A Consultation on the UK Civil Space Strategy 2007 – 2010

This consultation document seeks the views of stakeholders on the themes of the new UK Civil Space Strategy 2007-2010 currently being developed.

The responses of the Royal Astronomical Society (RAS) appear in bold italics after each of the 18 questions on which opinions are sought.

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Foreword by Malcolm Wicks, Minister for Science and Innovation

Space matters. Year by year, it forms an ever greater part of everyone's life. Sometimes this is obvious, as in weather satellites; sometimes it isn't, as in satellite communications. Space is helping us to learn about our solar system. The Stern Report showed the relevance of space to understanding climate change. Information from space is used by farmers and disaster relief workers, helps to protect fish stocks, supports sustainable development and may soon aid the management of road congestion. More and more, public authorities are seeing the benefit of using space applications as a viable solution for developing policy and providing services. Space is the great adventure of the coming millennium.

For the UK, space is a success story. The world space market is large and growing fast, and the UK has a healthy share. Space contributes £7bn to UK GDP and supports 70,000 jobs. Our scientists are world-leaders. Our successes in space strengthen us as a country in technology and science. Exploration helps us towards answers to fundamental questions about life. Young people who are inspired by space can develop a commitment to science.

The Government has an important role in fostering the space sector, to support and develop our strengths in space but also for the benefits which flow to the economy and country as a whole. We want to make choices that achieve this. So every few years we invite views on what the country's space priorities should be. At a time of rapid change it is appropriate to do this now.

I therefore warmly invite you to consider this consultation document. It aims to set out the range of issues and activities that we need to think about in setting our future direction. Whether you are in the space community, or have an interest in space, please let us know what you think. We will consider your views carefully and prepare a new strategy for the UK towards the end of the year.

Thank you for your help.

Malcolm Wicks

List of abbreviations used in this consultation document

ARTES	Advanced Research in Telecommunications
BNSC	British National Space Centre
CCLRC	Council for the Central Laboratory of the Research Councils
CSR	Comprehensive Spending Review
Defra	Department for the Environment, Food and Rural Affairs
DfES	Department for Education and Skills
DfT	Department for Transport
DTI	Department of Trade and Industry
EO	Earth Observation
ESA	European Space Agency
ESP	European Space Policy
EP	European Parliament
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FCO	Foreign and Commonwealth Office
GEOSS	Global Earth Observation System of Systems
GIFTSS	Government Information from the Space Sector
GMES	Global Monitoring for Environment and Security
GSTP	General Space Technology Programme
HSPG	High-level Space Policy Group
Met Office	Meteorological Office
MoD	Ministry of Defence
NERC	Natural Environment Research Council
NCP	National Contact Point
OSI	Office of Science and Innovation
PPARC	Particle Physics and Astronomy Research Council
RDA	Regional Development Agency
SSTL	Surrey Satellite Technology Ltd
YF	Yorkshire Forward

1. The consultation

The UK's civil space strategy supports the Government's aims of achieving excellence in science, supporting industry in key areas of wealth creation and encouraging innovation. The UK's objectives in space are also influenced by five long-term challenges, identified by HMT Treasury in a recent report[1], which will impact policy making and public service delivery:

- Demographic and socio-economic change
- The intensification of cross-border economic competition
- The acceleration in the pace of innovation and technological diffusion
- Continued global uncertainty and poverty
- Increasing pressures on our natural resources and global climate

This consultation is part of the process of updating the UK space strategy which is scheduled for publication in Autumn 2007.

During the run-up to the ESA Council Meeting at Ministerial level in November 2005, BNSC asked for views on the UK Space Strategy 2003-6 (http://www.bnsc.gov.uk/content.aspx?nid=5550) and on UK priorities for the European Space Policy. There is no need to repeat any comments you provided at the time but you may wish to refer to any you made.

The Government-wide 2007 Comprehensive Spending Review (CSR) will set Departmental spending plans for 2008-11. Along with other Departments, BNSC Partners are formulating their priorities and desired expenditure for this period which they will then feed into the wider CSR process. BNSC is co-ordinating the various space-related inputs of the main BNSC partners in order to maximise synergies and avoid duplication. The development of the inputs to the CSR process across the partnership is being closely co-ordinated with the development of the new UK Space Strategy.

You may respond to as many or as few questions as you wish. BNSC welcomes your views on any or all of the issues detailed in this document.

[1] Long-term opportunities and challenges for the UK: analysis for the 2007 Comprehensive Spending Review, pages 5-6. HM Treasury. November 2006. http://www.hm-treasury.gov.uk/media/298/55/csr_longterm271106.pdf

2. Vision and Focus for the UK Civil Space Strategy 2007-10

The UK approach to space is user-led, and driven by focusing on activities which will enhance scientific knowledge and bring benefits to the UK economy and society.

The UK Civil Space Strategy 2007-10 currently being developed proposes three primary objectives:

a. Delivering world-class science by exploiting the UK's space activities and expertise;

b. Delivering public benefits in partnership with Government bodies and institutions to exploit the full potential of space activities;

c. Maximising the potential for wealth creation from space activities by facilitating a progressive business environment.

