Space IGS

A UK Space Innovation and Growth Strategy 2010 to 2030

Contents

Minister for Science and Innovation's Foreword

> The UK Space sector is a genuine success story. We're responsible for world-class science in our laboratories and on international missions. We manufacture many of the satellites surrounding the Earth, and are experts in software design and systems integration. The sector contributes £5.6 billion to the economy and supports 68,000 jobs.

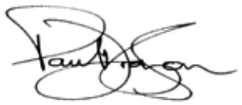
The Space industry has moved far beyond its origins in programmes whose motivation was national prestige. Today, it is integral to the digital economy. Space-based technologies are helping us to understand and address climate change, keep our armed forces safe, and deliver urgent aid when natural disasters occur.

The UK Space sector is a genuine success story. We're responsible for world-class science in our laboratories and on international missions. We manufacture many of the satellites surrounding the Earth, and are experts in software design and systems integration. The sector contributes £5.6 billion to the economy and supports 68,000 jobs.

Following a decade of consistent growth, the market for Space services has distinguished itself by being recession-proof. That trend should continue, given the emerging role for the sector in many aspects of the low-carbon agenda as well as in media and communications.

This report maps out those opportunities and points to an exciting future. Government will respond to the report in full.

In the meantime, I want to thank Andy Green and his team for producing this innovation and growth strategy. It is an ambitious, yet viable, blueprint for joint action by industry and government.



Lord Paul Drayson
Minister for Science and Innovation

Chairman's Introduction

> If ever there was a time to be bold with industrial strategy it is now. We should seize the opportunity to take a successful UK Space sector and transform it into a foundation stone of our future economy.

Space is a vibrant and high growth sector that has achieved great things in a relatively short amount of time and is now an essential part of the engine that drives the global economy. It has revolutionised capabilities in areas such as international communications, global navigation and national security, and has also provided a way to monitor the Earth's climate. These are fast growing markets in which the UK could enjoy a stronger position.

It would have been safe to focus on what the UK does well in Space and simply look for the opportunities in niche markets that use the UK's industrial and science capabilities. But I have encouraged the team to be more wide ranging — to look for specific opportunities that enable the sector to go further, faster. This is less comfortable. In difficult financial times we outline that the UK needs strong governance, a National Space Technology Strategy, and we advocate a national procurement of an Earth observation service.

All this will cost money. However, our recommendations should enable the UK to cost effectively meet national needs for services delivered from Space and to promote new UK-based services into overseas markets. It is true that these actions are attractive to industry. But they also provide the basis to help energise an economy emerging from recession.

Industry needs to invest to seize market opportunities and deliver the national benefits. Investment in Space will result in economic and social returns including the creation of at least 100,000 high-skilled, high-value jobs. Industry will help raise awareness of careers in the Space sector in order to inspire young people to choose science, technology, engineering and mathematics related subjects and meet the demand.

If ever there was a time to be bold with industrial strategy it is now. We should seize the opportunity to take a successful UK Space sector and transform it into a foundation stone of our future economy.

Investment will also provide an opportunity for the UK to take the lead on global issues such as managing food and energy supplies, monitoring climate change, and reducing its carbon emissions by up to 40 million tonnes.

I would like to thank the experienced team of experts who worked with me on this IGT report for the UK Space Industry and I look forward to seeing our recommendations becoming reality.

Andy Green, Chairman

Executive Summary and Recommendations

Executive Summary

Space: a vibrant and high growth sector

At half the age of the automotive and aerospace sectors, the global Space industry has achieved an enormous amount in a very short time. Having set foot on the moon in 1969, astronauts now routinely live and work in an international Space Station orbiting above us. We have also sent Space probes to the far-flung corners of the Solar System in pursuit of answers to the most fundamental questions about our origins.

These almost unbelievable endeavours have been widely publicised, and have entered into the public consciousness as evidence of mankind's unlimited imagination and boundless ingenuity. However, what is less generally recognised is that whilst these high-profile expeditions were grabbing the headlines, behind the scenes, Space was rapidly becoming a fundamental part of our everyday lives and an essential engine of the global economy. Space-derived data and services, together with the infrastructure needed to deliver them, have revolutionised capabilities in areas as diverse as international communications, global navigation and worldwide radio and TV broadcasting. Furthermore, as global warming assumes ever greater importance, Space provides governments and the scientific community with a unique and comprehensive means to study changes to the Earth, its ecosystems and climate. There is no doubt that over the past 40 years since the moon landings we have become increasingly reliant on Space for our security, commerce and future well-being. Equally, it is no exaggeration to say that over the next 20 years, Space will become even more important to us for ensuring not only the quality of our lives, but also the very essence of our existence. The supply of food, energy and humanitarian relief, the security, safety and support of our citizens and the combating of climate change will all be supported by Space-based services, technologies and capabilities to a far greater degree than they already are.

This report sets out the opportunities for the UK to take advantage of the coming Space revolution, not just for the benefit of society as a whole, but also for sound commercial and economic reasons.

The Space market

Between 1999 and 2007, the UK's Space sector grew by an average of 9% per year. This impressive growth highlights the resilience of our Space industry to the effects of economic and political turmoil, and is due to the diverse customer base for Space-enabled services — from commercial telecommunications, weather forecasting, global transport networks, military operations, civilian emergency services and environmental monitoring. It is built on a mix of market demand and strong UK industrial capabilities. The UK has long-standing and deep-rooted strengths in satellite manufacturing, satellite operations, Space exploration, remote sensing and in the vast array of services that are enabled via Space-based systems. Although data for 2008 and 2009 is not yet available, increasing revenues by both manufacturers and operators highlights that growth even through these difficult years has been positive.

The overall world market for the Space industry is likely to grow from £160 billion in 2008 to at least £400 billion by 2030 — a 5% annual growth rate in constant 2007 values. Although we expect growth in government spending on Space to moderate, particularly in the US and Europe, whilst damage to fiscal balances is repaired, demand in commercial and security markets is forecast to grow strongly. In particular, high growth is expected in Earth Observation (EO), Global Positioning Services (GPS) applications and global internet delivery.

UK Space: a hidden success story

Space has been one of the hidden success stories of British industry over the past few decades. In 2007, it generated revenues of £5.9 billion in the UK, of which £2.8 billion contributed directly to the nation's Gross Domestic Product (GDP). The sector also accounted for 19,100 jobs as a direct result of its activities, with employee productivity more than four times the national average. It consequently contributes some £145,000 per worker to UK GDP. Significantly, both manufacturing and operations are capital intensive and require highly skilled people resulting in graduates filling nearly two-thirds of all jobs. Space manufacturing is a uniquely advanced technology sector that builds very high-value bespoke products, which have to operate with guaranteed reliability for up to 20 years in a remote and hostile environment. Overseas demand for products and services will always far outstrip domestic needs, meaning the vast majority of the UK's Space products and services are exported.

Space is an industry that punches above its weight in the UK economy. Oxford Economics, the highly respected forecasting agency, estimates that the UK Space sector, including suppliers and induced employment and services, contributes around £5.6 billion in value added to the UK's GDP and supports around 68,000 jobs directly and through its wider spending.

Science remains a very strong and key part of our success in Space, with the UK being the second-largest publisher of major Space science papers in the World, providing a knowledge base for many other developments. The technology spin-offs from Space affect industries from medicine to manufacturing. The end-user applications affect our lives in every way, from communication at home and work to security, safety, entertainment and travel.

Exceptional growth from exploiting R&D

Avanti was a small company operating its internet service from London using space rented on existing satellites. In 2005 it committed to buying its first satellite — a new breed that can change frequency and power. This was only possible because a partnership of Astrium, Avanti, BNSC and ESA came together to develop and de-risk this novel architecture. This satellite will launch in 2010 and will deliver a 10 Mbps broadband service to rural communities in the UK and benefit those not able to connect to a service that most of us take for granted. By creating this supportive environment, the UK has helped Avanti secure £600 million of private investment over the last 5 years to purchase satellites and set up services and sell broadband capacity in Europe, the Middle East and Africa. The city has reacted well to this growth model: Avanti's share price has doubled between 2007 and 2010.

Helping the trains run on time

Rail operators increasingly need reliable, real-time, information about their trains if they are to maintain the safety, security, and performance of the network. They need access to performance data and diagnostics as the network operates to make real time decisions about how best to run the service. This data is critical if there is an incident and useful for assessing drivers. To really develop a fleet-wide real-time information and management services needs a seamless communications service across the network. By integrating terrestrial and satellite communications with traditional train reporting systems and satellite navigation services, Nottingham Scientific Limited (NSL), a UK based SME, is working with ESA and the train operators to implement a proof-of-concept solution. This will allow operating companies to communicate with their trains anywhere on the network and data to be uploaded or downloaded in real time. Initial applications will include train tracking, remote engine monitoring, incident management and driver training.

Advanced Manufacturing and Services

Satellite manufacturing in the UK is worth £800 million, around 14% of the UK's Space sector. Many of these manufacturing capabilities are world-class. For example, Astrium, a pan-European satellite manufacturer, builds one-quarter of the world's telecommunications satellites and chooses to manufacture the entire payload and mechanical systems for these in its UK sites, together worth 50% of the value of the satellite. Surrey Satellites has developed an enviable reputation as one of the world's best small satellite manufacturers, integrating commercial off-the-shelf components to supply complete small satellites to a growing commercial and institutional market for affordable Space capability. UK companies are also developing disruptive manufacturing technologies, for example, Reaction Engines Ltd is developing propulsion technology for next generation 'single stage to orbit' Spaceplanes. There is also the potential to link across manufacturing sectors where UK is particularly strong, such as autonomous systems, advanced robotics, encryption and power systems.

The UK also has a world recognised services sector. Companies such as Logica, Finmeccanica and QinetiQ provide entire systems integration solutions, software and applications technology. Inmarsat, Paradigm and Avanti Communications are very profitable UK-based satellite operators and BSkyB is one of the largest providers of broadcast content using satellites with over 12 million customers. Innovation in the sector is not just technical: Paradigm has provided a world leading PFI solution for secure satellite communications for the Armed Forces.

The UK's supply chain is relatively strong. It comprises many companies that have the high integrity manufacturing needed for Space systems and companies generally have access to facilities that they need such as specialised clean rooms. However, the relatively low volume of some very high value, bespoke, components means that only a very few companies manufacture these and they are all located overseas. For example, radiation-hardened application-specific integrated circuits are most often procured from the US. The value of these components can be significant: on one of the UK's flagship programmes some £15 million of components were bought from abroad.

