seven year Multiannual Financial Framework period will substantially be determined by the regulations proposed by the European Commission on the Global Navigation Satellite System, Horizon 2020 and (one anticipates) Copernicus. These regulations will also determine ESA's role in these EU programmes, working with a delegation on navigation and in a co-operation for Copernicus. Both Galileo and Copernicus now move into the exploitation phase and the funds available for space science and technology under Horizon 2020, as compared to those available in the Seventh Framework Programme, are substantially increased, emphasising the need for effective coordination.

2.5 Accordingly, the ESA DG proposed to the ESA Council at Ministerial Level to institute a process to determine the evolution of ESA, reflecting the overall evolution of European governance and aiming at making ESA the space agency that best serves Europe. This process would be aimed at increasing the value of ESA for its Member States and Europe. He saw the core elements of this evolution, based on partnerships, as: an appropriate relationship with the EU and its institutions; a growing number of Member States in ESA; a need to take into account the interests of larger and smaller contributors; and a revised relationship with the increasingly mature industrial space sector.

2.6 The ministers accepted this proposal and at their meeting in Naples, Italy on 21 November 2012 approved the political declaration 'Towards the European Space Agency that Best Serves Europe'. In this they:

"[REQUESTED] this further evolution of ESA to take full benefit of and encompass:

- (i) ESA's capabilities and achievements based on an intergovernmental framework offering to its Member States an efficient framework of cooperation for implementing their competence in space in pooling their objectives and resources; and
- (ii) the EU competence in space, in accommodating the consequences in ESA's operation and thus providing efficient programme management of EU funded programmes under EU rules;

with the objective of providing the most appropriate framework in which to develop the space capabilities and resources at European level for Research and Development."

The Council also:

"[MANDATED] in view of preparing the decisions to be taken by ESA Member States on the further evolution of ESA:

- the Director General to work with the European Commission in order to provide a common analysis on the situation of the European space sector and a common vision on its evolution aiming at building up coherence, convergence and complementarity among the different actors;
- the Director General to elaborate and assess, in consultation with the ESA Council, the different scenarios for ESA to respond to the objectives defined in this Resolution; and
- the Co-Chairs of the ESA Council at ministerial level to provide the Director General with the political guidelines for this reflection, in close consultation with the Ministers of Member States and coordination with the EU."

2.7 In parallel to the preparation of the ESA Ministerial Council, the European Commission prepared a communication on 'Establishing appropriate relations between the EU and the European Space Agency' in which it set out its proposals for analysing possible scenarios for this relationship and doing this in close cooperation with ESA. More recently, the European Commission released a communication on EU Space Industrial Policy. An effective industrial policy is clearly important to the space sector; it is closely linked to both the funding sources and to the evolution of the relationship between ESA and the EU.

2.8 This process of evaluating scenarios is ongoing with the objective of enabling the ESA DG to bring forward proposals to the next meeting of the ESA Council at Ministerial Level, expected to take place in 2014. Such proposals would be discussed with the Member States Delegations during the six to eight months of preparations for that Council meeting. The optimum scenario would be one which most effectively maintains the strengths of the ESA system while significantly improving the efficiency of its relationship with the EU. The options being studied will be measured against this goal.

3. How effective is the EU's support for research and innovation in the space sector? What effect have changes to the Multi-Annual Financial Framework had on ESA and support for the space sector from the Horizon 2020 programme?

3.1 The EU Multiannual Financial Framework and the proposed EU Horizon 2020 programme have not yet completed the approval processes in the Council and the Parliament of the EU and thus have not yet been brought into force. Nevertheless, the Select Committee is addressing one of the most difficult issues faced by ESA and the EU: how to achieve complementarity between the content of the two European level technology programmes, while respecting the decision making processes in each organisation and capitalising on the strengths of each. The ESA DG and his directors are engaged in detailed discussions with the European Commission on this and the ESA DG will start by assessing the lessons learned from past cooperation under the Seventh Framework Programme.

4. How effective has the UK Space Agency been and what improvements could be made? Is the UK effectively exploiting opportunities for growth in the space sector or could more be done?

4.1 As a matter of principle, the ESA DG does not comment on the actions or performance of one of ESA's Member States.

5. Does the UK get good value for money from its membership of ESA? How does its return on investment compare to other countries?

5.1 Space is an investment designed to achieve many different benefits, over many timescales. Return on investment can take the form of immediate contracts, the development of an industrial capability able to secure commercial sales, the growth of a services sector in satellite applications and value-added services and the strengthening of a nation's scientific base. Measuring all of these benefits and relating them back to the original investment in an intellectually coherent way is a challenge faced by all nations which invest in space.

5.2 ESA and its Member States take many actions specifically designed to maximise the potential for economic return, most notably the PPPs described above. A recent addition to these has been to introduce a number of Business Incubation Centres designed to bridge the gap between an idea and getting a technology transfer project off the ground, and assisting its development into a viable business. One such centre is being established in Harwell, managed by STFC Innovations Limited.

5.3 The Agency pursues an industrial policy whose goals are set out in the response to question 1 above. One facet of this is that the contracts secured by the industries in each Member State should be proportionate to that Member State's contributions, after taking account of the internal costs of the Agency and taking into account weighting factors relating to the technological content of the work concerned. This is expressed as a return coefficient where the ideal is a return of 1.

5.4 However, the majority of ESA's programme contracts are awarded in competition, or as follow-on contracts to earlier work assigned after competition. Competition is designed to ensure value for money, world

class scientific missions, efficient satellite-based services and, through the engagement of PPPs, effective global competitors in Europe.

5.5 Where, as result of competition alone, the performance of the industries of a Member State falls below a certain minimum, that Member State is entitled to special measures designed both to improve the short term statistical return and the long term ability of its industries to compete. The statistics on which the return coefficients are based are also discontinued periodically. The statistics are planned to be discontinued at the end of 2014, when the UK's return is forecast to be within the acceptable range, as it was when the statistics were last discontinued in 1999.

6. How resilient is the UK's space-based infrastructure? Are threats from space debris or solar activity being appropriately mitigated? What role do, or should, ESA and the UK Space Agency play in addressing these issues?

6.1 In 2008, ESA Member States began the Space Situational Awareness Programme, in which the UK is one of the Participating States. Under "Space Situational Awareness" are gathered the activities aimed at protecting ground and space infrastructure from the potential threats from space:

- Cosmic radiations that can influence the functioning and the reliability of space and ground systems and services and endanger property or human health, collectively known as Space Weather.
- Near Earth Objects which can potentially impact the Earth and, depending on their size and hitting point, produce considerable damage.
- Space Debris that pose the threat of collisions with active spacecraft, including potentially catastrophic collisions, and which can be monitored through Surveillance and Tracking (SST) activities.

6.2 Space debris is considered to consist of a wide range of man-made objects (decommissioned satellites, spent upper stages, launch adaptors, lens covers, fragment generated from explosions or collisions in orbit dust from solid rocket motors firings, droplets of coolant liquids...). For example, on 22 February 2012, a tank of an Ariane launcher hit the ground in Brazil. According to the analysis made by the ESA Debris Office, this debris related to a launch of an Ariane 4 that took place in 1997. There are some 120 upper stages in orbit, some 20 of them will re-enter Earth in the next 10 years. The crew of the International Space Station has had to take shelter in a Soyuz capsule three times since the beginning in 1998, and debris avoidance manoeuvres are made regularly; debris pose a serious threat to the ISS—in particular those between 1–10 cm which cannot be detected and which are too strong for the protection shield.

6.3 ESA has been active in R&D and operations related to space debris since the mid-1980s and has built up operational knowledge through its Space Debris Office at ESOC with an expertise that is unique in Europe. The Office provides operational support to ESA missions on collision avoidance, contingencies, post-mission disposal, and re-entry forecasts with world-class accuracy based on US-provided data. It also provides information to the authorities in ESA Member States and the EU authorities.