The new UK civil space strategy will outline our plans for maximising these benefits by focusing on key areas such as:

- **Enabling a suitable space business environment** to maximise the economic potential of space activities

- **Supporting excellent scientific activities** by maximising synergies and UK influence in international fora

- **Extending partnerships** within Government, the regions and internationally to harness available resources and to widen the applications of space in solving societal and environmental challenges

- **Facilitating key UK capabilities** by strengthening horizon scanning activities and where necessary supporting early risk reduction in commercial systems and developing a strong technology programme

- **Continuing to play a central role in ESA and EU fora** to ensure fit-for-purpose policies, programmes and best returns on subscriptions

- **Using space to enthuse young people** about science and technology

In the existing programme of activities, the UK believes there is an adequate market capable of ensuring access to space for the UK and hence support for launchers is minimal. There are no current plans to become involved in the International Space Station or manned space activities, as no funding partner currently believes that the potential benefits justify the costs involved.

Question 1: Are there additional primary objectives that would help to drive the UK programme and maintain excellence in space?

The Royal Astronomical Society (RAS) believes that the end-user sectors for space in the UK are adequately represented within the BNSC. An area of concern is whether the BNSC is sufficiently active in the area of technology development and training for the space industry. Many of our international competitors have active programmes for student training in space science and engineering. Access to such programmes will enhance the skills base that is critical to maintaining UK excellence in space.

3. Science

> *"Delivering world-class science by exploiting the UK's space activities and expertise*"

Introduction

Within the BNSC partnership, the responsibility for funding space-related science activities lies with the Particle Physics and Astronomy Research Council (PPARC) and the Natural Environment Research Council (NERC). The UK is a leading player in a wide range of space-related scientific activities and the BNSC Partnership helps to ensure maximum UK influence in European and wider science fora.

a) Space Science

Responsibility for funding space science lies with PPARC. Its space science remit includes space-based astronomy, planetary science, solar and solar-terrestrial physics and fundamental physics in space.

The majority of the space science activities are undertaken through subscription to the ESA Space Science Programme, supported by national funding of selected instruments. There are also bilateral contributions to the missions of other agencies such as NASA and the Japan Aerospace Exploration Agency, JAXA, when they are in line with the UK's space science aims.

PPARC's space science goals are encapsulated in its science agenda and the associated roadmap (http://www.pparc.ac.uk/roadmap/rmhome.aspx). PPARC is developing a space science strategy document which links its overall science goals to the broader BNSC remit and includes eight inter-related themes for achieving them:

Theme One: Delivering the science

Exploiting past investment through missions in orbit:

Operating existing space science missions and their instruments either directly or via international agencies as long as they remain scientifically viable and of sufficient priority.

Theme Two: Building the new generation
Instrument and data projects in build:
Delivering a programme of instruments and data systems to address key questions in the PPARC science agenda.
Theme Three: Future science
Preparing the next family of projects:
Selecting new instruments and supporting new technologies that will enable the next generation of space science missions.
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Theme Four: New frontiers
Shaping new opportunities:
Evaluating potential programmes for space science that offer new possibilities for national and international collaboration.
Theme Five: Space for education
Educating and inspiring the next generation:
Training the next generation of space scientists and bring the excitement of British space science to the widest possible audience, thus inspiring young people to train in science, technology, engineering and mathematics.
Theme Six: Industry and knowledge transfer
Innovation for science and beyond:
Helping UK industry maximise the commercial and technological benefit from UK investment in space science through supporting technological innovation and transferring knowledge and skills into the wider economy.
Theme Seven: Working together
PPARC's Relationship with the UK space science community:
Working with its partners in BNSC and across the UK to build a vigorous space science community.
Theme Eight: A global endeavour
PPARC working with international partners:
Working with international partners to deliver its science, technology and knowledge transfer agenda.

b) Earth Observation-related science

Observations from space are used to help understand many fundamental processes on Earth, from the behaviour of the atmosphere to ocean circulation and geological processes.
The main responsibility for funding Earth observation-related science lies with NERC. This includes the development of new techniques for exploiting Earth observation (EO) data, related satellite instrumentation and training EO specialists.
Implementation is primarily through ESA supported by national programme activities. There are also bilateral activities with other agencies (such as HIRDLS with NASA).
NERC maintains a vigorous and effective EO Programme as part of its 'Science for a Sustainable Future' strategy, providing a vital contribution to many of NERC's scientific priorities.

EO generates large and complex data sets, which require the concentration of technical expertise to use the data effectively.
The EO Programme is structured to meet these requirements through supporting the following areas of activity:

- **Exploiting current satellite observation systems** through the integration of data and models, and through data access, management and archiving; the planned NERC national Centre for EO; post-launch support; enabling / supporting schemes

- **Acquiring new satellite observations** and contributing to global Earth observations through participation in ESA's science-driven Earth Explorer missions within the Envelope Programme and through the development of new satellite instruments

- **Securing future satellite observations** by supporting and developing technology and instrument systems (e.g. through the planned Centre for EO Instrumentation) with LIDAR, low-frequency SAR and far-infrared radiometry technology being identified as priorities

BNSC will facilitate these activities by providing a strategic lead and developing relationships, particularly in relevant international fora.
In addition some funding for research into climate change is provided by Defra and the Met Office carries out research into the science of weather (see section 4).

Question 2: Do the current areas of activity in space science and EO science allow the UK to enhance its current level of excellence?

Both space science and EO science are very broad terms. Within the breadth of definition in use at present by ESA, the RAS believes that all the important areas of science are covered.

Question 3: Are there new and emerging areas of scientific activity using space-based systems in which the UK should take the initiative in order to develop a leading position?