Government support is key to unlocking economic benefits

The UK Government provides direct and indirect investment in the sector, by supporting research and technology, Space science and missions. Not only is it a customer, it is also a sponsor and it offers further help by promoting civil and defence exports. In 2008/09, Space received some £265 million in national project funding through ESA contributions, the Technology Strategy Board and Research Councils. However, this project funding represents good value for money as each activity must demonstrate that the economic and social benefits exceed the investment, including the opportunity costs of investing funds elsewhere in the economy.

As part of her support for the 'Innovation and Growth Report', the Chief Economist at the Department of Business Innovation and Skills has published an assessment of the economic impact of the UK's Space sector. This draws on common data sources but the analysis is independent.

With co-ordinated action we can create a comparative advantage for UK technology and services. We can secure greater wealth creation, more jobs and enhanced intellectual leadership

10%

market share

We have set a clear challenge to firmly establish the UK as one of the World's leading Space nations and grow the UK's share of the global market

The UK does not have a capability to collect valuable data for monitoring climate change and supporting activities related to national and international security, despite the fact that requirements for imagery exist across many Government departments

She concludes:

- Between 2000 and 2008 the global Space sector grew at a rate of 7% to 8% per annum in real terms with growth accelerating in the last three years. The UK grew at a rate of 9% per annum in real terms during the period 2006 and 2007.
- Government investments in Space deliver measurable direct benefits which are, on a proportional basis, at least as big as those in related areas. Space is a credible investment within a wider portfolio of private sector technology investments.

Space combines high-value manufacturing and services, advanced technology and an ability to deliver key government policy objectives

Space is a complex market characterised by strong government interventions prompted by issues surrounding international standing, national prestige, influence in international negotiations and military superiority. The US Government alone spends over $60 billion on Space annually, representing a mammoth 25% of the global market. Furthermore, France, Germany and Italy contribute as much to indigenous Space programmes as they do to ESA. Brazil, China and India, are also investing strongly in Space infrastructure. Therefore, successful competition in the Space sector requires industry, academia and governments working together at a national level. Fortunately, thanks to past investments, the UK is well positioned for this competition. We have a strong academic and industrial base and we are technologically ahead of Brazil, China and India. Space is therefore one of the high-skilled, high technology sectors where the UK should focus its efforts. But we must recognise that this should be a collaborative effort and UK Government intervention remains essential.

With co-ordinated action we can create a comparative advantage for UK technology and services. In doing so, we can secure greater wealth creation, more jobs and enhanced intellectual leadership. The UK Government is already a significant investor in — and beneficiary of — Space, but it could obtain more value from its investment and at the same time use Space to deliver more services to its citizens. Space is a diverse sector resilient to fluctuations in economic growth; it has high growth potential, it produces advanced technology, has low carbon credentials and strong scientific foundations. The UK should, therefore, allocate a disproportionately higher share of industrial funding to capitalise on the opportunities for growth that Space offers.

Space should have the opportunity of delivering more cost effective services for UK citizens. An advantage of providing services from Space is that often this is truly national (if not wider) — one solution can replace the need to integrate many local and intermediate delivery systems. Aggregating requirements for cooperative services should, therefore, include central government departments, devolved administrations, local government, agencies and emergency services. It is the local part of government that delivers the services most visible to citizens and where the majority of public spending is committed.

The time for positive action is now

We are at a crossroads in terms of the strategic direction for the UK. The UK's share of the world Space market in 2007 was around 6%. This substantial figure is about twice the size of many other major UK industrial sectors, but less than that of our leading industries. However, if we take a positive decision to go for growth, we can raise the market share significantly. But, if we fail to step up our efforts there is a strong likelihood that the sector will slide back to around the 3% mark. This might prompt the departure of some of the large multi-nationals which have chosen to invest in the UK's Space sector. It would certainly wipe out much of the UK's past investment in intellectual capital with a consequent loss of our existing strengths.

We should not overlook the fact that the UK is a major stakeholder in this sector both directly and via the European Commission. The time has come for us to use these investments to create economic growth and provide the best possible services for citizens at the best possible price. We have therefore set ourselves a clear challenge to firmly establish the UK as one of the World's leading Space nations and grow the UK's share of

the global market to 10% over the next 20 years. This drives Space in the UK from a £6 billion to a £40 billion sector. Of course, we will not achieve this overnight, and the scale of the investment needed to achieve this will only be manageable if it is selective. But, what we can do now is set a trajectory for growth. It is vital that we create the right business environment and seize the market opportunities to deliver the national benefits. We outline these elements below.

Providing the environment for success

If we are to realise our vision, industry will need to feel confident enough to aggressively and significantly increase the amount it invests in Research and Development (R&D), its capabilities and in its people. It will need to take the required risks involved in grasping new opportunities in order to be first to market with innovative services. We recognise that the majority of investment to meet the growth target will have to come from industry rather than government. That will require private venture capital taking advantage of opportunities offered in commercial markets and Private Finance Initiative (PFI) style arrangements to meet future government requirements for end-to-end services. Likewise, operators must be able and willing to raise the capital needed in financial markets. The overall scale of the private investment required will be large, certainly exceeding several billion UK pounds.

To succeed, Space must be seen as a strategic sector in the UK and one that can offer an important infrastructure for our economic and security needs. Britain does not secure as good a return on investment as other Space nations because it lacks a single, strong focal point. The UK's current civil Space policy is not sufficient to generate the change required — Space in the UK is a successful but small sector — but a better definition and commitment to a long-term policy should deliver significantly more in terms of innovation and growth. It should provide the framework for the UK to participate fully in the definition and build-up phases of new European programmes. By delaying entry to programmes and funding in an ad-hoc manner, the UK has lost both the best industrial work and the ability to influence programmes to best meet national needs. Examples include Galileo and the Global Monitoring Environment and Security programmes. The UK is generally perceived as a follower rather than a leader in Europe on large Space programmes.

The UK Government has done much to promote Space in recent years but does not have a coherent, overarching policy that encompasses civil, defence and security components. Consequently, it is difficult to draw together disparate government funding and requirements, and set out clear policy with associated implementation guidelines. A fragmented approach across the public sector wastes money and reduces the opportunities for UK industry to compete for domestic work. Therefore, we need a pan-Government National Space Policy that harmonises the needs of the public sector and creates opportunities for wealth creation in the UK. Industry will step up to meet UK needs with innovative technical and commercial solutions.

Applications and services using Space data will be one of the most important elements for delivering growth — typically the lifetime return from services is 10 times that of manufacturing — so an industry/government partnership must aggressively develop these too.

The UK should, therefore, consider the measures needed to enable UK operators to grow. Indirectly, this will also provide new opportunities for UK-based manufacturers to compete for business and exploit emerging technology. A large communications satellite and its launch can cost up to £400 million. Furthermore, a return on this significant investment can sometimes take as long as seven years to accrue. However, overseas competitors are able to take advantage of government-backed loans or export credit guarantees to fund the procurement and launch of satellites. The UK, on the other hand, operates schemes that may be suitable but are generally at a scale lower than overseas agencies, and this leaves the UK at a competitive disadvantage.

This report forms a starting point for a national policy and sets out options that will help deliver the 20-year vision.

An important start to more agile governance has been made by the current Minister of State for Science and Innovation with the announcement of the establishment of a UK Executive Space Agency. Although this is a much welcomed decision, it is imperative that the Executive Space Agency has the resources needed to effectively deliver the National Space Policy and the business and science opportunities for the UK. Moreover, the UK Executive Space Agency should cover civil space, security and defence requirements, be responsible for procuring Space programmes and lead on all Space-related activities in national and multi-national negotiations.

Promoting Space investment in an export-led Space industry

Satellite Earth Observation (EO) provides valuable data for monitoring climate change and supporting activities related to national and international security. However, the UK does not have a capability for collecting such data itself, despite the fact that requirements for imagery exist across many parts of the public sector. Today, although the UK is involved in a number of pan-European EO programmes, as a nation, we are reliant on Space EO data from other nations, particularly the US. We also purchase data from commercial suppliers. The reasons for this are varied, but it has been argued that no single department has a significant enough requirement to warrant a separate UK EO satellite service. However, when all of the public sector's combined EO satellite usage is considered together it seems more than likely that there is a sufficient user community to justify an indigenous capability. An important aspect for such a capability is that the UK chooses what to view, at home or abroad, without interference or delay, and understands exactly how that data is processed.

If the UK wishes to play a prominent role in future security, disaster relief and climate-change activities, the national need for access to independent data is likely to increase. Moreover, the UK's economic well-being and trading interests will be better served from independent data that can be used to derive new climate change, emissions monitoring and emissions trading models. Over a 20-year timeframe, many nations will build or procure an indigenous Earth Observation capability, and the UK will be seen as less relevant in the international arena if it cannot offer high quality analysis in this area. China's reluctance to accept independent monitoring of its carbon emissions at the December 2009 Copenhagen Climate Change Summit highlighted the future role that Space-based assets will play.

The UK has deep-rooted strengths in Space technology and a strong record in ground-breaking systems exploitation. It also has tried and tested expertise in risk-sharing and innovative commercial business models. The UK's Skynet 5 military satellite communications

Smart Homes

In the near future Smart Homes will use new technology to increase the energy efficiency of dwellings. Integral to these homes of the future will be 'Smart Meters', a technology proven to stimulate home owners to be more economical by providing information on energy usage, but also reduces costs by providing a link to the energy supplier removing the need for manual meter readings. All UK homes and businesses are to have smart meters by 2012.

Low data rate 2-way satellite communications offer the prospect to connect all of the UK's 26 million homes to the energy supplier's control centre with a common system. One satellite, already available in orbit, provides more than enough capacity. It is a green solution — the meters would link to modems which themselves could be solar powered.

Space will have to compete with existing, local solutions and show it is lower cost than alternatives. But the attraction of Space is one, national, integrated solution to a straightforward need, and technology and IPR that may be exportable to overseas markets.

programme has been delivered using an innovative service-based approach which has enabled the UK to export secure satellite communication services to a wide range of overseas organisations. There is considerable scope for applying this business model to acquiring a UK-based EO capability, so that in addition to meeting national needs it can catalyse a significant export business.