6.4 More recently, in order to strengthen and focus debris mitigation measures, the ESA DG has established in 2011 a set of activities, named the clean space initiative, which prepare technical solutions for environmental issues. Among these investigations are also the analysis for active debris removal concepts. The clean space initiative is thus working closely together with agencies as well as industry to safeguard the space environment and at the same time foster European competitiveness in the field of related new and innovative technologies.

6.5 Within the Space Situational Awareness Preparatory Programme, activities have centred around:

- establishing mission, customer and system requirements;
- identifying suitable system architectures to meet these; and
- establishing pilot data centres for Space Weather and NEOs.

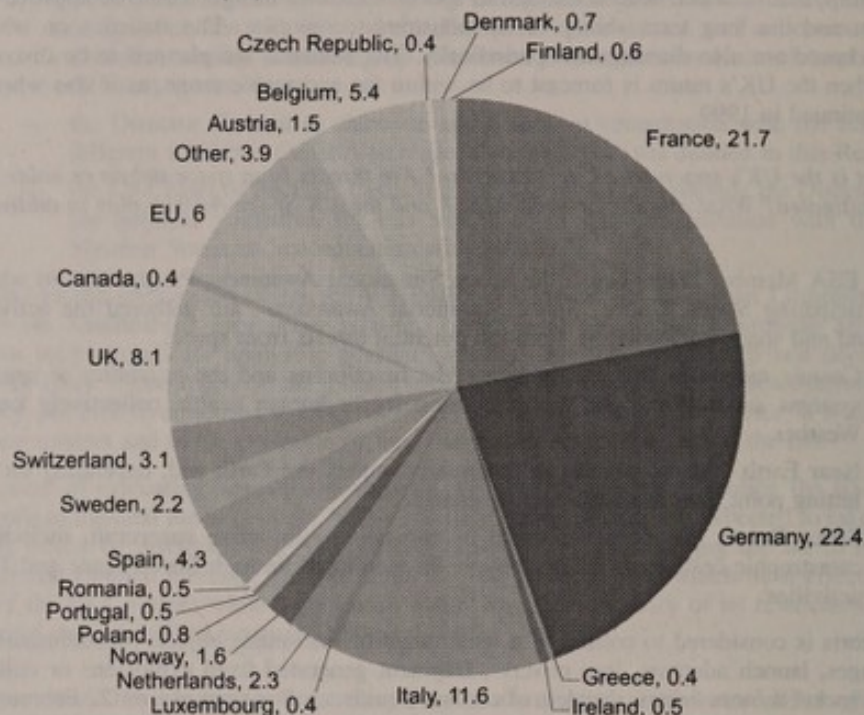
For space debris, mission and customer requirements have been established by the EU, combining civil and security requirements into a single document which has been approved by the Political and Security Committee.

April 2013

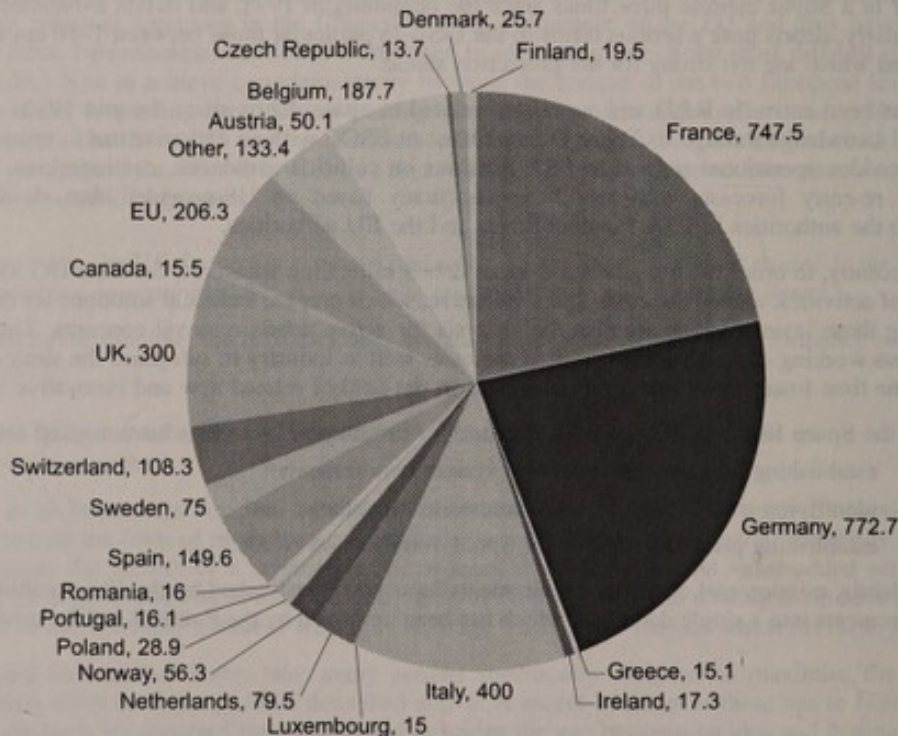
APPENDIX 1

ESA PROGRAMMES—TOTAL ESA BUDGET FOR 2013: 4282 M€

MEMBER CONTRIBUTION TO ESA (%)



MEMBER CONTRIBUTION TO ESA (M €)



<i>Member</i>		<i>Contribution to ESA (%)</i>	<i>Contribution to ESA (M€)</i>
FR	France	21.7	747.5
DE	Germany	22.4	772.7
GR	Greece	0.4	15.1
IE	Ireland	0.5	17.3
IT	Italy	11.6	400
LU	Luxembourg	0.4	15
NL	Netherlands	2.3	79.5
NO	Norway	1.6	56.3
PL	Poland	0.8	28.9
PT	Portugal	0.5	16.1
RO	Romania	0.5	16
ES	Spain	4.3	149.6
SE	Sweden	2.2	75
CH	Switzerland	3.1	108.3
UK	UK	8.1	300
CA	Canada	0.4	15.5
EU	EU	6	206.3
Other	Other	3.9	133.4
AT	Austria	1.5	50.1
BE	Belgium	5.4	187.7
CZ	Czech Republic	0.4	13.7
DK	Denmark	0.7	25.7
FI	Finland	0.6	19.5

APPENDIX 2

ESA'S ORGANISATION AND CENTRES

A2.1 ESA has eight operational sites: Headquarters (FR), European Space Research and Technology Centre (ESTEC) (NL), European Space Operations Centre (ESOC) (DE), European Space Research Institute (ESRIN) (IT), European Space Astronomy Centre (ESAC) (ES), European Astronaut Centre (EAC) (DE), Redu (BE), and the latest, Harwell (UK). In addition ESA owns the launch and production facilities and has teams deployed in Europe's Spaceport at Kourou (FR Guiana) and in the CNES site in Toulouse. It also has offices in Brussels, Washington, Houston and Moscow and a network of ground stations distributed over four continents. The first five named sites are categorised as establishments. ESA employs about 2,200 staff and a similar number of contractors in support capacities.

A2.3 ESA's most recently established site is Harwell. First opened in 2009, ESA will further develop the Harwell Centre through the following undertakings made in the MoU signed between ESA and UK in November 2012:

- By 2015 a significant part of the workforce of the ESA directorate of Telecommunications & Integrated Applications will be based in the centre.
- By 2014 the ESA Climate Change Office will be extended taking the lead within ESA in the area of Earth Observation climate data quality assurance.
- By 2015 additional activities belonging to the ESA Technical Directorate will be located in Harwell.
- The current Science & Robotic exploration activities will be continued with a view to planning the development of an incubation and test environment for autonomous planetary surface exploration.
- By 2015 the procurement activities of space nuclear power sources will be managed from the centre.

Written evidence submitted by Research Councils UK (RCUK) (EA019)

1. Research Councils UK is a strategic partnership set up to champion research supported by the seven UK Research Councils. RCUK was established in 2002 to enable the Councils to work together more effectively to enhance the overall impact and effectiveness of their research, training and innovation activities, contributing to the Government's objectives for science and innovation.¹⁰

2. This evidence is submitted by RCUK and represents its independent views. It does not include, or necessarily reflect the views of the Knowledge and Innovation Group in the Department for Business, Innovation and Skills (BIS). The submission is made on behalf of the following Councils:

Natural Environment Research Council (NERC).