The UK has a well recognized international position in space astronomy, solar physics, solar-terrestrial physics, planetary science and Earth observation. Newly developing areas such as Fundamental Physics offer the opportunity to develop technologies which will be of importance in fields such as formation flying and the assembly of large space structures. It is frequently the case that new fields bring large technology advances simply as a result of the novel measurement challenges posed by the science. The opportunities implied by the NASA " Return to the Moon" programme should be

studied to assess their scientific value and their cost effectiveness in delivering that science. The RAS has recently consulted its membership concerning the value of human spaceflight and a statement which received a very high level of support can be found on its website (http://www.ras.org.uk/index.php?option=com_content&task=view&id=1147&Itemid=2)

c) International collaboration in space exploration and exploitation

In January 2004, the United States announced a fundamental re-direction of US space policy towards a Vision for Space Exploration.
NASA is charged with implementing:

> "…an integrated, long-term robotic and human exploration programme structured with measurable milestones and executed on the basis of available resources, accumulated experiences, and technology readiness. NASA will focus on six major Strategic Goals over the next ten years to achieve this Vision of extending humankind's presence across the solar system, developing innovative technologies and promoting international and commercial participation in exploration to further U.S. scientific, security and economic interests."

All space agencies have been invited to participate in developing a global space exploration strategy encompassing scientific, technological, economic and societal goals. Initially focussed on the Moon with Mars as a subsequent objective, the emphasis for the 'return to the Moon' is currently on acquiring knowledge and capabilities for establishing long-term (scientific) settlements and learning about extracting resources.
ESA has been involved in discussions and are looking at how this initiative sits alongside its existing programmes.
The UK currently excels in robotic missions and satellite technology. BNSC is participating in these discussions, particularly with a view to exploring potential collaborative areas, for example the involvement of UK science expertise.

Question 4: What do you consider to be the technological and economic opportunities for exploitation through space exploration?

There are a large number technological developments and end-user opportunities generated by space exploration in its broadest sense. The process of product development to full availability, miniaturization and demonstration in exacting environments all prepare new technology for deployment in non-space applications. It is however not effective to choose space missions on the basis of perceived commercial usage. This will result in both poor science and poor technology. Demanding scientific goals have always been the most effective driver for technology development.

Question 5: In pursuing UK interests in exploration and exploitation, are there limits to robotic missions that the UK should consider ?

The case for robotics in space is a powerful one on cost grounds alone, even though there are clearly specialist functions which humans alone can perform. eg the servicing of the Hubble Space Telescope (see also the report of the RAS Commission on Human Space Exploration at http://www.ras.org.uk/images/stories/ras_pdfs/Final%20Report%20October%202005.pdf).

Currently the whole of the UK's (and ESA's) excellent space science programme, with the single exception of HST, is based solely on robotic missions. The planned successor of HST, The James Webb Space Telescope, will also be purely robotic.

Robotics will develop further as processors become smaller and software becomes more performant. The cost of placing and maintaining humans in space is huge and the safety issues are by no means negligible. The scientific power of robotic instruments has not yet been exhausted and the exploration of the solar system using robots will provide important scientific results for many decades. Indeed, with current technologies, human exploration beyond Mars seems impossible due to lethal exposure to cosmic radiation. Deeper human exploration of the solar system will require improved radiation protection, e.g. through novel shielding technologies. Such technologies could also facilitate deployment of robotic instruments in high radiation environments such as that around Jupiter's moon Europa, whose sub-surface ocean is a key candidate in the search for extraterrestrial life.

[2] Report of the Stern Review on the Economics of Climate Change, October 2006. http://www.hm-treasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm

4. Societal benefits

> *"Delivering public benefits in partnership with Government bodies and institutions to exploit the full potential of space activities"*

Space activities benefit society in a diverse range of areas from understanding the processes underlying climate change to monitoring the environment, weather, natural resources and land usage. The UK is working with partners in government and internationally to exploit existing space systems and to encourage the development of new ones with benefits for transport, security, health and disaster management.

Space missions play a critical role in the monitoring and understanding of **climate change**. In addition to the economic effects highlighted in the recent Stern Report[2], there are related effects that will have obvious impacts on society and on the environment which space techniques will help to address. These include ice cover, coastal erosion, habitat loss, ozone depletion, flooding, forest fires and sea level change. In addition, space techniques will be vital in assessing progress in meeting targets for reduced carbon emissions around the world.

Since climate change is an international issue, collaboration with other countries is vital. The UK is playing an important role in developing the Global Earth Observation System of Systems (GEOSS), which is intended to drive and coordinate international efforts in EO. Furthermore Defra coordinates UK involvement in the Global Monitoring for Environment and Security (GMES) initiative. This is a joint EU-ESA programme to provide data sets for climate change as well as a range of other services and information for environment and civil security policy in Europe.

Satellite data plays an increasing role in accurately predicting **weather** which in itself is of significant economic value. Weather prediction is undertaken by the UK Meteorological Office (Met Office). By working with European partners through EUMETSAT, the Met Office able to secure basic and sustained observations to help develop its weather prediction models and improve its forecasting. The observations from these satellites are also useful for many other areas of interest, in particular the monitoring of climate trends and some oceanographic applications.