The European Space Agency — winning a better return for British Space

At the moment, UK R&D funding for Space is largely provided through the European Space Agency. Although this creates benefits for Europe that would not otherwise be possible due to the high cost of research and demonstration programmes, it also requires compromise for the UK in multi-national decision making. Moreover, UK dependence on ESA for preparatory and development programmes has resulted in some areas of UK technology development becoming eroded to the point that they are no longer industrially sustainable.

In order to increase the UK's influence in ESA programmes and to maintain capabilities in key technologies, the UK needs a complementary national Space technology programme aimed at generating economic and social benefits for the UK, and reinforcing areas of national strength. Such a programme would enable the UK to assume a greater leadership role in ESA's R&D programmes and missions as well as increase our say when considering technical options.

A characteristic of Space programmes is that a disproportionately larger national and industrial benefit will accrue from a greater involvement in a targeted number of programmes as opposed to a fragmented, small-scale involvement in many ESA projects. This will be even more important as the European Commission assumes greater responsibility for determining a European Space Strategy under the terms of the Lisbon Treaty. As ESA becomes an executive agency for EU Space policy, there will be increasing opportunities to compete for a share of European programmes on a more commercial basis.

In addition to establishing a UK national Space R&D effort, as we emerge from recession, the UK should also set a pathway for significantly increasing its ESA contributions more in line with other leading ESA Members States. This will enable larger-scale Space programmes to be deployed from the UK and strengthen the UK's influence in ESA decision making.

The wider global competitive benefits of a national Space technology programme

It is important that the UK continues to secure a comparative advantage from developing and exploiting technologies for future markets in both the manufacturing and applications areas. The UK can best achieve this by establishing a National Space Technology Strategy (NSTS), underpinned by technology road-mapping from research to market, with a ring-fenced budget, separate and additional to ESA budgets. This would not be extraordinary, as most other major developed nations have such complementary technology funding programmes. A national strategy should be part of an integrated end-to-end process that drives manufacturing and applications technology from 'blue skies' concept development to research and then to demonstration and exploitation. Such a model would naturally need clearly defined roles for academia, industry and Government.

Supporting disaster relief with commercial satellites

In 2004, DMC International Imaging started a commercial service that provides quick-response satellite imagery of disaster areas that helps the international community plan its emergency relief efforts. This system has been deployed following the 2004 Asian Tsunami, Hurricane Katrina and the recent earthquake in Haiti. DMC International Imaging is a spin out company from Surrey Satellites, itself a company that grew out of a spin off from the University of Surrey. Surrey Satellites has been highly successful in developing small, low-cost, satellites and now exports these globally. Although this success is based on the innovative 'affordable satellite' concept, of equal importance was the vital support and protection the company received in its formative years as part of the University of Surrey. Not surprisingly, the company retains these close links with academia to this day.

Rocket launchers

Following the difficulties of the Sea Launch Partnership, the prices of alternative rocket launchers have reflected a lack of supply. This shortage is a concern. The UK needs to keep a close watch on this situation but cannot realistically enter this sector alone. However, the UK needs to retain technological options that have potential for future application, for example autonomous 'single stage to orbit' Spaceplanes that could launch satellites at significantly lower cost and risk than today's systems.

Space tourism provides an exciting new potential market for Space. It is also possible that launch vehicles such as Virgin Galactic's White Knight and Spaceship 1 could provide the basis not just for tourism but also low cost launch to the edge of Space.

Using Space to meet national 'big challenge' objectives

There is a clear opportunity for the public sector to increase its use of Space-enabled services to obtain tangible benefits for UK citizens. These benefits would be accrued through, for example, lower costs to consumers for obtaining a service, lower carbon emissions for running a service and access to a service for all UK residents regardless of location. Already, Space telecommunications are vital for delivering important entertainment and commercial activity such as live sporting events and up-to-date news coverage. In two years' time, the London 2012 Olympics will be a showcase UK event which will be broadcast to every corner of the Earth.

Space has the potential to enhance other aspects of daily life. It will improve many future journeys be they by air, sea or rail. For example, Space can cost effectively improve rail journeys to work by replacing ageing signalling systems with a Space navigation-based application. This will enable more trains to run on the network at peak hours.

Success in the business of Space will be based on exploiting its unique benefits:

- ubiquity of service, for example, delivery to all parts of the UK,
- low-carbon delivery of broadcast and broadband services,
- affordable deployment to remote and rural communities,
- a resilient and secure alternative infrastructure to terrestrial infrastructure,
- export potential of services and systems.

Space-based services: the UK's 'second' ICT infrastructure

The UK should seize the opportunity of fully developing satellite-based systems to complement the UK's fibre optic and wireless networks. Fibre optic and wireless will provide the majority of the superfast broadband in the UK as set out in Digital Britain. But access for all citizens to broadband will become important as new services and entertainment are only available via the internet.

100,000

new jobs

The proposed expansion will provide an estimated 100,000 new jobs in the UK, and to meet this demand our schools and universities will need industry support

The internet will be increasingly used by Government to deliver lower-cost services for citizens. 'Smarter Government' itself asserts that it can be four times cheaper to deliver services over the internet than by post. The Space sector is helping deliver a fast solution to the Universal Service Commitment (USC) for broadband from 2012, as set out in the Government's 'Digital Britain' strategic vision paper. The Government can also drive additional investment by accelerating the procurement of part of the next-generation superfast broadband from Space as part of a national approach. Space will have to deliver value for money to achieve this. A UK solution also opens the door for export opportunities in a global market for 'internet from Space' that we estimate is likely to be worth £29 billion per annum by 2030.

By playing to the very high efficiencies of broadcast from Space and by optimising the way that broadband internet services are delivered, we estimate that the UK can achieve a reduction of up to 40 million tonnes of CO_2 per annum from that required to run an equivalent terrestrial broadcast and broadband service. Space is also likely to be the only cost-effective way to deliver a good choice of High Definition TV and broadband to rural communities. Because it is quite separate from terrestrial infrastructure, it also provides an important element of commercial and Government resilience to natural disasters and terrorist attack.

Using Space to inspire and educate

The general public, some elements of the business sector and even parts of the UK Government have a limited understanding of the true value of Space. To counter this, the Space industry needs to continue to improve and build up a greater awareness of Space-enabled capabilities. This is particularly important given the need to influence a public policy and industrial agenda if we are to grow this sector.

The proposed expansion plans will provide an estimated 100,000 new jobs in the UK, and to meet this demand our schools and universities will need industry support to raise awareness of the opportunities afforded by a career in the Space sector. Industry will also need to offer more training and apprenticeships to fill the jobs that will arise from the planned growth in manufacturing and services. Consequently, the Space industry will collaborate with other Space stakeholders to launch a publicity campaign to inspire young people to choose courses based on Science, Technology, Engineering and Mathematics — the so-called STEM-related subjects.

The Space Age

The global data network is undergoing two massive changes. Firstly, the volume of data being moved around the Earth is finally hitting the vertical part of the J-Curve which was being predicted during the dotcom boom.

Reusable launch vehicles

In the 1970s, the UK made a choice not to develop new rocket launchers. But this may not be the last word — a growing demand for greener, more reliable and lower cost launching systems for satellites could enable the UK to re-enter a profitable niche in this sector. Reaction Engines are developing novel propulsion technology that will be needed for a single stage to orbit (SSTO) 'reusable' Spaceplane, research that is combining company, ESA, BNSC and Technology Strategy Board funding. Bristol Spaceplanes are researching alternative SSTO concepts. Virgin Galactic could provide an earlier satellite launch capability to the edge of Space based on their now maturing White Knight and Spaceship 1 Space tourism vehicles. There is no shortage of ingenuity and technology in the UK to help make something happen.

Revolutionising access to Space may have wider economic benefits. Can we reduce the build costs of satellites if they can be launched at a fraction of today's costs? Do we need to retain spare capacity in orbit if satellites can be launched at very short notice? Will insurance costs reduce significantly if a Spaceplane based on aircraft technology replaces a rocket?

These potential benefits, as well as the industrial manufacturing benefit, means the UK must continue to develop such disruptive technologies.

The use of multimedia by consumers, and video in particular, is resulting in end-users doubling their demand for data each year, but new applications emerging in navigating, monitoring and measuring our World are compounding this. Secondly, governments globally have realised that high-speed data connectivity is both a crucial infrastructure and also needs to be universal if major populations are not to suffer serious economic and social disadvantage. Thus, high data-volume applications and ubiquity will characterise the next phase of the evolution of the Internet.

This plays directly into the hands of the Space industry since those are the very two advantages that Space technology has over terrestrial technology. Already satellites dominate the global TV market and this will accelerate. In future, no-one will make a journey which is not enhanced in some way by satellite navigation. Only satellites can deliver the social inclusion of universal global access to broadband and mobile communications. And the only way to determine for certain how serious the climate change problem is and how we need to manage our environment is to gather a vast amount of data in real time — only satellites can do this. With comparably low investment, satellites can provide universal global coverage. As demand grows, capacity can be added in a scalable fashion. Moreover, it can be moved if demand patterns change. Terrestrial technologies provide a patchwork solution to some of the issues evolving in the corporate, institutional and consumer markets. Satellite technology development is necessarily slower than elsewhere because of the physical challenges of operating in Space, but we have caught up with the terrestrial telecommunications and computing advances of a decade ago. Finally, satellite technology is coming of age, and thus the next phase of evolution might rightly be characterised "The Space Internet".

Space-related benefits

There will be extensive economic and social returns from Government and industry's investment in Space-enabled services. Most prominent of these are:

- the creation of at least 100,000 high-skilled high technology jobs over 20 years,
- year-on-year growth of inward investment for Space-related activities over the 20-year strategy,
- the UK plays a more strategic role in the use of Space for European and world-wide security,
- the UK becomes the first 100% broadband-enabled country in the world,
- a leadership role in global climate-change monitoring and up to 40 million tonnes of reductions in UK carbon emissions,
- reduced costs of delivering Government services to all citizens, regardless of their location,
- increased student up-take of STEM subjects.

