SATELLITES FOR SCIENCE, ENGINEERING, TECHNOLOGY AND BUSINESS

PARLIAMENTARY AND SCIENTIFIC COMMITTEE BREAKFAST BRIEFING ON WEDNESDAY 8TH NOVEMBER

Hardly a day goes by without reports on new discoveries being made from space by unmanned satellites. While manned spaceflight consumes the greatest proportion of funds allocated internationally to space research, unmanned satellites continue to deliver the goods on time and to budget and at minimal risk to the people involved. Indeed satellite technology is evolving so rapidly that manned spaceflight is now mainly reserved for work requiring human intervention. This is an innovative technology where the UK is a world leader in the science, technology and manufacture of satellites and in creating successful business applications with the help of London's comprehensive financial expertise in this field.

Satellite technology underpins television, weather forecasting, telephone, internet and navigation, with applications in agriculture, fisheries, urban planning, geological exploration, risk management, humanitarian aid and disaster relief. Satellite-based positioning and timing is used by transport, aviation, banking, emergency services and for military applications. Satellites support the information society by generating and transferring data at regional and global scales and thereby contributing to e-learning, telemedicine, and monitoring global climate change. It is a fertile technology stimulator with spin-offs leading to innovative and commercial applications in manufacturing and the service sector. Unmanned satellites are increasingly being used to promote science and economic and social well-being on a global scale.

Professor John Zarnecki
Particle Physics and Astronomy Research Council (PPARC)

The Particle Physics & Astronomy Research Council (PPARC) is responsible for delivering fundamental scientific research – some of this is delivered through the medium of activities in space, either in order to escape the deleterious effect of the Earth's atmosphere or to give the opportunity to visit our own cosmic neighbourhood. PPARC is one of the partners within the British National Space Centre (BNSC) which provides the "glue" that binds together the various space "players" Other participants include industry, from SMEs up to large multinationals who build the spacecraft, after competitive selection, and who sometimes work with scientists to design and build the innovative instruments that are needed to make the scientific measurements. Much, though not all, of the UK's space science is done through the European Space Agency, who have overall responsibility for the complex task of putting together a space project.

There are 10 University research groups who actively design and build space hardware and some 30 who teach some aspects of space science and technology.

Apart from the basic science, there are three other principal outcomes of PPARC Space Science research. First there is the driving effect on innovation – very often, the demands of scientific space missions push the technology to the limits of what is achievable. Secondly, in delivering its programme of scientific research, a raft of trained people, scientific and technical, are produced, the majority of whom end up working beyond the PPARC domain in both the public and private sector. The City, large industry and small IT companies have traditionally all been beneficiaries of trained PPARC students.

Thirdly is inspiration and outreach. Some of these space missions are truly inspirational. Who can forget the Beagle 2 Mars lander – although ultimately unsuccessful, it caught the imagination of the nation during Christmas in 2004. Or the landing of the Huygens Space Probe on the surface of Titan, Saturn's largest moon, in January 2005? Events such as these can be quite inspirational and are instrumental in the business of attracting the next generation of scientists and engineers.

Space science missions can be divided into 4 broad categories:

(i) Earth orbiting space telescopes (such as the Hubble Space Telescope or the XMM-Newton X-ray observatory) which need to be lofted above the degrading effects of the atmosphere;

(ii) missions which visit their targets within the Solar System such as Mars or a comet;

(iii) Sun-Earth missions which study our "star", the Sun, and the environment between the Sun and Earth which has such an impact on our local terrestrial environment;

(iv) Fundamental Physics measurements in space for purposes such as the detection of gravity waves or to confirm the principles of Einstein's General relativity.

UK scientists and engineers have been involved in a veritable Who's

Who of successful space missions. In the past, ESA's Giotto spacecraft flew past Halley 's Comet in 1986 while more recently, the NASA Swift spacecraft has been studying gamma ray bursts, the most violent explosions that we have detected. The UK is involved in spacecraft currently orbiting Venus and Mars and is also working on the James Webb Space Telescope, the replacement for the Hubble Space telescope. Scientific results from recent and present space science missions ensure that the UK is well represented in terms of papers in the front line scientific literature. There are also very tangible benefits from our involvement in space science and technology. The spin off or knowledge transfer from these very demanding space programmes is increasingly being recognised as having significant economic benefits. Companies such as E2V, CODASciSys and Logica, to name only a few, all benefit from the extremely demanding requirements placed on them by these space programmes and increasingly are able to transfer the knowledge developed into other applications.

Space science and the associated technology have often been regarded as "the jewel in the crown" in the UK's space programme. And certainly the outputs place the UK close to the international forefront in many areas. But the picture is not universally rosy. The UK's investment is falling behind our European competitors. Judged by the percentage of GNP invested in civilian space activities, the UK is well down the table, committing as little as one third (in relative terms) of what our main competitors do. And furthermore the national space programme (as opposed to our contribution to ESA) is woefully under-funded. This situation shouldn't be allowed to continue if the UK's standing is to be maintained.