Space systems are well suited to monitor natural and man-made **disasters** (for example through the Disaster Monitoring Constellation built by SSTL), and can assist aid workers in planning responses, monitoring damaged infrastructure (such as roads, bridges and dams) and providing communications to remote or cut-off areas.

In addition to these areas, satellites are useful in monitoring **land usage** (for such purposes as agricultural regulation), **flooding** (for prediction, monitoring and management), and **natural resources** (such as minerals, water and energy).

Examples of other areas include spin-offs from space instruments (to both **medical technology** and **security**), and **telemedicine**. In addition the development of new services and products for consumers such as in-car **navigation systems** and improved **communication systems** may be seen as benefits to society as well as assisting the UK's commercial competitiveness.

BNSC believes that there is significant potential for further exploiting space applications to benefit society. Through its initiatives such as the Government Information from the Space Sector (GIFTSS) initiative, it is seeking to develop partnerships with other Government Departments and local and regional agencies to investigate and develop the use of satellite-based data to address key challenges. Examples of potential pilot studies are in areas such as intelligent transport, long-term monitoring of land use, and disaster monitoring and humanitarian aid distribution.

Question 6: For what new applications can space-based systems and services deliver greater benefits to society?

There are clearly important benefits in expanding our knowledge of the universe, the laws that govern its operation and the origin of the solar system and of life. Beyond those scientific outcomes which will benefit society in the long term, there are also more immediate applications such as those in location based services. Transport monitoring and regulation, land use control and demographic monitoring are all areas of societal issues in which space can play a positive role. Even these direct benefits depend on technologies developed to meet the challenging performance requirements of scientific missions in the past.

Question 7: Have you any views on ways in which we could improve coordination of activities in climate change and environment between different government bodies?

Improved coordination between NERC and PPARC (and the latter's successor STFC) would be important here. There is worldwide scientific interest in understanding the true contribution of solar and other space phenomena to climate change.

Question 8: How important is it to sustain basic sets of key observations over long periods of time?

In a changing world the measurement and assessment of long term trends is very important. Long-term measurements are central to such programmes, but naturally imply long-term financial commitments. It is therefore crucial to consider the relationship between long-term measurements and new methods of observation that can provide greater insight into the physical processes behind long-term trends. Thus funding for long-term measurements has to be tensioned against the funding needed to introduce more detailed observations. This tensioning has to be carried out by authoritative bodies with access to recognized experts.
The past 50 years have seen a revolution in our ability to monitor the environment in which humankind lives and works. Space-based elements have played a key role in this revolution by providing novel means for measurements and communications.
A closely - related issue is to preserve old data so that they can be mined to derive new science; most obviously, the study of long-term change. Recent scientific progress in the UK, and around the world, contains many examples of such work.
The UK has a strong interest in the study of long-term trends – in terms of both scientific expertise and data provision. Because of its history, the UK is a leading provider of long-term measurements, but this leading role is not well known because it comprises a number of small activities spread over several agencies, in particular NERC, Met Office and PPARC/STFC. There is a need to raise awareness of this UK role and find ways to sustain it.

[3] Size and Health of the UK Space Industry: 2006 edition. Bramshill Consultancy Limited.
[4] Ibid [1] .
[5] The Case for Space. The Impact of Space Derived Services and Data. Oxford Economic Forecasting, 2006.

5. Wealth creation

> “*Maximising the potential for wealth creation from space activities by facilitating a progressive business environment.”*

Space activity has significant potential for contributing to economic growth in a variety of ways. Firstly, it provides an excellent platform for providing a diverse range of high value business services such as broadcasting, telecommunications, navigation and environmental services. Secondly its challenging environment not only makes it a valuable high technology sector in its own right but helps it to act as an ‘incubator’ for spinning out technologies and applications into other sectors.

The UK space industry is growing strongly with an increase in real turnover of 5% seen in the last year[3]. In the last two years, there has been an increase in turnover of 17%[4]. Furthermore, a recent study by Oxford Economic Forecasting[5] has highlighted a number of factors illustrating the economic contribution to the wider economy made by UK space activities.

For example, the UK space industry:

- contributes around £6.8 billion a year to UK GDP including indirect, induced and spill-over effects
- employs directly more than 16,000 people
- invests 12% of revenue on R&D (including external sources).

The UK has an impressive track record in exploiting the diverse range of commercial applications in telecoms, broadcasting, navigation and in small satellite technology. The Government wishes to build on this position in order to enable the UK space industry to maximise its potential for wealth creation. Industry itself has a major role in this but Government too is keen to play its part.

Despite its growing maturity, space activity retains an element of inherent risk and expense, particularly in the development stages of projects. Many countries recognise the value of space technology and are investing heavily. This can lead to market failures in the early research and development phase, which Government funding can assist to overcome.

Furthermore the resulting benefits from space activity tend to be spread across many areas both commercial and non commercial. For this reason public funding continues to play an essential role in financing space activities.

[6] See also Section 6

The global space market is growing and international competition is very strong. The number of countries participating in space activities is also increasing. It is

therefore vital for the UK to remain competitive so it can benefit from this expanding global market.
In particular, the Government aims to promote wealth creation by:

- facilitating a suitable business environment
- horizon scanning
- building partnerships with other Government departments, regional agencies and private finance
- identifying and facilitating strategic technological capabilities[6].