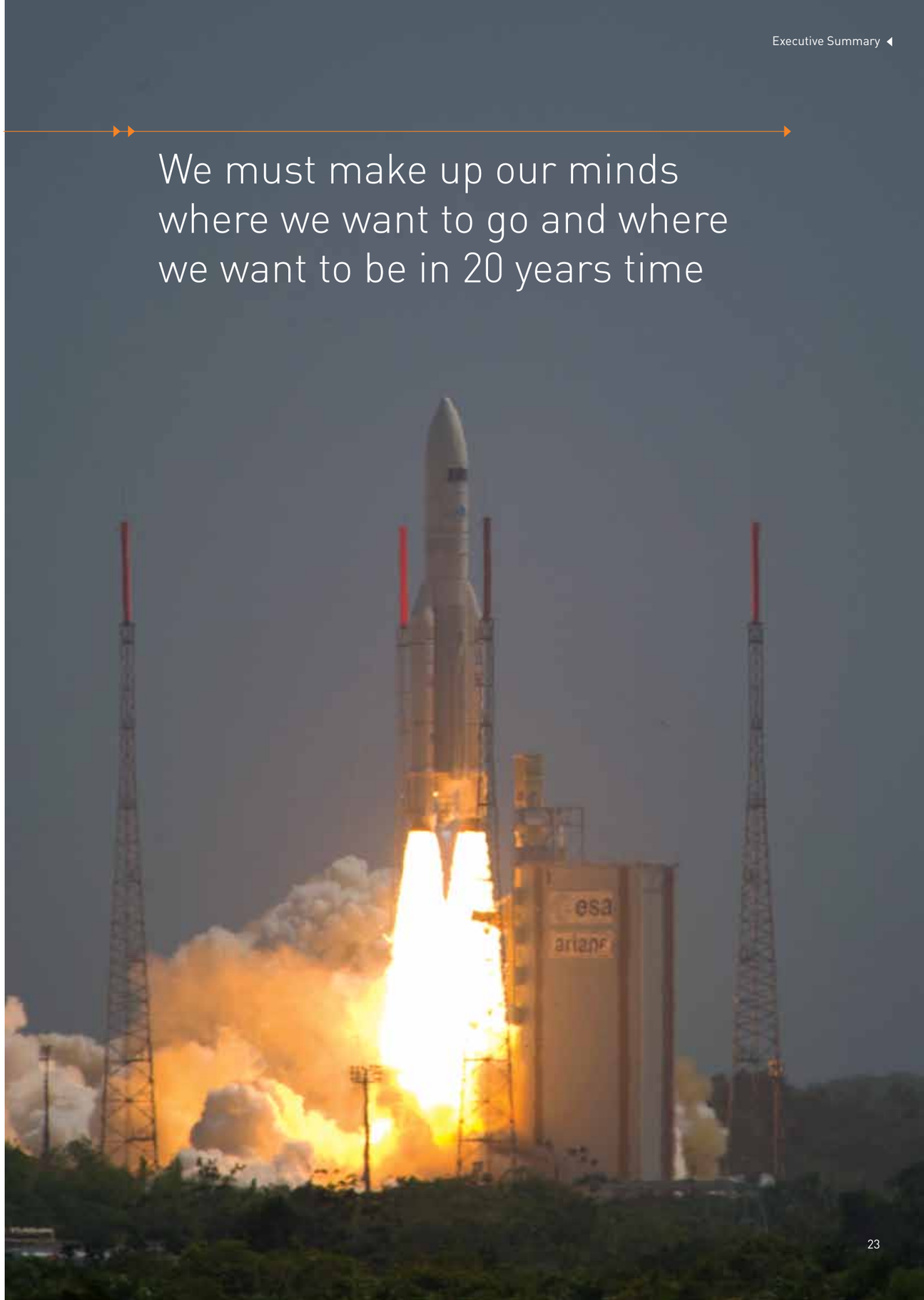
Implementation of the 2010–2030 strategy

A joint industry and Government partnership is needed to take our Space strategy forward and this should take the form of a Space Leadership Council, jointly chaired by the Secretary of State for Business, Innovation and Skills and the President of the UKspace trade association. We envisage that this Council will oversee progress and implement the specific recommendations in this Strategy until the new Space Agency is fully operational.

Over the last decade, industry and Government have collectively failed to grasp the opportunities we identify in this report. Space in the UK has been characterised by review after review allowing other countries to steal a march on us. This must now cease and be replaced by positive and practical actions. We must make up our minds where we want to go and where we want to be in 20 years time.

Today, through this Space Innovation and Growth Strategy, industry has made its choice. We will raise our game and go for growth and innovation. We ask Government to support us by providing the critical opportunities and the clarity of commitment and purpose that the Space community needs to succeed in this endeavour. Given the prize on offer, this is a challenge that we should all be prepared to meet.

We must make up our minds where we want to go and where we want to be in 20 years time



Recommendations

A trajectory for growth

The global Space market is worth a massive $250 billion per annum and is driven predominantly by commercial and consumer services. It includes satellites and their associated ground systems, which produce the Space-based applications as well as the consumer services and the numerous bits of equipment used to exploit them. The section of the market that exploits the satellite infrastructure is by far the largest as it crosses many industries such as agriculture, banking, broadcast and transport. In all, the end-user market segment accounts for between 80% and 90% of the total market.

Over the last decade, the Space market has seen substantial and sustained growth, with the UK industry growing at a steady 9% per annum since 2000. This expansion has been driven most strongly by the demand for telecommunications and navigation services, which represent over 50% of the entire market. Both these sectors have been growing by more than 10% each year. This growth is expected to continue for the foreseeable future as new technologies enable new services, faster speeds and greater access.

Over the coming decade, there will be significant growth opportunities in the telecommunications field, particularly in broadband internet from space, internet on the move, "smart homes" and mobile telephone services as well as High Definition (HD) and 3D TV. It is already almost impossible to make a journey that has not in some way been enhanced by satellite navigation.

In the future, with the completion of Galileo and the upgrade of GPS to its third generation, many more applications will be enabled. Applications such as mobile location-based services and indoor navigation systems, in particular, are expected to become more widely used in a variety of industries like agriculture, tourism and transport.

Major market growth is also expected in Earth Observation (EO) data provision and services where the market has traditionally been dominated by government applications. As EO data becomes more accessible to the consumer, through innovations like Google Earth, and as new markets related to climate change and carbon emissions monitoring emerge, and existing security markets grow, this will lead to a further significant expansion of the market. Furthermore, new markets and applications are also anticipated from the integration of EO and position data with telecommunications services.

However, for the service markets to prosper and grow, investment is needed in the satellite infrastructures on which they depend as access to them is crucial. But, this access is reliant on a whole spectrum of factors — from an appropriately trained and educated skills base to a healthy and diverse domestic Space industry and public awareness of the benefits and opportunities of this exciting sector.

The recommendations for growth in this report recognise the high growth markets, the need for innovation and the interdependence between service provision and the satellite infrastructure.

Keys to growth are therefore investment in R&D, targeted and "smart" infrastructure procurements, co-ordinated efforts to grow exports, academic research into industrial exploitation, skills development and the creation of a stable, long-term policy and regulatory framework, with economic growth at its heart.

Industry is ready to invest for growth in the Space sector and raise the UK's share of the global market to 10%. But, Space is a sector where national success can only come from industry and Government working closely together in a carefully planned and managed way. Both industry and Government need to be clear about their roles in the strategy and aware of what the requirements are. Therefore, we have developed the following 16 recommendations and grouped them into eight main themes:

1. Providing the environment for success
2. Promoting investment in an export-led UK Space industry
3. Increasing the use of Space within the National ICT infrastructure
4. A safer world with more resilient infrastructure
5. Regulating Space for success
6. Using Space to inspire and educate
7. Promoting a UK-wide SME Space sector
8. Making it happen

The background information supporting and explaining these recommendations is contained in the full report which is available at **www.SpaceIGS.co.uk** and can be downloaded along with complementary Working Group reports.

Providing the environment for success

Recommendation 1

The UK Government should define and implement a National Space Policy (NSP) that includes the UK's economic, social, industrial, defence and security interests. This NSP should combine all Public Sector requirements and funding for services that can cost effectively be delivered by Space in order to provide new wealth-creating opportunities for the UK.

Unlike many other industries, it can take as long as 20 years for returns on initial investment to cycle through the various phases of programme implementation. This means that a consistent policy environment is more important in the Space industry than in many other sectors for promoting investment. A national approach to Space would provide industry with important information about the likely requirements for Public sector services that are consistent with national needs and affordable. This, in turn, instils the confidence for industry and academia to invest in the technology and services that are likely to provide healthy returns and economic value.

To secure the highest benefits, Space should be seen as a strategic industrial sector in the UK — one that can offer an important infrastructure for our economic and security needs. We ask

that the UK Government recognise Space as a key high-technology industrial sector alongside aerospace, life sciences, biotechnology and defence, and resource appropriately.

A major step forward is the announcement of a UK Executive Space Agency. But the Agency needs to operate within a clear policy framework. We propose a Cabinet Office-led process to formulate and agree specific policy objectives that need to be agreed across Departments and signed off at Cabinet level. This report does not seek to define Government policy but it would be appropriate, given the industry effort, for the early stages of policy to build on this Innovation and Growth report by identifying a small number of consolidated Public Sector requirements that could produce early opportunities for industry.

Crucially, if the Public Sector can come together to define common requirements that lead to viable and attractive commercial opportunities, the UK Space industry is prepared to step up with innovative ways of exploiting the technology and services in export markets as well as at home. Much technology in Space is dual use and more can be made of R&D if it is clear how it can be exploited in both commercial and defence markets. Moreover, it is likely the defence and security needs will be met by adapting commercial technologies so it is important that defence customers are aware of the potential developments that are being driven by commercial demands. This would generate major wealth-creating opportunities.

Number	Action	Timeframe
A1.1	Define the National Space Policy that establishes the UK's likely public sector needs from Space, highlighting where early action by Government and Industry can deliver national and economic benefits	January 2011
A1.2	The UK Government should recognise Space as a key high-technology industrial sector alongside aerospace, life sciences, biotechnology and defence and resource appropriately	January 2011
A1.3	Industry to specify innovative proposals to requirements	January 2012
A1.4	Regular joint Government and Industry review of policy success	Annual

Recommendation 2

We recommend that the UK Executive Space Agency (UKESA), when established, should be resourced and empowered to maximise the growth opportunities for the UK Space sector. It should lead on all UK Space-related activities including national and international negotiations and delivery of the National Space Policy. It should have a remit including civil, defence and security Space domains.