Science and Technology Facilities Council (STFC).

EXECUTIVE SUMMARY

3. The Research Councils' primary interests in the European Space Agency (ESA) are the environmental science programmes (particularly for NERC) and space science programmes (STFC are key stakeholders). The Research Councils are supportive of the UK involvement in ESA and recognise that this has resulted in major advances in understanding of the Earth's environment, the solar system and the universe, contributing to the UK's position as a world-leader in environmental and space sciences.

4. The Research Councils welcomed the establishment of an independent UK Space Agency, bringing together stakeholders from across the public and private sector, creating the potential for a coordinated strategic UK approach to space. NERC, in particular, welcomes plans by the recently established UKSA Earth Observation Advisory Committee (EOAC) to engage more widely with the environmental research community.

5. Closer engagement between UKSA and the Research Councils could help to encourage the growth of the UK space sector, including integration of satellite observations and data from *in situ* networks and models. The UKSA's recent decision to participate in the ESA Space Situational Awareness (SSA) programme will enable the NERC and STFC-funded community to fully participate in and influence European Space weather research activities, placing the UK in a strong position to provide future space weather services.

6. In addition to the aforementioned benefits, the RCUK response to this inquiry refers to improvements that are being made or could be made to ESA and UKSA processes. The Research Councils will continue to work closely with both organisations towards optimum working relationships. Whilst the Research Councils are not in a position to comment on the specifics of the EU's proposal regarding future governance regimes, this RCUK response sets out several potential risks and opportunities. The Research Councils emphasise that there are significant benefits to the current governance of ESA and that, if ESA moves into the EU framework, the mitigation of associated risks should be carefully considered.

1. *What are the strengths and weaknesses of the funding, organisation, and work of the European Space Agency?*

7. For the Research Councils, the European Space Agency (ESA) is significant in that it manages a wide range of programmes related to research in environmental science, space sciences, human spaceflight, navigation, and telecommunications and integrated applications. As set out in the summary, NERC's interests in ESA are primarily in ESA's environmental science programmes, and STFC are a key stakeholder in ESA's space science programmes; our comments primarily relate to these programmes.

8. ESA is a Research and Development (R&D) agency. Its role is to design and ensure implementation of the European space programme, develop satellite-based technologies and services and promote European industries. It facilitates cooperation across Europe on space research and technology and their space applications, for both scientific purposes (including blue skies research) and operational space application systems.

9. Partnering with other member states through ESA enables the UK to develop and access a wide range of state-of-the-art space infrastructure, which the UK could not afford acting alone. Similarly, working through ESA enables us to share the risks associated with developing novel innovative technologies. Participation in research missions also positions academia and industry to play a strong role in any follow-on missions and to develop services and applications that exploit the data provided, for example the instruments on the Sentinel

¹⁰ www.rcuk.ac.uk

missions, the space component of Copernicus, are based on earlier research instruments. For these reasons, the Research Councils are supportive of UK involvement in ESA.

10. The UK's research community has a strong track-record in ESA, for example the UK has the science lead on two of the six Earth Explorer missions commissioned to date, and leads the candidate that ESA's Earth Sciences Advisory Committee is recommending as the 7th Earth Explorer; ESA's Earth Observation Programme Board will consider this recommendation at its meeting in May 2013. The UK's participation in ESA has resulted in major advances in our understanding of the Earth's environment, the solar system and the universe and has contributed to the UK's position as a world-leader in environmental and space sciences.

11. ESA has fully supported the UK Business incubation Centre in the UK, and is rapidly expanding its Technology Centre at Harwell. The ESA Harwell Centre started with support for its programmes in Earth Observation, Planetary Science and Industrial Applications, and will now encompass the ESA Directorate for Navigation and Communications. ESA is playing a full role in the expansion of the Harwell Space Cluster, with new facilities being built to house its new directorate.

12. ESA's programmes are either mandatory or optional; all of the ESA Earth Observation programmes are optional. Although having optional programmes creates the risk that a programme that is a high priority for the UK does not go ahead due to a lack of interest from other members, in general the optional programmes have been advantageous to the UK, enabling us to focus our investments in areas, such as Earth Observation, that are strategic priorities and well-aligned with our scientific and technical capability.

13. As with most large international organisations, there is room for improvement in ESA's decision-making and management processes. Given that approximately 20% of funds managed by ESA now originate from the EU budget, it is particularly important that ESA's space activities have a structural connection and coordination mechanism within the wider policy making of the EU.

14. It is recognised that progress is being made, for example the recommendations of the independent review of Phase 3 of the Earth Observation Envelope Programme (EOEP-3) have been incorporated into Phase 4 of the programme, which the UK subscribed to at the ESA Ministerial in November 2012. The Research Councils would encourage UKSA to continue to push for improved efficiency in ESA and for improved coordination of EU policies and funding opportunities in any emerging governance regime, avoiding overlap of objectives or related parallel activities.

2. In light of the European Commission's recent Communication on relations between ESA and the EU (COM 2012 671), what relationship between ESA, the EU and the UK would provide the most effective governance regime? Why?

15. The Research Councils are not in a position to comment on the specifics of the EU's proposal that should be incorporated into the EU framework. However, we would note that there are significant benefits to the current governance structure of ESA, which could be lost if ESA moves into the EU framework and we would recommend that careful consideration is given to how the associated risks will be mitigated.

16. One risk is that ESA has been leading the R&D component of planned EU space-related activities, such as Copernicus and Galileo, but many ESA programmes, including those that are a high priority for the UK, such as the Earth Observation Envelope Programme and Climate Change Initiative, are not directly linked EU programmes. Currently member states are responsible for deciding the direction of these programmes, which enables the UK to exert significant influence and ensure that the programme aligns with national priorities and capabilities. It is not clear from the EC's communication what level of influence countries that subscribe to a programme will have in the direction of the programme, which may discourage subscriptions.

17. Similarly, the geo-return model of ESA ensures that ESA supports the UK scientists and technologists in both academia and industry, and that UK gets a return on its investment. It is not clear how the EU will manage the risk associated with a move away from a geo-return model.

18. It is essential that ESA maintains its R&D role both in terms of the science it enables and the technology it develops—this is not highlighted sufficiently in EU (COM 2012 671). These elements are essential for long term growth of the space sector.

19. The emphasis in EU (COM 2012 671) on security and defence will require careful consideration as, at present, ESA's activities are "for exclusively peaceful purposes".¹¹

20. The ESA members who are not also EU members—Norway, Switzerland and Canada—are making significant contributions to ESA's activities and it is important that these countries are not disenfranchised. Changes to the ESA/EU relationship, may also have an impact on other international organisations, eg EUMETSAT which also has a complex relationship with ESA (mismatch of financial rules, membership asymmetry).

21. Conversely, there may be some advantages to moving to a more integrated structure such as improved policy and programme coordination and greater clarity on data access and policy—the latter is particularly important to the success of Copernicus.

¹¹ Article II, Purpose, Convention of establishment of a European Space Agency, SP-1271(E), 2003)

3. *How effective is the EU's support for research and innovation in the space sector? What effect have changes to the Multi-Annual Financial Framework had on ESA and support for the space sector from the Horizon 2020 programme?*

22. Developing major operational systems that are designed to support the needs of policymakers and citizens and promote economic growth (such as Copernicus and Galileo) through the EU has been beneficial as managing operational systems is beyond the remit of ESA, which is an R&D agency. Until the Multi-Annual Financial Framework negotiations have been concluded it will not be known which activities will be supported in the operational programmes, but the pre-operational Copernicus services, have provided opportunities to develop new applications and services.