The largest opportunities for wealth creation from space in the UK are in the areas of communications, broadcasting and navigation. The UK already has a strong position in this field, for example in satellite TV and mobile satellite communications, as well as secure communications for military purposes. Much of this strength is a result of previous Government funding of research in key technology areas. Investment in underpinning technologies for future expansion areas will be important in retaining the UK's strong global position in this sector (see section 6).
Expected areas of opportunity include the Broadband Global Access Network (which will open up new markets through increasing the data rate available for mobile satellite services), the growth of digital, high-definition and interactive TV services, communication services for civil protection and security applications, and environmental services based on satellite information. In addition, the Location and Timing Knowledge Transfer Network is helping to develop applications using navigation satellites.

Question 9: What areas offer the best commercial opportunities to maximise wealth creation, considering both upstream and downstream?

Since most space missions originate from scientific, technical or commercial ideas that are formed by small expert groups, often in academia, the opportunities for wealth creation could be substantially improved by increasing the UK investment in the early (and relatively cheap) stages of space project evolution.

Question 10: How can BNSC best deploy its resources to ensure that industry is well placed to exploit these opportunities?

While this is not directly within the remit of the RAS, there is clearly a case for better alignment of the technology programmes in universities with those of industry. BNSC could take a more pro-active role in such coordination.

6. Technology Programme

In both European and world markets, early stages of technology development and risk reduction are assisted by government funding. In particular, within Europe individual countries have an underpinning technology programme, enabling industry to bid more successfully for contracts within ESA and elsewhere.

The UK recognises the importance of ensuring that UK companies are in a position to successfully compete for international contracts. The new strategy therefore proposes a national technology programme which will bring together all existing programmes. This would coordinate existing activities to establish critical mass and manage the generic technology aspects of the UK's user-led approach to space. Such a programme would provide for the efficient management of the knowledge transfer process for space technologies to the benefit of all the BNSC partners and UK industry.

The core activities in the programme could be:

- To identify opportunities for knowledge transfer and the exploitation of established and emerging space technologies

- To perform technology risk reduction, from initial 'proof of concept' to flight heritage, to establish the viability of candidate technologies and systems

- To exploit opportunities for collaboration and to stimulate private investment

- To offer advice to partners to inform their investments and the delivery of services.

The benefits of the programme could include:

- A more competitive UK industry better positioned to participate in activities that directly contribute to the three overarching objectives and to participate in international programmes, enabling the UK to maximise the benefit of its investment in those programmes

- Increased knowledge transfer and innovation through improved exploitation of the UK science and technology base
- Increased and accelerated private investment in the space value chain

- Quantified socio-economic benefits of individual emerging technologies across the three objectives

- Greater scientific return to the UK space science community

- A more stable supply of trained scientists and engineers for the wider economy

- Ability to respond strategically to a range of issues of national interest such as climate change, natural hazards, space weather and infrastructure security

- Increased confidence for Partners and the public in the quality of the decisions made on the use of space enabled systems

The programme would provide a focus for industrial and academic research.

Question 11: What priorities for technology would best enable the UK to achieve its programmatic goals across science, wealth creation and the public good?

A thorough audit of the technology base in Industry, University and Institutes would be a necessary step in moving towards a coherent technology policy for the UK space sector.

7. Education

It is widely acknowledged that space activities are highly effective in inspiring young people to pursue an interest in science and technology as well as increasing understanding of scientific and technological concepts among the general public.

To this end, BNSC and its partners have a developed a range of space-related education outreach activities aimed at young people and teachers and also the general public to help raise the awareness of UK space policy and the value and benefits of UK space activity. For example, the BNSC website, www.bnsc.gov.uk, includes an area specifically aimed at teachers and young people. Visitors can download space education resources including lesson plans and worksheets, created with input from teaching professionals, to help support learning both in the classroom and at home.

Through its attendance at a range of exhibitions and events, the BNSC partnership aims to engage young people's interest in science, engineering and technology.

There are also education activities being carried out by many organisations throughout the UK. Greater coordination of these activities would bring considerable value.

The European Space Agency has also been seeking to raise awareness of space within member states through the establishment of European Space Education Resource Offices. Earlier this year extensive discussions resulted in ESA asking Yorkshire Forward (YF, the Yorkshire and Humberside RDA) to take forward the arrangements for the UK, in conjunction with BNSC.

Looking forward, a comprehensive website resource is planned, providing education professionals with a "one-stop-shop" for space education information and material. It will also act as a forum to share best practice.

BNSC will continue working with partners to develop educational materials which will be available on this web site. A longer-term objective is to improve young people's engagement with space, for example through exhibitions at a local and regional level.

Question 12: What further mechanisms for education and outreach do you think are important to inspire young people and encourage them to take up science and technology?

It is extremely important that there is good coordination of the educational activities relevant to space within the UK. At present there seems to be considerable confusion about the role of the BNSC and DfES. A strong lead is needed and proper coordination of the UK universities which run space based undergraduate courses.

8. Security and dual-use

In Europe there is an increasing debate on the institutional role of the EU and ESA in dual-use applications of space. Satellite technology (for example in Earth observation, communication and navigation) is inherently capable of 'dual-use', meaning it can be used in both civil and military applications.

Where significant technological and operational synergies exist between civil and military applications, industry and national governments should exploit them. However it can be questioned whether the EU and ESA (which by constitution have a civil remit) should become involved explicitly in military applications of space.

In addition, the use of space systems for civil security and counter terrorism purposes is gaining importance, whilst the UK Met Office, an agency of the MoD, funds meteorological satellites which are a largely civilian application.