The UK Executive Space Agency (UKESA), which will replace the British National Space Centre (BNSC), should provide the mechanism for delivering a National Space Policy that maximises opportunities for the UK Space sector. It is therefore absolutely vital that it is sufficiently resourced and empowered, as a lack of these vital elements resulted in the BNSC's inability to fully achieve this goal. The UK Executive Space Agency should aim to develop itself into an organisation capable of being a champion for the UK's Space industry both at home and internationally, and in terms of functions it should:

- be empowered to lead on all Space-related activities for the UK in national and multi-national negotiations and in prioritising programmes,
- have a broad remit which includes civil, defence and security requirements, particularly where these will develop cross-cutting technologies and applications,
- be responsible for the administration of a national Space budget and provide the backing for the UK to lead national and multi-national programmes,
- be responsible for procuring Space and Space-related programmes wherever the procurement budget is held within Government,
- promote the UK's Space sector.

Space knowledge, expertise and talent are a scarce global resource. Our universities produce generic talent in the form of scientists and engineers, and there are excellent research centres producing MSc and PhD graduates with relevant Space sector skills. However, the majority of Space industry recruits have no direct commercial experience on leaving academia. Quite naturally, industry provides this through formal and on-the-job training. We propose that UK Government benefits from this training by putting in place a framework to promote an exchange of cultures and experience between industry and the Agency through staff secondments. In the early years, industry would be very interested in placing experienced staff in the Agency to rapidly build its capability, with the intent that this becomes a two-way process by 2015. As well as covering science and engineering disciplines, these secondments should also apply to non–science-based personnel such as those engaged in finance, economics and law. This activity should be complemented by steps to expand both the public and private Space education sectors.

Number	Action	Timeframe
A2.1	UKESA fully operational	January 2011
A2.2	10 Industry Secondments to Agency	January 2012
A2.3	Two way Secondments underway	January 2015

Promoting investment in an export-led UK Space industry

Recommendation 3

The UK Government and industry should establish a National Space Technology Strategy (NSTS), with a clearly identifiable budget separate and additional to ESA and research council budgets. This recommendation is a key building block in delivering the ambitious innovation and growth planned and should be established quickly and funded properly. A National Space Technology Steering Group should be set up immediately to oversee the NSTS, chaired by industry, but with Government representation.

The UK will secure a greater comparative advantage in research by deploying a National Space Technology Strategy that is complementary to ESA R&D programmes. This strategy should be owned by a National Space Technology Steering Group (NSTSG), comprising industry subject matter experts supported by relevant Government officials. It should be facilitated through the Technology Strategy Board KTN (Knowledge Transfer Network) Space Special Interest Group. The NSTSG will be responsible for producing a technology strategy that is underpinned by road-mapping, includes estimated programme costs and outlines the progression of products from research to market entry. It should deliver the first of its reports and a set of technology road maps to the Technology Strategy Board before the end of September 2010.

R&D funding should be maximised as it is this budget that drives the ability to be first to market which with technical superiority will allow the UK industry to capture a greater proportion of the huge growth available. A £20 million national programme should start in 2010, jointly funded by Government and industry, rising incrementally as it becomes affordable by Government and industry to around £100 million per annum by 2015/16. The exact funding for years 2 to 5 should be determined from the road-mapping activity.

The strategy should be aimed at developing technologies that can be exploited in commercial and institutional markets. Funding should come from both industry and Government and be additional to the UK's spend on Space science through the Research Councils if it is to be effective in contributing to growth. However, the NSTS should be seen as part of an integrated approach by the UK from academic 'blue skies' research through to technology demonstration. It will, therefore, need to be integrated into a model that demonstrates how technology will be pulled through from Technology Readiness Level 1 through to exploitation and will need the support of Research Councils new to Space, such as the Engineering and Physical Sciences Research Council (EPSRC) and the Technology Strategy Board.

Technologies that play to UK strengths in autonomous systems, robotics, security, sensors, Space communications and software should be included in this national strategy based on the premise that there is a customer for the end product.

R&D funding should be maximised as it is this budget that drives the ability to be first to market which with technical superiority will allow the UK industry to capture a greater proportion of the huge growth available

As part of the NSTS, the UK should also continue to invest in technology for systems that could revolutionise Space services and access to Space over the next 20 years. This will help retain opportunities for the UK to develop high-risk options that have 'visionary' appeal and potentially very large commercial

value, for example, autonomous 'single stage to orbit' Spaceplanes that could launch satellites at a fraction of today's cost and risk.

These sorts of alternatives, often termed disruptive technologies, could revolutionise much of the Space economy by dramatically reducing the cost of satellites and the need to launch spare capacity. We should pursue these alternatives through international and national R&D funding programmes and they should be included in the UK's technology roadmaps.

Number	Action	Timeframe
A3.1	Establish the National Space Technology Steering Group	April 2010
A3.2	Launch a National Budget with funding	April 2010
A3.3	Finalise Technology Roadmaps	September 2010
A3.4	Identify increasing budget in line with roadmap needs and industry ability to co-fund	2011
A3.5	Increase annual budget to £100 million (£50 million private R&D matched by £50 million co-funding)	2015
A3.6	Review alternative (disruptive) technology development and funding	2015

Recommendation 4

The UK Government should provide more capital guarantees and/or anchor tenancy agreements to allow UK-based operators to raise the necessary finance to buy satellites and fund launches so that they can enter new Space-enabled service markets and grow their businesses. Although this need is not unique to the Space sector, we ask Government to note the high capital costs involved in the procurement and launch of individual satellites and the need for the UK to be first to market to exploit a growing export market.

Commercial activity in Space is capital intensive and start-ups can sometimes be very difficult to get off the ground. Moreover, it is a feature of this market that large upfront investment is often followed by protracted construction and payback periods, with significant risks along the way. But, when a company gets it right, it can create a business capable of generating huge cash flows. It also raises the barrier for competitors to enter into the same market segment. Another characteristic of this market is that the cost of satellites is frequently much greater than the investment required to set up and run a service operation. However, a major plank of our 20-year strategy is to expand UK Space operations as part of a broad approach to the sector which encompasses large multinationals as well as home-grown Small and Medium-sized Enterprises (SMEs).

Recently, a number of major commercial contracts have been secured by foreign companies in high-value export markets thanks to the availability of overseas government-backed

finance. COFACE, the French export guarantee agency, has been particularly active and French Space companies have won major contracts with the likes of O3B, Globalstar and others due to their Government's proactive stance. The UK lags in this area, and this has become more of an issue now that there is a significant difference between central bank rates and commercial rates following the recent financial crisis.

Space finance expertise is scarce but is a key factor in exploiting UK technology in commercial and institutional markets. In London, we have primary Space expertise in insurance, law, debt and equity capital markets but not enough transaction flow to compete with New York. We have a venture capital industry which has produced several Space winners, but is under threat from New York and Hong Kong following the removal of tax advantages.

It is important that we maximise the use of private finance to make Public Sector procurement of Space technology efficient, and in doing so strengthen transaction flow and expertise in London. We should encourage a selection of UK banks to actively develop capabilities in co-financing Space projects involving European Space Agency and Export Credit Guarantee Department contributions. We should also promote the AIM market as a Space venture market by identifying and publicising those city institutions which have an interest in investing in Space projects.

On the one hand, tax reliefs like Venture Capital Trusts (VCT) and the Enterprise Investment Scheme (EIS) have been instrumental in enabling new companies to enter the market. On the other, their reduction has further damaged the ability of small UK companies to compete. It is therefore imperative that macro issues like this are addressed so that these domestic businesses are better able to compete in the global Space market.

Number	Action	Timeframe
A4.1	Industry will set out all projects that will need intervention to proceed	December 2010
A4.2	Government to clarify methods of awarding loan guarantees or anchor tenancy that will satisfy city investors	December 2010
A4.3	Government to review (in concert with other hi-tech, hi-risk industries) wider financial mechanisms to grow the Space market	December 2012

Promoting Space investment in an export-led industry

Recommendation 5

The UK Government should procure an innovative indigenous Earth Observation (EO) data service that meets all Public Sector needs and creates wealth for the UK in domestic and export markets. Industry, in parallel, will offer innovative technical and commercial options to provide a PFI service and work with UKTI to maximise export opportunities.

A specific and very realistic opportunity for UK manufacturing and service organisations is in the fast-growing export market for Earth Observation data and systems. A co-ordinated approach from Government and industry is critical to secure a UK position in this market, particularly as this is destined to expand dramatically on the back of climate-change monitoring and mitigation activities.

Earth Observation is a huge and, to date, a relatively immature market. Many countries in Asia, the Middle East and South America are looking to develop or procure EO services because of the commercial, security and institutional value they generate. Space-enabled digital mapping services, like Google Earth, are attractive to many different customers, including those interested in monitoring climate change, disaster relief and border protection. The UK has an opportunity to build sovereign capability in this market and to take advantage of data and system export opportunities ahead of its competitors.

Government can use innovative procurement methods to meet UK needs for an indigenous digital planet-mapping and observation service and at the same time build new industrial capabilities that can be deployed in an important world market. If the Public Sector can identify the EO needs that generate most value, industry is prepared to commit to technology development and capital financing to make a PFI service attractive. Public Sector national needs could range from regular monitoring of heat emissions across the county, estimation of coastal erosion and flood risk, light pollution, measurement of UK carbon usage, project management of north/south high speed rail line and all-weather monitoring of shipping volumes in the channel, in addition to international needs.

Although no single UK Government Department has a requirement for EO data significant enough to warrant a separate UK EO satellite service, when all of the Public Sector's combined EO satellite usage is considered together it seems credible that there is a sufficient user community to justify an indigenous capability. It would also meet objectives to join up Government Departments to achieve more from the same — or even less — funding.

Space-enabled digital mapping services, like Google Earth, are attractive to many different customers, including those interested in monitoring climate change, disaster relief and border protection

A study should be conducted across all potential users within the Public Sector to gather and combine requirements, including a consideration of the potential savings available and the industrial/commercial benefits as well as international partnership and sovereignty issues. Industry should offer options for providing this service as a Private Finance Initiative (PFI) which would meet the anticipated UK requirements and have significant export opportunities.

The Technology Strategy Board (TSB) and SEEDA (South East England Development Agency) are currently considering the procurement of a small satellite platform for flight demonstration of various industrial payloads. We welcome this initiative and urge that the scope is expanded to encompass the demonstration of an affordable UK EO capability, including UK-developed synthetic aperture radars for small satellite systems.