Colin Paynter
Managing Director, EADS Astrium Ltd

"I didn't know Britain *had* a space policy" – a common enough response when the subject is ever raised in Parliament. After all, Britain doesn't have a manned space programme, it doesn't support the International Space Station, and it doesn't build rockets. So what then *is* UK space policy and why does it matter so much that it merits a full inquiry by the Science and Technology Select Committee?

Firstly, because UK space policy does matter. The global reach, reliability and accuracy of satellites can help improve both the evidence base behind decision making and its implementation.

Secondly, the timing of the inquiry could not have been more crucial. In fact, Britain does have a space strategy, a strategy that is currently being rewritten, in only its third strategic review. Space investment is also under scrutiny through the Comprehensive Spending Review.

Today, satellites provide our Armed Forces with a secure global communications system. Elsewhere in Whitehall, satellite navigation, or satnav, could become the basis of a fairer national road use taxation scheme, which taxes use not ownership, helping to reduce emissions and improve the efficiency of our roads. Satnav is also being trialled by the Metropolitan police to help deploy their forces more effectively. And the Home Office is trialling the tracking of offenders by satellite. Aid agencies already rely on satellites both for emergency mobile communications in the field and for the imagery that helps them locate and monitor disasters.

Satellites keep an eye on our planet 24:7. They monitor land use, coastal erosion, fishing stocks and other scarce resources; they help predict and monitor natural disasters, and they monitor the impacts of climate change, such as rising sea-surface temperatures and melting ice caps.

More immediately, we all benefit from satellite based weather forecasting. The Met Office's forecasting has improved by 25% in the last ten years, much of this thanks to advances in satellite meteorology. Oxford Economics estimates the economic value of satellite-based weather data at between £400m and £1 billion a year.

And satellites are themselves *green*. Satellites can help deliver Stern's vision of a low-carbon economy. Satellites run on sunshine – ground-based infrastructure doesn't. Take the digital switchover as an example. Britain's 1,100 UHF transmitters emit 250,000 tons of CO_2 every year. Just one of today's advanced satellites can carry 150 HDTV channels.

Some of the striking benefits are economic. Satellite technologies and applications are a major catalyst in high growth sectors such as the media and communications. Mobiles are expected to be routinely fitted with satellite navigation chips by 2020. So when you ask Directory Inquiries for Thai restaurants in your area, it can direct you to the nearest one. How much is that worth to advertisers?

As a result, the sector scores well against the Chancellor's hot buttons. Its value added is four times the national average. It employs the most highly skilled workforce in manufacturing – with two thirds of its workers holding a degree or equivalent. Space is six times more R&D intensive than the economic average. And the sector is growing consistently four times faster than the rest of the economy. Moreover, Britain enjoys a 7.3% stake in a global industry forecast to be worth $1 trillion by 2020. Space also inspires Britain's next generation of scientists and engineers. 38% of respondents to an IMechE poll of its engineer members said space influenced their education choice. How much is each extra engineer worth to our economy?

So is UK space policy working? Britain's Space Strategy is supposedly "user driven" – the end users across Government decide what to put in and where. In the centre, it is left to around 35 civil servants to do the co-ordinating. The French space agency, CNES, employs around 1,500. Does Britain's approach work? In December 2005, Defra led the UK decision to put in a minimal amount into Europe's flagship environmental monitoring programme GMES.

How can the UK maximise the commercial opportunities? Space is a fast-moving industry – today's media satellites are 24 times as powerful as those built only ten years ago. This pace of change is driven by technology. And yet last December, the DTI cut its space technology fund from £20million to £8million, and it will disappear altogether in two years. Yet DTI figures point to a return of 7:1. How will this level of investment impact the future competitiveness of UK Space?

Space is undoubtedly one of Britain's great opportunities, both economically and politically. Across the world, satellite technology is cherished as a strategic national asset. Yet Britain, the world's fourth biggest economy with one of the world's leading space sectors, ranks 16th in the world in GDP terms when it comes to investing in space – behind Belgium, amongst others. I believe that Space technology and applications will help to shape the world we live in. UK technology and UK policy provide Britain with an opportunity to play a lead role. Now is the time to decide.

Sir Martin Sweeting
Surrey Satellite Technology Ltd (SSTL)

We have come to take space for granted – so much so that we do not realise how deeply embedded it has become in our everyday lives.

Of course, if we stop to think for a moment, most people would recognise that space provides us with satellite TV, weather pictures, stunning images of far galaxies from Hubble, the excitement of landing on Titan or rovers on Mars – but all too few outside the space community realise that their personal in-car navigation system is using transmissions received directly from 4-5 US military satellites orbiting some 20,000 km above us.

The world is increasingly dependent on satellites – and space technology is delivering major benefits to UK citizens: indeed, as a nation, we have become fundamentally reliant on space to underpin our lifestyle and security.