BNSC through its partners MoD, FCO and DTI will continue to be closely involved in the crucial debate on whether Europe should have a role in developing and exploiting harmonised security applications.

The UK position supports European exploitation of space for civil security and counter terrorism purposes. However the UK is opposed to the broadening of the EU and ESA remits to fund and develop space systems specified for military use.

Question 13: How can BNSC improve its approach to the issue of security and dual-use to ensure UK participation in space activities brings maximum benefit to the UK?

The publication of the Defence Technology Strategy in October 2006 has provided much better public visibility of the scientific support needed by MOD. This Strategy shows the need for scientific understanding of MOD's "operating environment" and that this includes issues such as climate change and the space environment. BNSC should work to improve collaboration between MOD and those parts of the UK space science community that are concerned with this operating environment. That collaboration should include sharing of data (subject to any constraints imposed by

security, e.g. delays in release of time-sensitive data) and perhaps costs of data collection. We note that UK scientists already benefit greatly from public access to data from US military sources and encourage BNSC to take that as a model for dual issue.

9. Delivery structures

a) The BNSC partnership

The British National Space Centre (BNSC) was set up in 1985 to co-ordinate civil space activities across a number of Government Departments and Research Councils that have interests in space. It also acts as the UK point of contact with the European Space Agency (ESA), the European Commission, and space-faring countries.

It is a voluntary partnership of 11 Government departments and Research Councils: the Department of Trade and Industry (DTI); the Office of Science and Innovation (OSI); the Department for Education and Skills (DfES); the Department for Transport (DfT); the Ministry of Defence (MoD); the Foreign and Commonwealth Office (FCO); the Department for Environment, Food and Rural Affairs (Defra); the Council for the Central Laboratory of the Research Councils (CCLRC); the Natural Environment Research Council (NERC); the Particle Physics and Astronomy Research Council (PPARC); and the Met Office.

BNSC's overall steering and strategic decision making is provided by the UK Space Board whose members are composed, at Chief Executive/Director level, of the five main funding partners: PPARC; NERC; DTI; the Met Office and MoD.

The UK Space Board is advised by the Space Advisory Council, whose members consist of senior representatives from each BNSC partner; the chairs of the BNSC Advisory Boards; the trade association of the UK space industry and UK academia.

The five Advisory Boards advise the Director General of BNSC and include representation from BNSC partners, industry and academia. The current Boards are: the European Union Advisory Board; the Earth Observation Programme Board; the Telecommunications and Navigation Advisory Board; the Space Science Advisory Committee; and the Space Technology Advisory Board.

The Government has announced that PPARC will merge with CCLRC to form the Science and Technology Facilities Council with responsibility for many large UK science facilities. The new Council will inherit the space science work of PPARC and CCLRC but its exact role will be a matter of the new Council.

[7] Joint EU / ESA Space Councils at Ministerial Level have been organised periodically to guide the development of the European Space Policy.

b) The European Space Agency

For the UK, membership of the European Space Agency (ESA) is the primary delivery mechanism for space programmes in Europe as we believe it offers best value for money and allows the UK to participate in programmes which it does not have the resources to carry out alone.

ESA Member States are required to contribute to its mandatory programme in proportion to their GNP; the UK contribution currently stands at 17.7%, the second largest contribution to the mandatory activities.
Member States may also contribute to ESA's optional programmes according to their own national priorities. For the UK, the five main areas are the Earth Observation Envelope Programme, telecommunications-related programmes (ARTES), Galileo, Aurora and GMES.

c) The European Space Policy

The European Space Policy (ESP) will be a framework for the future governance and management of European space activities and it is expected to be endorsed at a Space Council meeting[7] in May 2007.
The European Space Policy (ESP) will comprise:

- a strategy outlining objectives
- a programme listing priority activities and projects
- a commitment by the main contributors to their roles and responsibilities
- key principles for implementation

The UK believes that the ESP should aim to use space to provide services to EU citizens where it makes economic sense to do so and not as an end in itself. The ESP is currently being developed within EU/ESA institutional fora.
The UK, through BNSC, is an active participant in each of these groups and plays an influential role, seeking to ensure a user-driven approach and a clear and appropriate split of roles between the EU and ESA (e.g. on flagship projects such as GMES and Galileo).
The EU has also opened negotiations with EUMETSAT with a view to securing a framework agreement similar to that between the EU and ESA. Following that agreement, EUMETSAT interests are likely to be incorporated into any future European Space Policy and BNSC partners will work to ensure a sensible approach is taken.

d) 7th EU Framework Programme for Research and Development 2007-13 (FP7)

The EU's framework programmes are its main source of funding for research and technological development activities and cover almost all scientific disciplines, including space.
It is hoped that the final content and budget for FP7 will be agreed by the end of 2006. It is expected that the first calls for proposals will then be published early in 2007.
BNSC is seeking to influence the drafting of the work programmes which have potential for funding space-related activities; primarily the Space thematic priority but also the Security, Environment, and Information and Communication Technologies thematic priorities.
BNSC has been active in informing and influencing negotiations of space-related aspects of FP7 in EU fora.

e) International Relations

Bilateral agreements are established with other countries and international organisation to achieve benefits for the UK space community, and where they are in accord with wider government policy.
The main reasons for pursuing such international collaboration are:

- to assist companies in securing access to markets

- to develop good relations on broad policy grounds

- to facilitate access to specific projects, especially where opportunities are not available within ESA

In the future, BNSC will continue to consider agreements on their merits. BNSC partners will also continue to assess proposals for their own collaboration according to their priorities.
Furthermore, BNSC partners will continue to play a full part in the development of global collaboration, through such bodies as the United Nations Committee on the Peaceful Uses of Outer Space; the International Astronautical Federation; the Inter-Agency Space Debris Co-ordination Group; and the Committee on Earth Observation Satellites.