23. Earth observation has received significant funding from the EU's Framework programme, through both the Space and Environment components. The development of the Copernicus services has been supported through the Space programme, and activities in support of the intergovernmental organisation, the Group on Earth Observation (GEO) have been included in the Environment Programme. Many of these activities have focussed on the integration of space-based observations with data from *in situ* networks and models, essential for advancing our understanding of the environment and an area where the UK has world-leading capability. However, it will be crucial that the data policy for Copernicus is also considered and clarified as the feasibility and business cases of a number of services are extremely reliant on this aspect.

24. Whilst some of the research projects the EC have funded through the Framework programme seem to have been more successful than others, the Framework programme has made a major contribution to the growth of the European Earth Observation sector. Although it is not yet known exactly what Earth observation activities will be funded under Horizon 2020, we welcome the recognition of the role Earth Observation can play in delivering many of the focus areas in the draft Horizon 2020 Strategic Programme, including oceans, food security and water security.

4. *How effective has the UK Space Agency been and what improvements could be made? Is the UK effectively exploiting opportunities for growth in the space sector or could more be done?*

25. The Research Councils welcomed the establishment of an independent UK Space Agency, bringing together stakeholders from across the public and private sector, creating the potential for a coordinated strategic UK approach to space. NERC, in particular, welcomes plans by the recently established UKSA Earth Observation Advisory Committee (EOAC) to engage more widely with the environmental research community.

26. NERC and STFC both have a "dual key" partnership with UKSA.¹² It is important to recognise the significance of the UK space research programme having been underpinned by this "dual-key" mechanism on establishment of the UKSA. Whilst the dual key mechanism is working well, significant changes in the NERC or STFC budgets, outside of the Research Councils' control, may affect their ability to fully invest in missions which UKSA has endorsed. Likewise, constraints on UKSA's budget may impact on the ability of ESA to deliver capabilities to match the NERC and STFC community's strategic scientific goals. This is a risk.

27. In addition to investments by UKSA in ESA programmes it will be important that these are reflected in UKSA plans for the National Space Technology Programme to ensure that UK researchers continue to influence and lead future environmental science missions.

28. The Research Councils welcome the strong UK subscription to the ESA programmes of relevance to the Research Councils at the 2012 ESA Ministerial, and notes the role UKSA played in securing the subscription. We also welcome the continued engagement by UKSA on ESA programme issues, for example seeking our views on key papers ahead of Programme Board meetings.

29. The Research Councils recognise that coordinating and facilitating the diverse range of stakeholders with an interest in Earth observation is a significant challenge. We understand that UKSA are currently reviewing their management structures and will continue to engage with UKSA to ensure that there are effective communication links with RCUK going forward. One recommendation would be that UKSA could make better use of their advisory bodies, such as the Space Leadership Council and Earth Observation Advisory Committee.

30. Closer engagement between UKSA and the Research Councils could also help to encourage the growth of the UK space sector. For example, the development of services and applications in areas such as climate and disaster management will require satellite observations to be integrated with data from *in situ* networks and models to produce the products and forecasts users require. The Research Councils are already working with others in the space sector, eg through the Satellite Applications Catapult, to try and achieve this and would welcome additional support for this from UKSA.

31. In the context of "exploiting opportunities for growth", the Space Applications Catapult is a major investment by UK Government and it is important that it receives adequate support. At this early stage of the Space Applications Catapult, it is important that the objectives and programmes are clear to ensure maximum demonstrable impact.

¹² The dual key mechanism for STFC was outlined in a memorandum in the submission to S&T Committee's first inquiry into establishment of UKSA.

5. *Does the UK get good value for money from its membership of ESA? How does its return on investment compare to other countries?*

32. As noted in the response to question 1, participation in ESA allows the UK to develop and access a much wider range of space-based infrastructure than we could afford acting alone. On the Earth Observation programmes the UK's geo-return is approaching 1, ie the return to the UK in the form of contracts is equivalent to our level of investment. This is similar to the geo-return situation of other major contributors to ESA, such as Germany and France.

33. However, the return on investment is not limited to the geo-return situation. The UK's participation in ESA has had major scientific benefits, for example the ATSR series of instruments developed in the UK has provided accurate measurements of sea surface temperature, one of the Essential Climate Variables, and the UK-led Cryosat mission is enabling a much better understanding of how ice sheets and sea-ice are responding to climate change. Involvement in ESA activities, also positions the UK to secure contracts for follow-on activities, such as EUMETSAT missions, and to develop applications and services exploiting the data from ESA missions, for example at the Facility for Climate and Environmental Monitoring from Space (CEMS) at Harwell.

6. *How resilient is the UK's space-based infrastructure? Are threats from space debris or solar activity being appropriately mitigated? What role do, or should, ESA and the UK Space Agency play in addressing these issues?*

34. To set the context, the UK has a significant investment in space based infrastructure, via satellite design and construction, operations and services and space insurance. About 35% of all space insurance is done through London. About 170 satellites on orbit are insured, and typically each cost around \$200 million.

35. This response focuses on space weather, both its implications for space-based infrastructure and its wider threat as recognised in the 2012 National Risk Register. The former was comprehensively analysed in the Royal Academy of Engineering severe space weather report¹³ published in February 2013. This recognised that our space infrastructure has a high degree of resilience through good design and operational practices, but that the infrastructure could be significantly degraded during a severe space weather event, eg through anomalous behaviour of control systems, through disruption of radio links with the ground, and through premature aging of spacecraft systems.

36. The Academy's report made extensive recommendations on ways to improve resilience of space infrastructure and to mitigate the wider threat to critical infrastructures from space weather, notably that to the power grid, but also those to aviation, to communications systems, and to the control systems embedded in most ground-based infrastructures. These recommendations include R&D activities that can be, and in many cases are being, enabled by ESA and UKSA. Examples include the need for better monitoring of the solar, interplanetary and terrestrial phenomena that lead to adverse effects on critical infrastructures, both in space and on the ground, and for better forecasting of those adverse effects.

37. UKSA's recent decision to participate in the ESA Space Situational Awareness (SSA) programme will facilitate the mitigation of space weather impacts on space-based and ground-based infrastructures across Europe, not least the UK. This programme will support the development of space weather services and technologies, and improve the integration of space-based and ground-based space weather monitoring activities that NERC and STFC are well placed to contribute to. NERC has responsibility for Earth-oriented solar terrestrial physics research, including aspects of space weather research, whilst STFC leads on non-Earth space weather research, including the solar drivers of space weather. Both Councils have contributed to the emerging UK Space Weather Strategy¹⁴ with other government and industry stakeholders. This strategy is a response to the inclusion of space weather in the 2012 National Register of Civil Emergencies, where it is recognised that the UK is providing leadership on national contingency planning.

38. The UK's strong financial contribution to the SSA programme (second largest) gives us the opportunity to influence the programme so that it meets the requirements being identified as part of our national contingency planning. It also means that the programme engages relevant UK expertise (eg work supported by NERC to mitigate threats to the power grid and to forecast satellite environment conditions, and work supported by STFC to track the solar ejecta that can cause severe space weather conditions and to monitor satellite environments). UK participation in the next phase of the SSA should, therefore, enable the NERC—and STFC-funded community to fully participate in and influence European space weather research activities. This will put the UK in a better position to secure a strong role in the provision of future space weather services to both the public and private sectors.

¹³ Space weather: impacts on engineered systems, infrastructure and society, <http://tinyurl.com/burj2xy>

¹⁴ <http://www.ukssdc.ac.uk/twiki/bin/view/UKUSSpaceWeather/SpaceWeatherstrategy>

Written evidence submitted by the UK Space Agency (ESA022)

INTRODUCTION

1. The UK space sector has changed significantly since the Committee's 2007 Inquiry into space policy. Domestically, the creation of the UK Space Agency as an Executive Agency of the Department for Business Innovation and Skills in April 2011 marked a significantly strengthened focus for the Government's objectives for space. Newly articulated space policies reflect the strong growth experienced by the UK space sector and the Agency is working with industry and the research community to deliver ambitious targets for accelerating this growth in the medium term. Government investment in space has created a new space eco-system in the UK that is gaining recognition at home and abroad. Ground-breaking space science projects have achieved remarkable results and industry has evolved to a point where prize funds and private capital are supporting space activities that were once solely within the realm of sovereign states. Demand for space derived data and services has grown dramatically as use has become almost universally routine for the public and business. Internationally, the entry into force of the Lisbon Treaty introduced a remit for the European Union to engage in space policy, bringing another major European player into the space sector alongside an expanded European Space Agency that now comprises 20 countries.