Number	Action	Timeframe
A5.1	UKESA to identify full future Public sector needs and aggregate their use of Space-based EO data	December 2010
A5.2	Accelerate the TSB/SEEDA initiative to produce a demonstration satellite to test the most likely payload needs including EO	December 2010
A5.3	Joint industry and Government project study to respond with a PFI to meet the aggregated requirements	July 2011
A5.4	Offer an anchor tenancy/PFI programme to a UK-based operator for Government EO data	December 2012

Recommendation 6

Government, in partnership with industry and academia, should map out a strategy for the UK to secure world leadership in the technologies and services related to climate-change validation, adaption and mitigation. This should include verifying international carbon agreements. The UK should ensure that it levers its world-class research and modelling capabilities in climate change to full economic and social effect and support ESA's contribution to climate change through its recently established ESA Climate Office at Harwell.

Climate change is undoubtedly one of the greatest challenges facing mankind for generations to come, and there is an urgent need for the UK government to join international efforts in validation, mitigation and adaption. An early priority is to regain public confidence in the scientific evidence for action through the gathering of independent, incontrovertible evidence of the changes in climate. There is an equally urgent need to measure and to gain greater understanding of the "essential climate variables" in our ecosystem and atmosphere — the causes of climate change.

Together with the challenge, there is a significant opportunity for UK businesses to lead the world in the Space-based technologies and services that will play a significant role in climate change validation, mitigation and adaption. Measurements from Space are the only means of gathering global and independent evidence for validation of climate change and carbon agreement verification, and are often the most cost-effective means for supporting mitigation and adaption activities on the ground. The UK is well positioned to exploit these new technologies and services with an already strong industrial and academic base. This is expected to grow to a major global market, offering a significant economic growth prospect for the UK.

There is a significant opportunity for UK businesses to lead the world in the Space-based technologies and services that will play a significant role in climate change validation, mitigation and adaption

Number	Action	Timeframe
A6.1	UKESA with academia & industry to form a task force to develop a UK strategy	September 2010
A6.2	Develop the strategy with EU partners	December 2010
A6.3	Identify implementation plan actions into NSTS, EO data needs and ISIC	July 2011

Increasing the use of Space within the national ICT infrastructure

Recommendation 7

The UK should seize the opportunity to develop Space-enabled services to become the complementary Information and Communication Technologies (ICT) infrastructure to both the fixed fibre optic and wireless networks.

It will not be affordable to provide fast broadband services to all of the UK's communities as part of the Next Generation Access using just fibre optic or mobile networks. However, a mixture of fixed and mobile Space services can deliver more efficient High Definition TV broadcast for everybody and 'Next Generation Broadband' to rural communities in the UK. The issue to resolve, therefore, is exactly how much of the country must be covered by broadband from Space because it will take time for industry to provide this capacity.

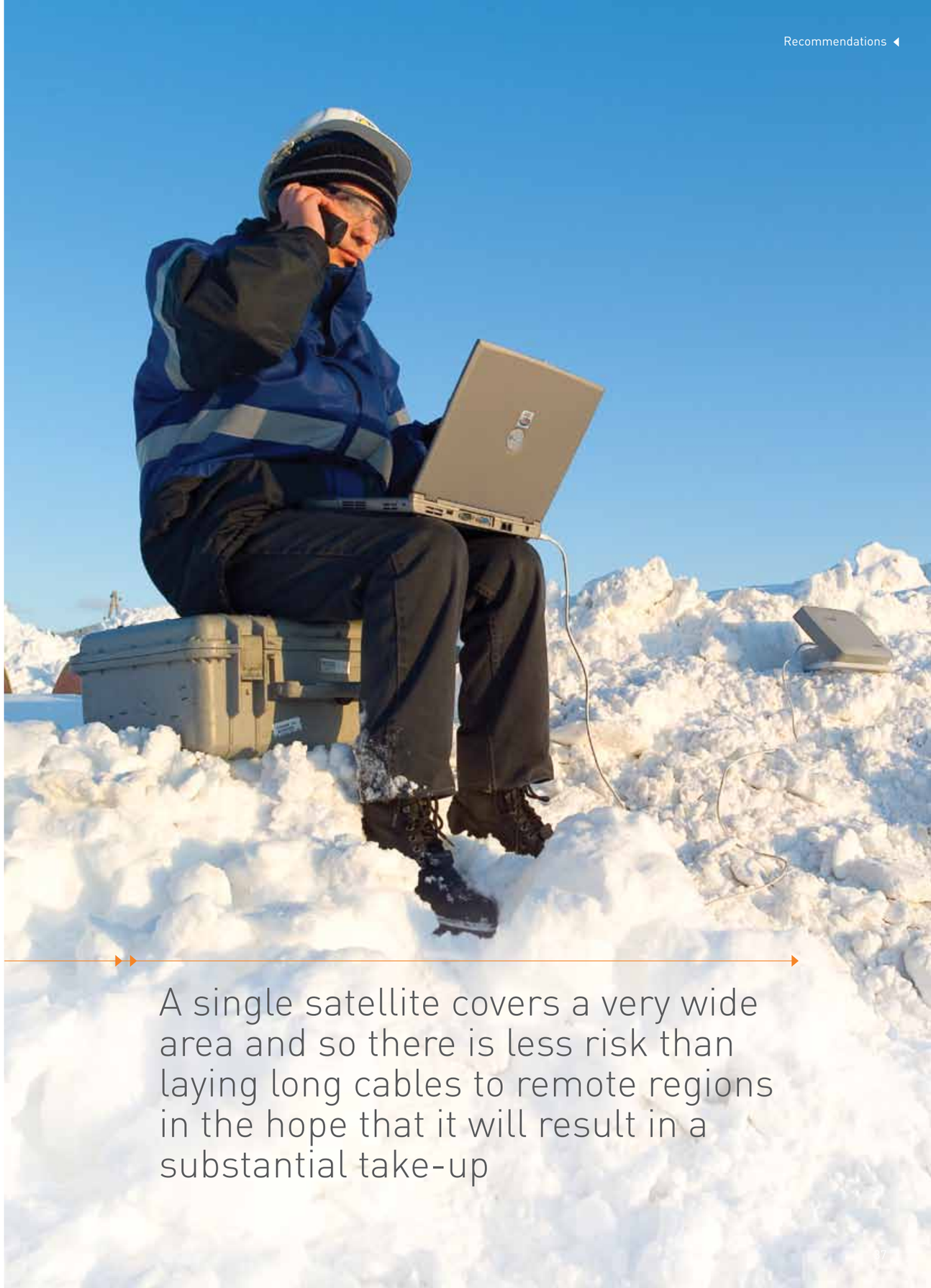
Government and industry should work together to define the infrastructure and architecture that enables Space to provide an affordable, ubiquitous delivery mechanism that is an enabler of a modern, low-carbon, digital economy. Space will help deliver a solution to the Universal Service Commitment (USC) set out in Digital Britain for broadband to all communities by 2012. Moreover, the Government has committed itself to supporting investment in the next-generation, superfast broadband reaching 90% of homes by 2017. The cost of achieving ubiquity in next-generation services will be extremely high, and future decisions which avoid disadvantaging rural communities will mean that terrestrial solutions start to become impractical as we move to 100% accessibility.

Government can also drive additional investment by accelerating the procurement of the next-generation broadband from Space as part of a national approach. This UK solution opens the door for export opportunities in a global market for 'internet from Space' that we estimate is likely to be worth £29 billion per annum by 2030.

Future broadband and broadcast requirements will stretch the UK's technology base. Over the 20-year period covered by this report, satellite manufacturers will need to increase satellite capabilities to deliver at least 100-fold improvements in bandwidth and develop satellites that can deliver a true 50 Mbps broadband and a large broadcast capacity at the same time. This will offer consumers a true 'one dish' solution for a Space infrastructure.

An important aspect of using Space-enabled services for broadband is that capacity can be added incrementally. Moreover, a single satellite covers a very wide area and so there is less risk than laying long cables to remote regions in the hope that it will result in a substantial take-up of premium broadband use. In addition, and depending on the model selected, Space-enabled services can provide for competition at the wholesale and consumer levels.

Number	Action	Timeframe
A7.1	Digital Britain team to assess how Space can assist the Universal Service Commitment for Next Generation Broadband	June 2010
A7.2	Digital Britain to support the current initiative by Space operators at no Government cost	June 2010
A7.3	The UKESA to fund a study by UK industry to respond with a Next Generation Broadband Architecture to allow early development of suitable hardware	December 2010
A7.4	Government to propose a complementary satellite infrastructure to add to fibre optic and mobile networks	January 2012



A single satellite covers a very wide area and so there is less risk than laying long cables to remote regions in the hope that it will result in a substantial take-up

Recommendation 8

The UK should use the low-carbon characteristics of delivering broadcast and broadband services from Space to help meet our national emissions reduction targets.

Low-carbon services will be critical if we are to meet national carbon emission reduction targets, and we therefore propose to use the potential of Space as a way of reducing the ICT sector's carbon footprint. We should not constrain ICT growth, but this sector must also play its part in achieving the 80% reduction in carbon reductions by 2050 promised by the UK Government. Crucially, Space services can help the ICT sector grow whilst controlling its emissions. Depending on the architecture adopted for the Next Generation Broadband infrastructure, Space can deliver as much as 40 million tonnes of CO_2 savings per annum for the UK compared to terrestrial infrastructure. This is a complex argument and needs to be developed fully in the light of independent studies being produced for ESA.

It is important that the new Digital Britain delivery team, UK infrastructure and Ofcom take full account of the wider environmental and 'ubiquity of service' issues, as well as export potential, when deciding which infrastructures to use to deliver the next generation of broadband. Likewise, it should consider Space when allocating radio frequency spectrum to mobile and satellite operators. Government may be in a position to accept higher commercial risks in adopting novel infrastructures than a civil operator. Government can therefore, act to pull through new technologies. Government and industry should work together to establish whether low carbon delivery of services from Space is a case where there is huge potential for growth and export opportunities.

However, as an industry we need a clear and early indication from Government that it will promote Space-enabled services for the UK's remote communities. This will enable the industry to provide them with access to High Definition TV and broadband. In turn, this will encourage UK operators to buy new satellites and UK manufacturers to bid for these contracts. Without doubt, this is an extremely important aspect of building industry investment and growth in this sector.