Question 14: How do you think that BNSC could improve its ability to direct programmes to meet its objectives?

It is not always clear that the whole space sector in the UK is fully engaged in formulating space policy or strategy. A separate, and independent, UK Space Council reporting annually to ministers would provide an authoritative and respected source of guidance and evaluation that would benefit both the BNSC and its users.

Question 15: How can these delivery structures in the UK and internationally best be used to meet the UK's objectives?

The UK needs to have a much stronger and ambitious profile in space affairs worldwide. It is noticeably absent from many international meetings on space policy. The UK model of using lead government departments to run space missions such as GMES and Galileo are simply not effective compared to the alternative of using space professionals skilled in the appropriate technology and management methods. Our international partners are not convinced that the UK is serious in some areas of space activity as a result of our current structure.

Question 16: What can BNSC do to assist the space sector in exploiting FP7 funding lines?

Exploitation of FP7 depends the detailed content of the FP7 Work Programmes and Calls for Proposals, which are reviewed at least annually. It would be very valuable if BNSC were to raise community awareness of the need to lobby on the content of these documents, e.g. through personal contacts with the Commission and other players. Exploitation also depends on the financial model of the participating organization. Most organizations have specialized effort directed at maximizing the EU funding stream and it is unlikely therefore that the BNSC can add much value to this aspect.

10. Trade promotion

BNSC works closely with UK Trade and Investment, the FCO and OSI to support UK companies doing business overseas. Such activities are tailored to specific initiatives such as co-ordinating government support for companies bidding for projects overseas, inviting and arranging visit programmes to the UK for key space industry decision makers, and taking part in international exhibitions.
In addition, BNSC has recently established an advisory group on International Relations and trade promotion involving partners and industry. The group's remit is to advise the Director General of BNSC on these issues.

Question 17: What opportunities do you think exist for BNSC to assist industry in increasing its share of international markets?

This is outside the professional remit of the RAS.

11. New opportunities

We look forward to receiving your responses to the questions raised in this consultation. We will use them to inform our thinking as we draft the new UK Civil Space Strategy 2007-10.
This consultation aims to cover the key areas of importance to the UK. However, if you believe there are any other opportunities that will help the UK deliver its objectives as set out in Section 1, we would welcome your views.

Question 18: Are there any other opportunities that would help the UK maintain its excellence in any aspect of space activity?

The UK excellence in space is patchy and fragile. Current excellence in space science and Earth observation has been built on previous investments by research councils and industry. The general level of coordination is felt to be poor and the overall picture is of a sector about which the government feels some embarrassment. BNSC has not been as effective in promoting the benefits of space within government as is desirable and a more ambitious, pro-active and technically informed approach is now necessary to protect an industry which is half the size of the motor industry and growing at a

considerable rate. It is one of the few high technology manufacturing sectors left in the UK and needs more dynamic stewardship.

List of organisations consulted

Organisations:

Advanced Composites Group
Advantage Business Group
Advantech AMT Ltd
AdvoTek Limited
AEA Technology Battery Systems Ltd
AEA Technology Plc
Aegis Systems Ltd
AEL Consultants
Aetheric Engineering Ltd
AI Satcom Ltd
ALSTOM Aerospace
Ampac – ISP (UK) Ltd
Analyticon Ltd
Antrak
Aon Ltd
APECS
AquaSat Ltd
Arqiva
AsCo Tech Ltd
ASTOS
ASTRA
Astro Pioneer Ltd
Auriga Astronomy
Avanti Screenmedia
AWS Electronics
Barclays Capital
BARSC
BHR Group Ltd
Birkbeck College University of London
BNSC Advisory Boards
Bristol Spaceplanes Ltd
Brit Space Consortium
British Antarctic Survey
British Geological Survey
British Interplanetary Society
British Telecom
British Rocketry Oral History Project
BSkyB
C2 RF Solutions Ltd
Callisto Ltd

33
CCLRC
Centre for Ecology and Hydrology
Centronic Ltd
Century Dynamics
Clyde Space
Coldon Engineering Co. Ltd
ComDev
ComSine Ltd
Cortex (South West) Ltd
DC-Sat Net
Delta Communications Ltd
Department for Education and Skills
Department for the Environment, Food and Rural Affairs
Department for International Development
Department for Transport
Department of Enterprise, Trade and Investment, Government of Northern Ireland
Department of Trade and Industry
DIDEY Consulting Ltd
Drake Electronics Ltd
DYNEX Semiconductor Ltd
E2E Services Ltd
E2v technologies (uk) Ltd
EADS Space
EBC
EBIS Iotron Ltd
Electron Tubes
EM Technology
EMV Ltd
Engineering and Physical Sciences Research Council
Environmental Systems Science Centre
EOCI
ERA Technology Ltd
ERDAS (UK)
ESRIN
ESYS
ETL Systems Ltd
Europe*Star Ltd
European Antennas
European Centre for Medium Range Weather Forecasts
4Links
Field Fisher Waterhouse
Five Owls
Flow-Line Communications Ltd