THE UK SPACE AGENCY

2. The UK Space Agency was launched in March 2010 and became a full executive agency on 1 April 2011 when responsibility for the majority of civil space activities was transferred from Department for Transport, the Research Councils and the Technology Strategy Board. The Agency's mandate is to provide strategic leadership to the UK's civil space activity with a central focus on the growth of the industrial sector, working in partnership with other actors where appropriate.

3. The Agency was established following a public consultation to consider which management structure would be best placed to meet the increasing challenge of continuing to deliver a successful UK space programme. The consensus was that the British National Space Centre (BNSC) structure needed strengthening and that an agency structure was the best way to achieve this. The 2010 industry-led Space Innovation and Growth Strategy¹⁵ endorsed this approach.

4. The Committee's 2007 Inquiry noted that the arrangements that governed BNSC had a number of limitations. BNSC was an umbrella organisation of 10 Government departments, research councils and other non-departmental public bodies. This multi-partner approach meant that BNSC could not take active responsibility for the overall delivery of the government's civil space strategy, and the "bottom up" approach could result in the UK losing its critical mass competence in space. The structure also meant that each partner's budget operated on a different timescale which militated against having a unified long-term outlook, particularly at key decision points such as the European Space Agency's Council of Ministers where major funding decisions are taken.

5. In establishing the UK Space Agency, consideration was given to the sort of structure which would ensure and encourage continued growth, and equally importantly, ensure that the UK retained a core competence on space applications, technologies and systems in both industry and academia.

UK SPACE AGENCY'S MISSION

6. The UK Space Agency is responsible for ensuring that the UK retains and grows a strategic capability in the space-based systems, technologies, science and applications. It leads the UK's civil space programme to win sustainable economic growth, secure new scientific knowledge and provide benefits to citizens. It is responsible for all strategic decisions on the UK civil space programme and provides a clear, single voice for UK space ambitions.

7. The Agency has three core functions:

- Funding and delivery of civil space projects and downstream space related activities nationally, bilaterally and via the European Space Agency;
- Development of policy including advice to Ministers and oversight of EU space policies (eg EU space industrial policy), EU programmes (eg Galileo, Copernicus, Horizon 2020), and representing the UK in the United Nations on space matters; and
- Regulation of UK space activities to meet international obligations including licensing of UK-based satellite operators.

8. From 2014 onwards, the split of spend¹⁶ through ESA and the EU for which the Agency has policy responsibility will be around 40% European Union, 52% ESA with around just 8% of the funds under the direct management of the Agency through national programmes.¹⁷

¹⁵ <http://www.bis.gov.uk/assets/uk-spaceagency/docs/igs/space-igs-main-report.pdf>

¹⁶ NB, the final budgets for some EU funding elements are not yet finalised but the approximate percentage split is not expected to change significantly.

¹⁷ See National Space Programmes 2012-13 (www.bis.gov.uk/assets/uk-spaceagency/docs/space-science/national-space-programmes-nov-2012.pdf)

GOVERNANCE OF THE AGENCY

9. The Agency's working relationship and lines of accountability with the Department for Business Innovation and Skills are defined through a Framework document, Corporate Plan and Financial Memorandum.

10. The Agency's Executive Board manages the day-to-day operations and activity of the Agency, including policy advice to Ministers. The formal Accounting Officer role lies with the Chief Executive who chairs the board.

11. The Steering Board advises the Chief Executive on the strategies to be adopted by the Agency in its Corporate Plan, the targets to be set for quality of service and financial performance (including monitoring and advising on performance) and the resources needed to meet those targets.

12. The Audit Committee is an advisory body to the Steering Board. Its main functions are to ensure propriety and accountability of public funds through monitoring and promoting financial reporting and discipline. The Audit Committee's role is to support the Chief Executive in his role as Accounting Officer.

13. The Space Leadership Council advises the Minister for Universities and Science on UK civil space matters and is jointly chaired by the Minister and Andy Green, President of UK Space, and includes senior representatives from across industry, the research community and government. A number of other specialist advisory committees also engage with the Agency to provide advice to the Chief Executive.

14. The Agency is small comprising 44 staff based mainly in Swindon. This compares with 43 staff in the previous BNSC (which had a narrower remit), 230 in the Germany agency DLR working on space (with 1,000 more in research teams within DLR), 2,400 in the French space agency CNES and 250 in the Italian space agency ASI (with several hundred more staff engaged in research through companies part owned by ASI). The modest size of the UK Space Agency means that it relies on industry, national laboratories and academia for domestic space projects rather than doing this work within Government.

15. The Agency works closely with other public organisations which also have a role in space:

- The Met Office which funds UK participation in operational weather satellites via EUMETSAT;¹⁸
- NERC¹⁹ which funds the exploitation of scientific missions studying Earth and the National Centre for Earth Observation as a focal point for the discipline;
- STFC²⁰ which funds the exploitation of scientific missions studying the Sun, the Solar System and beyond;
- Technology Strategy Board (TSB) which funds innovation including in space technology and application activities;
- The Satellite Applications Catapult at Harwell, a not for profit company funded by the TSB to promote, develop and facilitate the commercialisation and advancement of the satellite applications industry;
- DEFRA²¹ which leads on the EU Copernicus²² programme and DECC,²³ both of which fund the use of space data in support of their policies;
- Ministry of Defence and the Defence Science and Technology Laboratory which maintain an interest in dual-use space technologies and assist the Agency with regards to security aspects of key programmes such as the Galileo; and
- Research Councils UK on the wider application of space research and development.

16. In some of these areas, in order to ensure a coherent approach to managing the development of science related infrastructure, a "dual-key" process has been established whereby the Agency and the Research Councils share the decision-making on investments.

17. The Agency hopes to have secondees from academia and industrial to strengthen its skills base.

UK SPACE AGENCY CIVIL SPACE STRATEGY 2012–16

18. One of the Agency's first initiatives was to develop the UK civil space strategy²⁴ which set out six pathways for growth, reflecting the focus on growth at the heart of the Agency's activities and taking on board the Innovation and Growth Strategy recommendations:

- Growth through new opportunities;
- Growth from export;
- Innovation supporting growth;

¹⁸ European Organisation for the Exploitation of Meteorological Satellites

¹⁹ Natural Environment Research Council

²⁰ Science and Technology Facilities Council

²¹ Department for Environment, Food and Rural Affairs

²² Formerly GMES—Global Monitoring for Environment and Security

²³ Department of Energy and Climate Change

²⁴ UK Space Agency Civil Space Strategy 2012–16

- Science to underpin growth;
- Education for growth; and
- Growth through smarter government.

19. The UK space sector is doing well with a total turnover of £9.1 billion in 2010–11. This represents a real growth of 15.6% since 2008–09 and an average annual growth rate over the last two years for which data is available of 7.5% (Figure 1). It is estimated that the UK space sector directly employs 29,000 people and supports a further 60,000 jobs across a variety of industries.

20. In the Innovation and Growth Strategy, the UK space sector set an objective for it to capture 10% of the global market for space by 2030, equating to a space industry worth £40 billion at that point, compared to £9 billion in 2010–11 (6% of the current global market).

21. UK industry is revisiting the Strategy with the support of the Agency to define a set of actions to take steps towards delivering these ambitious targets. The objective requires a significant increase in the rate of growth of the UK space sector (see Figure 2). Analysis suggests that the UK upstream market will need to double and the downstream market quadruple over the 20 year period.

22. A National Space Policy which will be published later in 2013 will provide the focal narrative and overarching principles which will bind together the Civil Space Strategy and the National Space Security Policy.