Space addresses UK Government priorities, such as:

Creating prosperity in a competitive globalised economy;

Responding to and driving rapid technological change;

Climate change & environmental constraints – it was space that alerted us to climate change, ozone depletion and desertification;

Sustainable development and inclusion – satellites bridge the digital divide;

New complex security threats including terrorism – transparency from space underpins risk assessments and international security; distant operations need maps, navigation and mobile communication from space; BBC World Service Arabic satellite TV for trusted, independent news and cultural understanding;

Fostering scientific excellence that creates wealth and guides policies – space attracts youngsters to science, maths and engineering; space is at the heart of international science co-operation;

Rising to public expectations of world-class public services – transport planning and management

Furthermore, active participation in space creates political opportunities that allow the UK to achieve a more balanced relationship with the USA, to increases its influence in Europe, and to shape standards worldwide (critical for the success of our industry).

Fortunately, the UK possesses a vibrant and capable space industry – both manufacturing large and small satellites and exploiting their use once in orbit – contributing billions into the UK economy and creating a world-class technical workforce. Recognising the need to concentrate on specialist areas

appropriate to our national skills and resources, the UK space industry focuses on:

applications and services;

satellite payloads;

innovative small satellites;

cost reduction and capacity building;

innovative financing strategies (HYLAS, Paradigm) and international co-operation (DMC).

The Government has a key role to play alongside industry and commerce in space. Global space markets are growing and the UK can increase its market share and create wealth, but this needs significant investment by industry and the capital markets *and* complementary seed-corn investment by Government where the risks are too high for industry to bear alone. The Government needs to be an investor *with* industry in major wealth creation opportunities – and there are many examples demonstrating the high financial returns achieved from such investments.

Government and industry decisions to date have been largely sound in principle – investment through ESA produces significant leverage to both science and enterprise and positions UK academia and commerce to take advantage of international opportunities. However this is only half the picture; a complementary *national* space focus is also needed, both to position UK organisations to bid successfully for worthwhile activities through ESA and then subsequently to exploit them. Other member countries in ESA recognise the value of this and recently have increased their support for national programmes accordingly.

There are therefore four urgent issues that need to be addressed by Government:

Renewed public investment in space technology – the UK should invest sensibly in Galileo, GMES and Aurora; and create a national satellite programme supporting research, technology development and pre-service demonstrations;

Security & defence – to develop key military space skills with UK-controlled operational smallsats providing independent optical and radar surveillance;

Improved co-ordination across Government – co-ordinating policy, strategy and action on space across departments, so that the UK can maximise its benefit and financial return;

Review regulation – to stimulate free and competitive markets for space-derived services.

Unfortunately, however, space does not command much attention or priority at the top levels of UK Government and this represents a real risk to the nation. So, in conclusion and to put all of the above into context, just contemplate some of what would happen if, hypothetically, we "switched off space":

Disruption to telecommunications to remote locations around the world; to ships or aircraft in flight; no live news feeds from many parts of the world; no ability to support disaster relief operations; no satellite TV and consequential loss of revenues to the UK;

Loss of accurate weather forecasts – with a £1.5bn/year impact to the economy of the UK alone. We would be blind to the progress of global warming;

Loss of SatNav – most vehicle fleets could not operate efficiently; our military campaigns would falter – or increase collateral damage and civilian losses

In discussion the following points were made:

Recently social research has informed us that children benefit from contact with their parents and that attraction is initially based on physical appearance before other factors come in to play. How can we as a nation justify spending money on this type of junk science to provide insights into the obvious and at the same time under-resource planetary science and engineering?

Can space technology assist us to continue working from home in the event that a pandemic should strike and disrupt normal working practices? The UK response model will differ significantly from emerging economies due to the prior investment in copper wire and glass fibre communications to individual domestic residences that already provides an effective communications network. In emerging economies lacking this infrastructure the situation is much more likely to be dependent on satellite communication.

Industrialisation of the launching platform technology has significantly reduced the cost of unmanned spacecraft compared with the additional costs attributable to manned spaceflight for which more expensive safety standards are obligatory. Solar electric propulsion has been used following a satellite launch.

It was pointed out that the 66 satellites in the Iridium LEO constellation are due for renewal in 2013. Given that the constellation provides truly global coverage, all of the time, it was considered a generally good idea to take this opportunity to piggy-back scientific packages on commercial space craft.

There is a long history of national underfunding of UK space initiatives, in spite of the great opportunities recognised by scientists, engineers and latterly economists. Is this mentality still prevalent and what needs to be done about it? Is it possible that the undoubted successes of the UK space research community with minimal financial resources from Government sources has had the perverse effect of persuading Government to reduce its financial commitment? Should we not be emphasising difficulties requiring further investment rather than successes which generate income? The relative advantages of the Galileo (EU) over the GPS (US) were discussed in relation to the high precision location system available on the former that is not under the control of any single government. All Parliamentarians should visit French Guiana to see the investment made by the French Government in satellite launching technology, and Toulouse that has been transformed by the aerospace industry. Government investment in space should be a high priority.