Number	Action	Timeframe
A8.1	Using ESA's independent investigation into low carbon delivery of broadcast and broadband delivery, UKESA to form a team with industry and BIS to propose a strategy of carbon reduction	December 2010

A safer world with more resilient infrastructure

Recommendation 9

The UK Government and industry should set up a senior-level panel to ensure that Government can take a strategic view of emerging Space capabilities and sovereign industrial capabilities, and reflect them in future national security and defence planning. This panel should contribute directly to the forthcoming Strategic Defence Review.

The importance of security in the future is clearly explained in the Cabinet Office National Security Strategy (NSS), published in June 2009. The NSS reflects the radical changes that have occurred since the start of the new millennium, including the emergence of a wide range of threats which will continue to evolve against the backdrop of an increasingly complex global environment. As identified in the NSS, Space has a key part to play in assuring the security of our nation and our people; indeed in assuring the security and prosperity of all nations and all peoples from both man-made and natural threats.

This panel should also review the future need for low cost launching of small satellite systems and related services, with an emphasis on the defence and economic benefits of adapting launch systems from emerging Space tourism vehicles and reusable Spaceplanes.

The role of Government should be to ensure that the reliability, inherent resilience and surveillance offered by future Space services are used in future infrastructure planning. Security should be interpreted in its widest sense given the increasing importance of secure back-up systems for UK businesses and Government in the modern economy. It is for industry to set out how new Space services can improve security for the citizen and resilience of Space-based and terrestrial infrastructure.

Space, like security and defence as a whole, offers key opportunities for us to build upon a strong industrial base which, in many cases, already offers world-leading capabilities. However, to be successful in this respect we need to realign our national policies and build an environment and mechanisms which will enable our industry to service our own resilience needs effectively. At the same time, it should support our ability to offer competitive export services to our global partners and allies. This requires close and effective co-operation between Government and industry.

Number	Action	Timeframe
A9.1	Government set up an expert panel to advise the Cabinet Office on the industrial and operational issues of Space-based capabilities	April 2010
A9.2	A review of future Space-enabled services to be included in a Strategic Defence Review	December 2010
A9.3	Cabinet Office to identify if additional action is required to ensure all Public sector groups and contractors have resilient back-up systems	January 2012

Recommendation 10

We recommend that the UK take the lead in promoting the use of mobile satellite-based services (MSS) as a core element of the UK's and Europe's future emergency, safety and security communications infrastructure. MSS can work with and extend the capability of terrestrial private mobile networks in a cost effective, safe and immediate way. We therefore strongly advise the UK's relevant departments and agencies to work with European national governments and EU agencies to support UK proposals for a pan-European Private Public Partnership (PPP) initiative to complement private funding of the necessary infrastructure and product development.

Mobile Satellite services (MSS), including both communications and positioning, are already vital to the success of emergency rescue and disaster relief operations around the world. MSS provides highly responsive, flexible, cost effective and dependable communications when local infrastructure is compromised, destroyed or non-existent. Mobile and fixed satellite services played a key role following the 9/11 attacks and the 2004 Indian Ocean tsunami, as they do today in support of the relief efforts following the Haiti earthquake.

There is however a much more permanent opportunity for MSS to be used within the UK and wider European emergency, safety and security communications infrastructure. Advances in MSS technology can complement and extend terrestrial mobile networks without requiring a permanent terrestrial infrastructure. Broadband data and mobile video communications are becoming an essential operational tool for the future, they will enable greater situational awareness allowing emergency and security personnel to share a wide range of multimedia tools such as, navigation, image recognition, sensor data, and video, to build an accurate real time operational picture.

Private Mobile Radio (PMR) networks, such as TETRA, are largely narrowband and can only support voice and limited data communications. Public 3G networks are increasingly used to support some of the more content-rich applications, but offer limited control over service availability and security. Therefore, existing terrestrial mobile communications used by emergency, safety and security organisations are at a crossroads. Significant investment would be required to up-grade terrestrial PMR networks to reach the same level of capability already offered by MSS. The use of MSS can reduce these costs and time to market by providing a pan-European overlay service to complement and extend terrestrial networks by introducing vehicle based relay functionality and/or dual mode (TETRA/MSS) handsets. Furthermore, satellites, with their EU wide footprints, enable seamless cross-border operations between national and European-level agencies, for example, in controlling the Schengen border. Close cross-border collaboration is currently hindered by the proprietary and national nature of most PMR networks.

European satellite programmes, especially the Inmarsat EuropaSat system, which was awarded with an EU wide S-band license by the European Commission in 2009, could realise the vision set out above. However, the public safety and security nature of this opportunity make this a fragmented market, which is regulatory dependent. Joint government and industry support is required to align the diverse stakeholders, both at home and across Europe. The EU wide S-Band license award to a UK company offers the UK the opportunity to take the lead in shaping and promoting this capability across the EU. The UK's emergency and security services stand to gain significantly in their own right, but such a capability also embraces EC initiatives to further harmonisation of public safety and security services across Europe. This offers an export opportunity for UK industry via the implementation and future operation of mobile satellite services.

Number	Action	Timeframe
A10.1	Convene a group of interested parties from industry and Government to agree Sat-Mob requirements and approach	April 2010
A10.2	Above group to engage with other relevant EC interested parties, including ESA and various US	December 2010
A10.3	Take lead in supporting pan-European PPP with UK-based satellite operator to complement private funding of necessary infrastructure	July 2011

Regulating Space for success

Recommendation 11

The UK Government should take full account of the wider value of Space-enabled services when engaged in activities relating to radio frequency spectrum allocation, the operation of the Outer Space Act, allocating orbital slots for new satellites and treaty negotiation with other Space nations.

The UK should make specific allowance for new growth in bandwidth for Space infrastructure and services as this is likely to require reserved rights to that part of the radio frequency spectrum that is most useful to satellite-based operations. Reserved spectrum for future satellite-based operations will allow for competition within the Space framework.

We must ensure that we have the right regulatory environment in the UK that does not inadvertently constrain growth or the adoption of new technologies or services in commercial or institutional markets. Immediate concerns are the availability of spectrum for the Universal Service Commitment (USC) and 'Final Third' projects set out in Digital Britain to ensure that the government services which move to electronic delivery are accessible to everyone. Additionally, if the growing market for direct-to-home HDTV and broadband services by satellite in the UK encourages new entrants into this market, then the UK will have to consider providing additional spectrum or orbital slots if it desires to have effective competition from multiple providers.

As part of its climate change agenda, the Government should make a clear international signal that it backs the retention of the C-band frequencies in current use for satellite services as a key component of its support to the poorer nations who rely on these frequencies for high availability services, especially after disasters.

Ofcom and the UK Executive Space Agency should take a lead within Europe in establishing a more effective process for eliminating the registration of unlikely satellite launch bookings — so-called paper filings — from the ITU (International Telecommunication Union) register and to secure fully co-ordinated orbital frequency resources for existing and aspirational UK operators.

The UK has a multitude of MoUs (Memoranda of Understanding) with other governments concerning agreements about aid, scientific research and a wide range of civil and military technologies. When competing in international markets, MoUs play an important part in ensuring that UK firms are playing on a level field, and the industrial benefits from MoUs are often long term. For example, the UK has MoUs regarding the long-term access to launchers at preferential rates, the ability to bid on equal terms in foreign national procurements and agreements to collaborate on future Space missions. Nonetheless, UK Departments sometimes take a narrow view of the benefits of

A sector worth

£40 billion

by 2030

Applications and services using Space data will be one of the most important elements for delivering this growth

MoUs and this constrains and prevents the UK from accessing these new opportunities.

Therefore, Government Departments should give prompt and well-informed support to the UK Executive Space Agency in evaluating and agreeing MoUs in market sectors prioritised by a joint Government and industry advisory committee. Moreover, the ongoing evaluation of the potential MoU with Russia should be concluded early in 2010.

There is a possibility that we will deter Space tourism operators from developing UK launch locations because the Outer Space Act requires operators to provide the UK Government with an unlimited indemnity against damages resulting from an accident and provide £100 million insurance cover. This is a potentially important consideration as the technology used for Space tourism could provide the basis for launching small satellites into low-Earth orbit, a potentially lucrative niche market where launch capacity could become scarce.

Number	Action	Timeframe
A11.1	The UKESA to ensure the Outer Space Act does not dis-advantage the UK and constrain future Space tourism or launch activity	December 2010
A11.2	Government Departments to maximise the use of MoUs to facilitate international co-operation and UK wealth creation	December 2010
A11.3	Ofcom and the UK Spectrum Strategy Committee (UKSSC) should review the allocation of spectrum to ensure that the quality of existing or future satellite-based services is not reduced by interference	July 2011
A11.4	Ofcom and industry should review the effect of market pricing of spectrum on satellite services in the light of the IGT growth objectives and the forthcoming strategic review of spectrum pricing	July 2011
A11.5	Ofcom and the UKESA to ensure suitable orbit slots are available for UK future use and to minimise paper filings	July 2012

Using Space to inspire and educate

Recommendation 12

The Space industry and UKESA should show exemplary and proactive support in championing initiatives aimed at addressing the STEM (Science, Technology, Engineering and Mathematics) issues in our schools, colleges, universities and businesses.

The ambitious expansion plans outlined in our 20-year Space strategy will provide an estimated 100,000 new jobs in the UK. But, to ensure that these plans can be realised, industry and Government must guarantee that sufficient training and apprenticeship schemes exist to meet this demand and that schools and universities are given the industry support needed to make young people aware of the personal fulfilment, career benefits and excitement they can get from working in the Space sector. Among the best-positioned people to influence students are their teachers. Having a strong research and teaching staff with particular expertise in Space science, engineering or in Space law is the best way to promote such an interest in a student.

Industry will increase participation in graduate entry schemes, advanced apprenticeships and sandwich courses at universities to attract and retain high-quality entrants and meet modern gender and ethnic diversity objectives. It will also work in concert with the Science, Engineering and Manufacturing Technologies (SEMTA) sector Skills Council to ensure that Higher Education representatives and employers collaborate on the design and scoping of degree and higher degree qualifications.

The Space sector led by the UK Executive Space Agency will also launch a publicity campaign to inspire young people to choose STEM-related subjects and help increase the attractiveness and take-up of related courses and apprenticeship schemes.