Question 1. What are the strengths and weaknesses of the funding, organisation, and work of the European Space Agency?

23. The European Space Agency was established in 1975 as a bespoke inter-governmental agency to provide for and promote cooperation among European States in space research and technology and their applications. The UK was a founding member and there are now 20 Member States. Canada is an associate Member.

24. ESA's organisation, governance and funding all reflect this focussed remit. Almost all of ESA's work (around 90%) is undertaken through competitive procurements from industry through a "juste retour" system in which the overall contract value is proportional to each state's financial contribution, less an administration fee. Member States choose to fund space projects through ESA in order to develop national capability. By working collaboratively, it is possible to deliver much larger projects than would be possible individually.

25. The Government considers that ESA has proven itself to be an extremely effective in developing a world class European space capability. With a budget of around one-third that of NASA's, it undertakes a wider range of activities including commercial projects co-funded with industry. It is known for being a reliable international partner, having scientific and technical excellence, and achieving an excellent success rate.

26. ESA is a flexible organisation. A small core of ESA's programmes (around 15% by value) are "mandatory" covering space science and basic technology, education and facilities but ESA Member States can also subscribe to a range of "optional programmes" to align investment with domestic priorities.

27. At the most recent ESA Ministerial Council in November, the Government exploited this flexibility to make strong but selective new commitments to strengthen the UK's role in several areas including telecommunications, navigation, Earth observation and exploration. In contrast, the Government chose not to participate in the programme to develop the next generation of Ariane launcher.

28. The Government's investment was strongly targeted at optional programmes with significant potential to generate growth in UK industry and bring new business through future orders and exports. This will enable the UK to lead on economic services, aspects of space exploration such as space nuclear power and robotics; and climate studies using space data. Investment in the ESA core science programme will also ensure the UK maintains involvement in world-class scientific space research through projects such as GAIA and Solar Orbiter which the UK could not achieve alone.

29. The UK's higher level of investment at the Ministerial secured the future of the ESA facility in Harwell which will grow from 20 to 100 staff through the transfer of ESA's telecoms satellite team to the UK, an extension of ESA's Climate Change Office to develop UK leadership in quality assurance of Earth Observation data and the transfer of procurement for space nuclear power sources. This outcome is part of the Government's strategy to make Harwell a successful space cluster where the enlarged ESA Harwell centre will interact with the Satellite Applications Catapult, the UK's ESA business incubator centre, RAL Space (part of STFC) and different space companies.

30. These decisions reflect the confidence that the Government has in the value of working through ESA to deliver space programmes and projects in collaboration with other European states.

31. Challenges have arisen for ESA, in particular in projects such as Galileo which are jointly funded by the European Union (see below). Galileo has also demanded that ESA improve its management of security matters.

32. Under the current Director General, Jean-Jacques Dordain, ESA is has sought to ensure that Directorates work across administrative boundaries, reduce administrative overheads and implement a new financial management systems compatible with international accountancy standards. The Chair of the UK's space

leadership council, Andy Green, is supporting ESA with this work. ESA needs to be an organisation in which Member States continue to have confidence with regard to its efficiency and value for money and accordingly, improvements should be constantly sought after.

Question 2. In light of the European Commission's recent Communication on relations between ESA and the EU (COM 2012 671), what relationship between ESA, the EU and the UK would provide the most effective governance regime? Why?

33. The European Commission Communication set out the need for a discussion about the future relationship between the EU and ESA given the EU's much stronger remit for space as set out in the Lisbon Treaty.

34. The Government supports the EU's wider role in space policy and programmes and the likely spend of around €12 billion between 2014 and 2020 on space related activity. It also recognises the need for a discussion on the future relationship between the EU and ESA.²⁵ However, the Commission's Communication is overly critical of ESA and the "strategic obstacles" set out by the Commission are over-stated, though there are some issues that need to be addressed.

35. EU funding for ESA is divided across its programmes, where the EU contributes just 6% of the budget, and for specific arrangements related to EU programmes where ESA is in effect, the EU's delivery agent (eg Galileo). Taken together, the EU is single largest source of funds for ESA but the majority of these funds are managed according to EU rules under specific Commission/ESA agreements.

36. Broadly, ESA supports support three different constituencies: it serves the science community which is focused on cutting edge research and peer-review driven selection; it serves the industrial community developing technologies for commercial sale to the global market, often in co-funding arrangements; and it serves institutional users of space such as EUMETSAT and the European Union. It is unclear how the Commission's Communication would apply to the full range of ESA's activities or indeed the rationale for doing so.

37. Difficulties have occurred on the Galileo satellite navigation programme due to incompatibilities between ESA and EU rules and procedures. This may reflect the problem of a research programme funded by ESA Member States transitioning into an operational programme funded from the EU budget. Improvements could be made. In the new Galileo regulation,²⁶ the Commission proposed new provisions on contracting and delegation of functions to ESA specifically to overcome difficulties encountered in the programme. Where ESA acts as an expert delivery agency for the EU, the Government considers that EU rules need to apply rather than those of ESA.

38. The Government considers that the Commission's proposal that ESA should become a part of the EU as a Union Agency is unrealistic and it raises significant questions around budget, EU competence, and efficiency. It is not clear why ESA as a whole needs to change, although improvements in efficiency and effectiveness should be made to ensure that ESA continues to serve its members in the best way possible. The Government considers that ESA should remain a separate institution primarily dedicated to space research and development (including work on applications) and as a general principle, there should not be duplication of expertise or functions between space bodies at any level.

39. As an independent inter-governmental organisation, any change to ESA will be determined by its Member States. They have recognised the need for ESA to evolve and instructed the Director General to engage with the European Commission in a discussion about how that might take place. ESA's goal should be that is the natural choice for collaborative research on space in Europe due to its expertise, success and efficiency. The UK, as a Member State of both ESA and the EU, will seek to ensure that the discussion is managed efficiently on both sides so that recommendations with wide support can be made towards the end of the year.

Question 3. How effective is the EU's support for research and innovation in the space sector? What effect have changes to the Multi-Annual Financial Framework had on ESA and support for the space sector from the Horizon 2020 programme?

40. European Union support for space research and development has been a theme of several research Framework Programmes and a total of €1.43 billion was spent on space research and development during the most recent (2007–14).²⁷

41. The UK has done well from the programme. In the latest call for space projects, around 80% of successful bids include a UK partner and around 24% are led by a UK partner. The total investment secured by these partners totals approximately €29 million which is 23% of the available budget for the call. Inclusion of UK partners seems to make projects more likely to secure funding and UK partners include universities, companies and public bodies.

42. ESA investments are made in accordance with the *juste retour* principle but EU and ESA support for research and development differs in another important way. EU support takes the form of open calls in general

²⁵ See Explanatory Memorandum 16374/12 of 6 December 2012 submitted by the Department for Business Innovation and Skills

²⁶ See Explanatory Memorandum 17844/11 of 12 January 2012 submitted by the Department for Business Innovation and Skills

²⁷ European Commission

thematic areas rather than competitive selection as part of a defined technology roadmap aiming at specific missions. One is more focussed on a particular outcome than the other.

43. It is expected that ESA will manage some of the Horizon 2020 funding under a delegation agreement from the European Commission. Such investment will need to be managed according to EU rules including on procurement but it is unclear whether the objectives set for the research will follow predefined road-maps such as the European Space Technology Master Plan maintained by ESA and its Member States. If the goal for the research is to facilitate a specific mission, a clear structure is necessary and it seems unnecessary for the EU to recreate that. It is essential that ESA and the Commission achieve a well-defined partnership in space research and development from 2014 onwards when Horizon 2020 will begin. There is a clear opportunity to align ESA and EU research agendas for space.

Question 4. How effective has the UK Space Agency been and what improvements could be made? Is the UK effectively exploiting opportunities for growth in the space sector or could more be done?

44. The benefits of moving from the BNSC model to an Executive Agency have become evident. The Agency can act much more effectively as the flagship for the UK civil space sector as demonstrated by the significant increase in funding for ESA based on strong engagement with industry and others to establish priorities, the ambition for the Harwell space cluster, new scientific and commercial initiatives and the ambitious targets for growth of the UK's industrial space sector.