Fluid Gravity Engineering Ltd
Foreign and Commonwealth Office
Frazer Nash
Gas Dynamics Ltd
GEO Group
Gliant
Global Aerospace Underwriting Managers Ltd
Global Communications (UK) Ltd
Globec (UK) Ltd
Grafton Technology
Graphic Plc
HCD Research
Headway Consultancy Ltd
Helios Technology Ltd
HILTech Developments Ltd
HISCOX Plc
Histar Solutions Ltd
HME Partnership
Hollycroft Associates
Holscot Fluoroplastics
Home Office
Hovemere
HPM Ltd
HTS Development Ltd
Highlands and Islands Enterprise
IGG Component Technology Ltd
Imperial College University of London
Infoterra Ltd
Inmarsat Plc
Institute of Cryogenics
INSYS Ltd
Integrated Engineering
Intellect
Intelligent Autonomous Systems Laboratory
International Aerospace
Invacom Ltd
Invest Northern Ireland
ISP International Space Propulsion Ltd
Jodrell Bank Observatory
JRA Technology Ltd

Keen Associates Ltd
Kudos Technology Ltd
Laser Transport International Ltd
Lobo Systems Ltd
Lockheed Martin STASYS Ltd
LogicaCMG Space and Defence
Logistica Telecom
Lola Composites Ltd
Loral SkyNet
LyonSpace Ltd
Mainstay Space Products
Mansat Ltd
Manufax Engineering
Marchbanks Measurements Systems Ltd
Mardale Technology Ltd
Maris Technologies Ltd
MarketStream Ltd
Marotta UK Ltd
Marsh Ltd
Maycast Nokes
McGinley Systems International
Meggitt Aerospace Components
MEP Aeroplastics
Met Office
Microlaunch Systems Ltd
Microsais Systems
Ministry of Defence
MKW Engineering Ltd
MOLTEK Consultants Ltd
Moreton Hall Associates
MT Aerospace Satellite Products Ltd
Mullard Space Science Laboratory
Multispark Erosion Ltd
National Maritime Museum
National Physical Laboratory
National Space Centre
Natural Environment Research Council
NCAS Centre for Global Atmospheric Modelling
Neal Ltd
NetSensors
Nohmia Ltd

Nottingham Scientific Limited
Nova Space Associates Ltd
NPA Satellite Mapping
Ocean Numerics Ltd
Ofcom
Office of Science and Innovation
ONELAN Ltd
Open University
Optimus Consulting Ltd
Orbit Research
Orbital Mechanics
Ordnance Survey
Oxsensis Ltd
Pabugi Ltd
PCI Geomatics Group Ltd
Peak Production
Pender Plating
PentaMedia (Europe) Ltd
Physics and Astronomy Research Council
Pinpoint Faraday
Plasma Antennas Ltd
Plymouth Marine Laboratory
Polymer Systems
Printech Circuits Laboratories
Proudman Oceanographic Laboratory
Psi-Tran Ltd
Qi3
QinetiQ
Quartzlock UK Ltd
Rapco Electronics Ltd
Raytheon Systems Ltd
Reaction Engines Ltd
Regional Development Agencies of England
Remote Sensing Applications Consultants Ltd
Resin Technical Systems
Reynolds Industries
Roke Manor Research Ltd
Rosenberger Micro
Roth Southwell Consulting
Royal Astronomical Society
Royal Meteorological Society
RPC Telecommunications Ltd

Rutherford Appleton Laboratory
SAIC Ltd
Salcey Precision Engineering
Sapienza Consulting Ltd
Satellite Observing Systems
SciSys
Scottish Enterprise
SELEX Sensors and Airborne Systems Ltd
Sematron UK Ltd
Semelab
Senior Design Associates
Serco Group plc
Silicon Valley Group
SimComm (Europe) Ltd
Space Connexions Ltd
Space System Engineer
Spectrascan (Emsworth) Ltd
Spectrum Metrology
Spirent Communications (SW) Ltd
SPL-ACT Wireless
Spur Electron Ltd
Sounding Rocket Services Ltd
Southampton Oceanography Centre
Space Education Council
SSTL
Sula Systems Ltd
Symban
Systemation Software
Systems Engineering & Assessment Ltd
21Net Limited
Technites Ltd
Teldis
Telesphere
Tessella
Thales ATM Ltd
Thales Avionics Ltd
Thales Research, Satellite Systems Division
Thales Space Technology
The 425 Company
The London Satellite Exchange
The Mathworks
Thompson Valves Ltd
Time Is Ltd
Tpoint Software
TRAK Microwave Ltd
Trinity House

TRL Technology Ltd
UKSEDS
UKspace
University College London
University of Aberystwyth
University of Birmingham
University of Bristol
University of Cambridge
University of Edinburgh
University of Glasgow
University of Kent
University of Reading
University of Leeds
University of Leicester
University of Manchester
University of Oxford
University of St Andrews
University of Sheffield
University of Surrey
University of Wales
Vector Electromagnetics
VEGA Group Plc
Vexcel UK Ltd
Vislink
VT Communications
Welsh Assembly Government
Wilde & Partners
Wired Ocean
World Wide Pictures
Wrekin Circuits Ltd
Zelinda Ltd