45. The UK's total investment in ESA will now reach an average of £240 million per year over the next five years. The UK space sector expects significant returns from this further investment: industry has already identified projects to the value of £1 billion that should follow from this additional funding. The extra investment will also secure the expansion of the ESA facility in Harwell, creating over 80 new high-tech jobs for the UK.

46. The Government is using the expanded ESA centre and other investment to build a space cluster at Harwell. The Satellite Applications Catapult will drive growth in the rapidly growing downstream markets for space derived data and services. Existing centres of expertise at Harwell such as RAL Space, the ESA business incubator and businesses will create an open environment for innovation combining expertise in both the upstream and downstream sectors. Relevant Government Agencies (UK Space Agency, TSB and STFC) are working together on this initiative and are keen to ensure that it benefits the whole UK space sector without losing sight of UK clusters elsewhere such as the Midlands and Scotland.

47. Other European countries are developing their own space clusters in order to support their industry compete more effectively for the growing global space market. The long established cluster in Munich has now become a focus for initiatives such as the European Satellite Navigation competition and the European Navigation Conference, extending its influence. The cluster recently announced that it had now created 1,000 new jobs since 2004. A new cluster was recently branded as such in the Netherlands focussed on the ESA centre in Noordwijk and Luxembourg also has a space cluster. The Government's approach at Harwell is to use European initiatives to maximise domestic benefit in support of industry.

48. The Agency's national space programmes are supporting scientific programmes such as Euclid and Solar Orbiter; technology development through the National Space Technology Programme and the Centre for Earth Observation Instrumentation; downstream opportunities through the new National Space Applications Programme, and commercially focussed projects such as the NovaSAR Earth observation project in partnership with Surrey Satellite Technology Limited and pilot programmes on Galileo's Public Regulated Service with support of the Technology Strategy Board and the Space Applications Catapult. The UK's first cubesat (Ukubel-1) will be launched in 2013 together with a technology demonstrator satellite.

49. The Agency has been active in bilateral cooperation with other space agencies. For example, it will fund an instrument for NASA's next Mars lander "Insight" due for launch in 2016, and regularly enters into agreements with other agencies around the world to support industry initiatives to break into new markets or secure export agreements. The higher profile for space in the UK has attracted interest from several overseas companies to establish a manufacturing or service presence in the UK. The Agency and UKTI are working together on these opportunities.

50. To make the UK competitive with other countries, the review of the licensing regime for the launch and operation of UK satellites has been accelerated since the creation of the Agency. The Minister for Universities and Science announced in 2011 that the insurance requirement for the launch or operation of a satellite would be reduced to €60 million from £100 million and that a cap of €60 million for liability would be set for the majority of missions in place of the currently unlimited liability. A review on the insurance and liability requirements for smaller, nanosatellites is likely to take place after these changes have been made to assess whether these limits are appropriate.

51. The legislative work of the Agency, for example in the EU on the Galileo programme in ensuring better programme management, cost containment, provision of early services, and contract opportunities for industry has continued. Galileo is an example of a programme where UK industry has done well in competing for contracts. The Agency has also hosted new, market-focussed events such as the European Space Solutions Conference in London in order to support the growth of the downstream market for space based services and

data. The Government has worked to ensure that Copernicus was brought back into the EU budget to ensure sound financial management but also to place the programme on a more secure basis. The Agency will seek to ensure that new EU initiatives such as the Space Industrial Policy support the Government's objectives for space.

52. The Agency has an active programme of raising awareness of space and in ensuring that sector has the necessary skills. In partnership with the Department for Education and ESA, the Agency has established a space education resources office which provides teachers with access to information on using space in the classroom. The Agency co-funded the National Space Academy established by the National Space Centre in Leicester to offer professional development for teachers in using space to teach STEM subjects. The Agency develops innovative ways to inspire children about science and engineering such as the astronautics activity badge developed with the Scout and Guiding Associations and participates in events such as the Big Bang Fair. It has established a biennial national space conference (this year in Glasgow) and has a twitter feed with nearly 40,000 followers.

53. The most recent data for size and health of the UK space sector is from 2010–11 and will in effect act as the baseline year for the Agency against which the growth of the UK space sector can be measured.

Question 5. Does the UK get good value for money from its membership of ESA? How does its return on investment compare to other countries?

54. In terms of direct industrial return, UK industry secures its fair share of ESA work and has made notable progress in winning new prime contracts for spacecraft, for example Solar Orbiter and Sentinel 5P. Analysis of returns from commercially oriented programmes such as telecoms show commercial sales far exceed the initial government investment in ESA by a factor of 5–10. The revenue generated by commercial operators using this technology is an additional benefit of the investment.

55. For example, the UK invested £40 million in an ESA programme to develop advanced broadband telecom technology developed by Astrium Ltd. This technology was initially used by London-based company Avanti Communications, which was able to raise financing to launch its first satellite Hylas-1, creating a company with a market capitalisation of several hundred million pounds. The company delivers broadband services to Europe without the need of a fixed telephone line and the technology is now achieving export orders.

56. The Government recently invested £81m in the programme to develop the second generation of the Metop weather satellites that are fundamental to the UK Met Office's services. This investment will allow UK industry to play a key role in developing prototype units with a guarantee of repeat orders funded by EUMETSAT, generating an assured multiplier for the UK economy. In 2008, under previous arrangement of BNSC, the UK did not invest in the Meteosat programme. The new investment in Metop 2nd generation is an example of the joined-up strategy now being implemented by the Agency.

57. In terms of science value, UK scientists are able to participate in world-class missions at an affordable cost. For example, the Government's £20 million investment in the Mid Infrared Instrument for the NASA/ESA/Canadian James Webb Space Telescope allows the UK to have a prominent role in a \$8 billion project, the most sophisticated space astronomy mission ever attempted.

58. Although there are individual ESA programmes where the UK remains under-returned, the situation overall is back to parity with the return coefficient currently at 0.99, with the projection of a return of 1.0 at the end of 2013/early 2014. The under-return highlighted in the 2007 inquiry has not been repeated.

Question 6. How resilient is the UK's space-based infrastructure? Are threats from space debris or solar activity being appropriately mitigated? What role do, or should, ESA and the UK Space Agency play in addressing these issues?

59. The risk of a severe space weather event was first included in the UK National Risk Assessment in 2011 and uses the 1859 Carrington Event as its reasonable worst case scenario. This risk is owned by the Met Office and, together with the UK Space Agency and the Natural Environment Research Council, it is responsible for space weather situational awareness, forecasting and modelling.

60. The likelihood of a major event happening is approximately once in a 100 years. Due to recent technological advancements and the evolving understanding of the underpinning space science, there is significant uncertainty about the impacts of a severe event. These impacts would affect a wide range of industries, including power generation, transport, telecommunications, financial markets and space. However, space-based infrastructure is designed to survive the harsh environment experienced in orbit and is already considered to be resilient to some extent.

61. The Cabinet Office (Civil Contingencies Secretariat), working closely with the Met Office, has set up a space weather project as part of its High Impact Hazards programme. The space weather project aims to increase the UK's preparedness to mitigate and respond to the risk from a severe space weather event, assess the impacts on the UK of a severe space weather event, identify capability gaps and, if appropriate, determine what new and/or additional capabilities are required to respond to such an event.

62. Space weather remains a new area in terms of scientific development and understanding, and although much has been done over the last year, more work remains to understand the risk fully. The recent Royal Academy of Engineering report into extreme space weather has provided useful research in identifying potential impact areas and mitigation strategies.

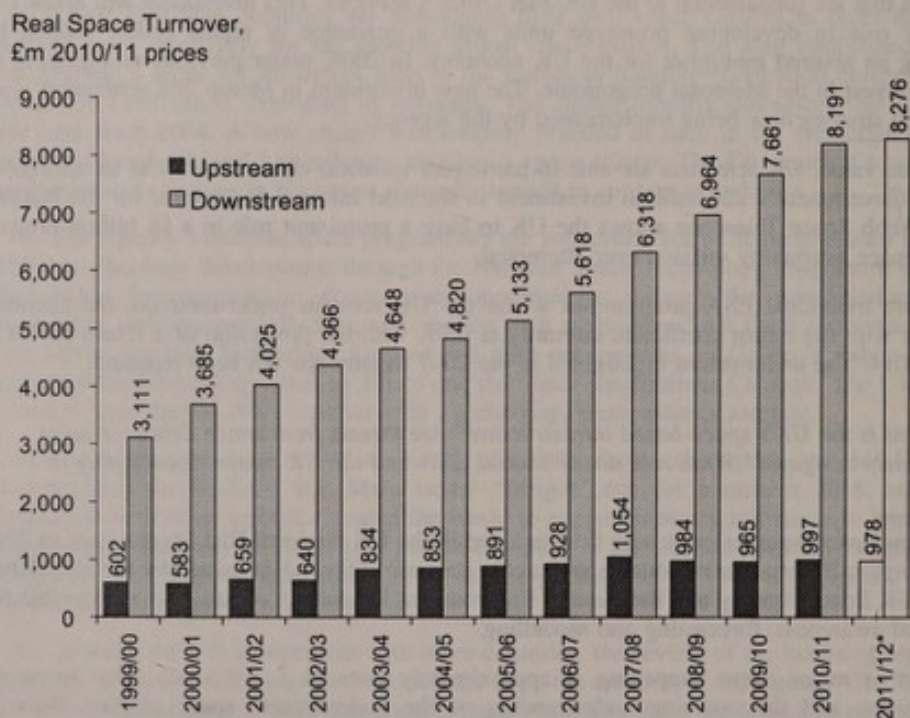
63. The Met Office continues to work closely with the US National Oceanic and Atmospheric Administration to build capability in forecasting and monitoring. The UK Space Agency and the Met Office have also been developing this work through the ESA, including a recent funding investment of £5.6 million to the Space Situation Awareness Programme to enhance and make more resilient the satellite measurement capabilities and models needed to forecast extreme space weather events. The Programme is working towards a long-term solution, for example a possible operational service. Both Agencies and the Cabinet Office are also engaging widely across America and Europe to aid research collaboration, develop protocols to coordinate the aviation response, and agree public communication standards.

64. There is currently a vulnerability in the forecasting of space weather as the satellites we rely on for measurements are well beyond their design lifetime and forecast modelling is at an early stage of development when compared to terrestrial weather forecasting. The Met Office has been developing the necessary knowledge and IT capabilities to predict space weather and recently submitted a business case to secure sustainable operational funding.

65. In relation to space debris, along with ESA, the Agency has been a member of the international Inter-Agency Space Debris Coordination Committee (IADC) since the 1990's which performs a number of activities associated with space debris such as monitoring, measurement, modelling and mitigation of the debris population. The IADC provides the baseline estimates of the future debris environment that satellites must survive within.

66. The UK helped draft the 2007 United Nations Space Debris Mitigation Guidelines which are reflected in the UK licensing regime for satellite launches which aim to ensure safe and sustainable use of space. UK operators benefit from tracking data and collision warnings provided by US STRATCOM. Further the UK is home to Space Data Association which is a commercial initiative to share orbital data between operators to minimise collisions on orbit.

Figure 1
SIZE AND HEALTH OF UK SPACE SECTOR



Source : Oxford Economics

Figure 2

Growth scenarios

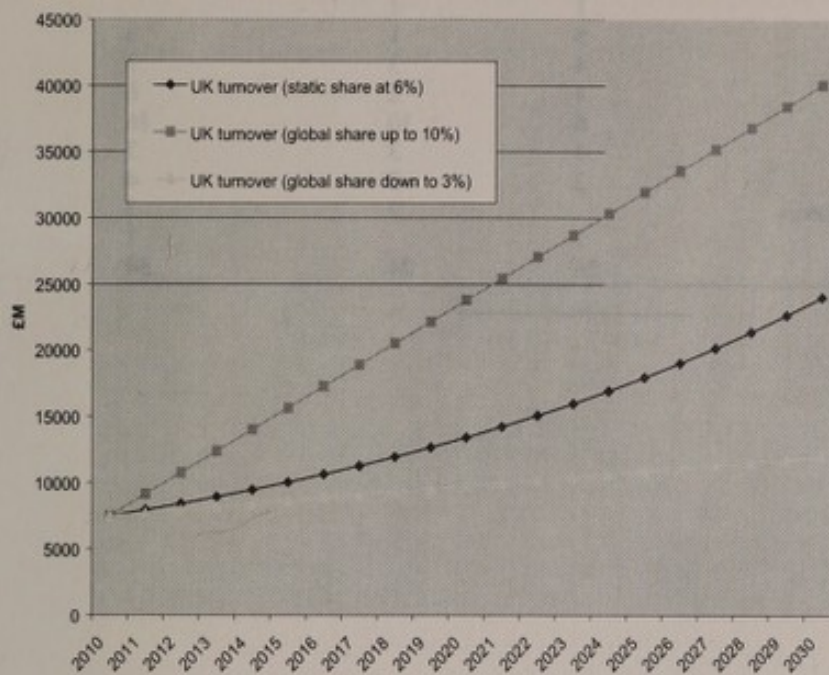
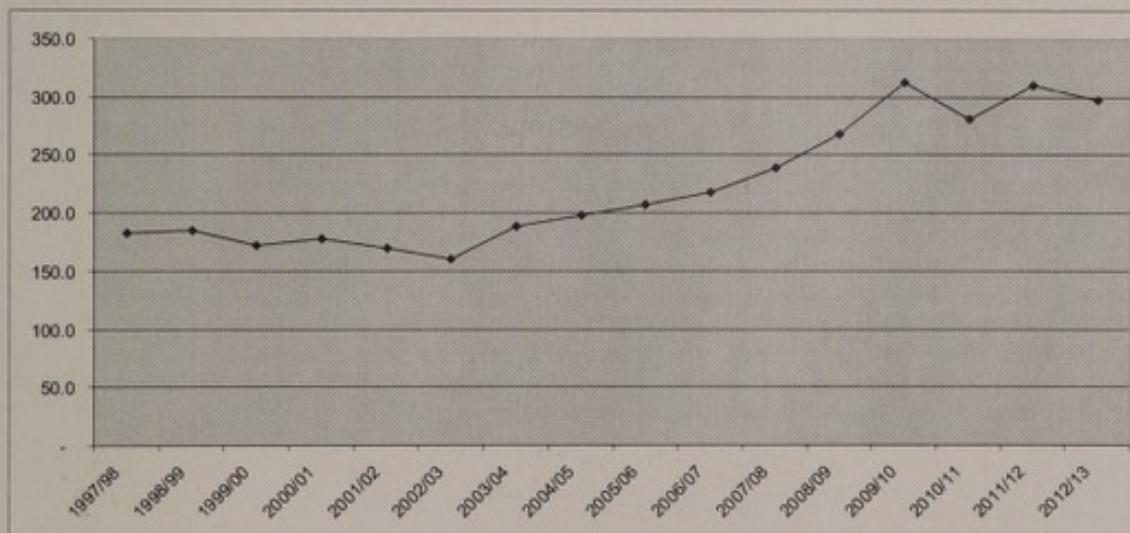


Figure 3

UK CIVIL SPACE SPEND (ACTUAL SPEND, NON-ADJUSTED PRICES)



Supplementary evidence submitted by the UK Space Agency (ESA016)

COUNT OF GENDER

<i>UKSA Grade Equiv</i>	<i>F</i>	<i>M</i>	<i>Grand Total</i>
AO	1	1	
EO	5	1	6
HEO	4	3	7
SEO	4	2	6
G7	6	10	16
G6	4	3	7
SCS	2	2	4
Graduate Secondments		2	2
Intern	1		1
Grand Total	26	24	50

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