Number	Action	Timeframe
A12.1	The UKESA to have promoting awareness of the Space sector as an identified and budgeted function	December 2010
A12.2	Develop a national school-level education programme that exploits Space, for the benefit of the national STEM agenda, based on existing regional and pilot programmes	July 2011
A12.3	Industry to double the number of school and college visits made by its STEM ambassadors	July 2012
A12.4	The UK Executive Space Agency and Ukspace to liaise with SEMTA to ensure new courses are designed to suit their needs	July 2012
A12.5	Industry to double its use of apprenticeships to meet recruitment needs	January 2015

Recommendation 13

The UK should initiate and lead at least three Space exploration or science missions by 2030. These missions could be undertaken within the ESA framework or as separate national programmes with other international partners. The UK should also support exploration activity options as set out in the UK's Space Exploration Review published in December 2009 in line with increased funding levels agreed in Recommendation 15.

Despite being a significant contributor to the European Space Agency, the UK has not provided, funded and led significant Space science missions either within or outside ESA over the recent past. Other countries, particularly France, Germany, Italy and Spain are taking the lead in Space missions by providing increased funding for their scientists and industry and having their own nationally funded missions to complement ESA programmes. Such national missions and the instruments and systems developed for them often lead to new market opportunities. If the UK were to take the lead on at least three ESA missions, it would allow the UK Space industry to develop key technologies and capabilities and its own indigenous Space supply chain. Furthermore, UK Space mission leadership would position the country for future missions not only within ESA but also with other Space partners such as China, India and the US.

Increased investment in academia by industry and Government to procure research would also improve the ability of universities to supply and inspire the next generation of engineers and scientists for the Space sector. As well as helping the Space industry to meet its skills challenges and fulfil its own growth potential, this additional proficiency is expected to have wider benefits for other industries reliant on STEM expertise.

The UK is one of the major participants in the ESA Aurora programme and has developed a high degree of competency and leadership in many areas of exploration technology, in particular autonomous robotics, instrumentation and sensors. A recent BNSC study, 'Space exploration: Options for UK involvement' highlighted the significant economic impact of increased investment within these areas. It included detailed case studies that outline the potential for substantial returns on investment in exploration robotics and associated technologies. In addition, economic survey work has shown that a large terrestrial market exists for robotics, instrumentation and sensors — from military equipment through to healthcare systems and transport for the sick and elderly. Germany and Spain are investing heavily in Space-based robotics, and should the UK wish to retain and expand its current role, Government investment is required.

National missions and the instruments and systems developed for them often lead to new market opportunities

The UK Government should, therefore, endorse and support the Global Exploration Strategy (GES) and wider EU exploration initiatives. The UK can offer autonomous systems, instrumentation and sensors as contributions-in-kind to unmanned exploration in the short term as well as to the longer-term aspirations of Human Space Flight (HSF) missions. The UK can best exploit astronaut opportunities and benefit from strategic R&D investment in HSF by focusing on healthcare technology for terrestrial applications.

Number	Action	Timeframe
A13.1	UKESA to negotiate lead positions for the UK in key strategic areas	January 2011
A13.2	Plan to maximise participation in Aurora to be developed, also maximising spinout into terrestrial applications	January 2011
A13.3	The UK should participate in both the human and robotic elements of the Global Exploration Strategy as individual programmes become defined and also wider EU exploration initiatives. The UK should actively pursue strategies which facilitate engagement in HSF activities without incurring significant programme cost	January 2012

Promoting a UK-Wide SME Space sector

Recommendation 14

The UK Government should establish a hub and spoke network to link UK centres of excellence in all Space disciplines to drive benefits from closer relationships between customers, businesses, academia and the UK Executive Space Agency. The IGT community fully support the proposal to establish an International Space Innovation Centre at Harwell as the best way to deliver growth and business benefits from the Hub.

Government and industry should support an open innovation International Space Innovation Centre (ISIC) at Harwell as the centre-of-gravity of a UK Space cluster. This ISIC should proactively nurture the development of Small and Medium Enterprises (SMEs), and improve links between academia and industry, particularly in the operations, applications and science areas. The ISIC should be used as a centre of focus for improving the UK's standing in Space security as well as providing a UK climate hub, which will be of benefit to all stakeholders and give the UK a national facility with credibility on a global stage.

A UK-based Earth Observation centre, particularly if backed by a new UK EO service as set out in Recommendation 5, should provide an opportunity to develop a group of small businesses to exploit the international market for applications in this area. This would include security-related activities as well as climate-change, meteorology and mapping applications.

We also propose that a Regional Development Agency (RDA) partnership should be set up specifically to promote uptake of emerging Space technologies in close-to-market end-user applications. Academic-to-industry links and technology transfer should be achieved through existing or new partnerships in a joined-up regional centre. The hub for this activity should be the business incubation centre proposed as part of an International Space Innovation Centre (ISIC).

The current Space applications and services end-user sector in the UK has an annual turnover of £750 million. Although there is a concentration of Space organisations and businesses in the South East, there are strong Space communities across other parts of the UK like the GRACE and G-step navigation applications centres in Nottingham and Leicester supported by EMDA and GMES. Wales, Northern Ireland and Scotland also have Space-related concerns and all of these sites and academic research centres should be linked in a hub-and-spoke model. The proposed SME partnership would build on these existing centres to involve the geographically dispersed

universities and companies that comprise the end-user segment and make full use of the hub-and-spoke model for Space.

The market opportunities are potentially huge. For example, a recent ESA study on the EU Global Monitoring for Environment and Security (GMES) project suggests that the revenue generated from climate-change monitoring and mitigation activities alone will reach €7 billion per annum by 2030. Growth should also come from a more systematic joining up of Space companies with businesses in other sectors as diverse as agriculture, construction, health and transport who often have an in-depth knowledge of their sector but little or no understanding of the capabilities of the Space technologies they could be using. These represent major opportunity for the UK's applications and services sector, particularly small and medium sized companies.

Government and industry should set up a GNSS applications test bed, connected to the hub-and-spoke network, as a focus for the development of services using the Galileo GNSS data. This will help companies develop the new applications and technologies to use Galileo as soon as it becomes operational. This will help UK-based companies develop a 'first-mover' advantage from combining initial Galileo data with existing GPS data, rather than waiting until the whole Galileo constellation is available. New ideas, such as increasing the number of trains that can run safely on a network or being able to locate elderly citizens in a way that enables them to live in their own homes, rather than residential care institutions, are likely to have a substantial social as well as business value. Moreover, these sorts of applications and services are likely to transfer well to export markets.

Number	Action	Timeframe
A14.1	Government and industry to fully support of ISIC at Harwell	April 2010
A14.2	The UKESA to relocate to Harwell	July 2011
A14.3	South East England Development Agency (SEEDA) and Technology Strategy Board (TSB) should locate and support a Regional Development Agency (RDA) Partnership/ Innovation hub at Harwell and promote centres of excellence as its spokes	July 2012
A14.4	TSB/RDA to set up a GNSS test bed at a suitable hub	Jan 2013

Making it happen

Recommendation 15

The UK should invest earlier, more consistently, and at higher scale in ESA Space programmes in order to maximise the UK's economic and social benefits from these programmes. We estimate this requires a doubling of UK spend, in real terms, including national programmes, over the next 10 years. This would raise the UK from its worldwide current position of 21st to 10th in Space funding as a percentage of Gross Domestic Product (GDP).

Investing earlier and consistently will enable the UK to obtain the highest national benefit by influencing programme objectives before these become firm and enable industry to access the best industrial opportunities that are usually lost by entering programmes at a late stage. UK should also insist on a greater leadership role in European missions, security projects and R&D as part of any enhanced funding towards European programmes.

Achieving the growth goal to 10% of a growing world-wide market will require a huge commitment and substantial increases in investment from everyone: companies, financial institutions, and the public sector. It will require a major uplift in UK funding for Space-related programmes and technologies to enable the UK to maintain its competitiveness in commercial, institutional and exploration capabilities. Most importantly, the UK must maximise the economic and social benefits from its funding. It is unrealistic to believed that the UK can achieve its growth goal without this increase in public sector investment.

With the ratification of the Lisbon Treaty, there is the potential that the EU will choose to exercise its greater responsibilities in Space. If it chooses to spend on Space from central budgets, over which UK has no direct control, then it will become even more important for the UK to retain industrial capabilities and influence if it is to maximise its return from an EU spend on Space services. The UK can secure greater benefits from ESA missions by engaging early in the formation phase of new programmes because that is when the UK can best influence the requirements for programmes and hence obtain solutions that most closely match national needs and enable industry to secure the greatest industrial benefits.

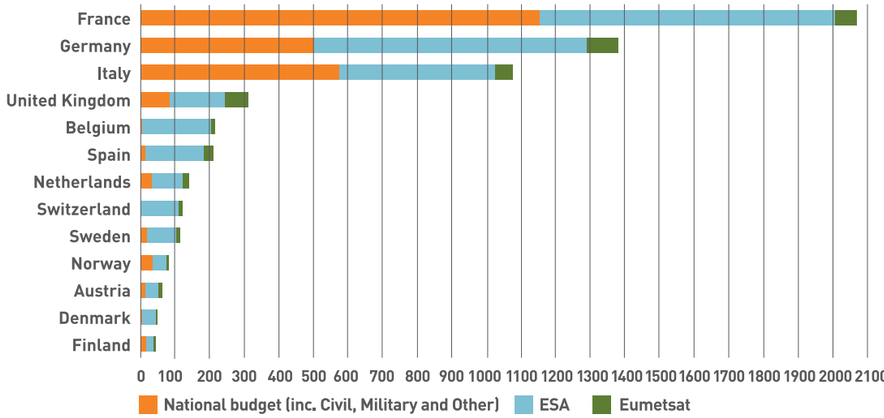
It is important that the UK Executive Space Agency (UKESA) also works with ESA to improve the agility and pace of European programmes. The UK should continue to invest in programmes that deliver the greatest national return but should ensure that it invests at a high enough level to lead relevant programmes and secure the important industrial and economic benefits. The UK should also support UK SMEs to ensure that are better prepared to work with offshore primes when they lead ESA programmes. In addition to a separate national programme, there are major advantages for the UK in participating in ESA-led R&D programmes. Preparatory activities, risk mitigation and technology demonstration opportunities, derived from the national programme, will place UK organisations in a better position to collaborate in European and international Space programmes and where appropriate, lead them. Therefore, the new UKESA should work closely with the user communities and industry to promote programmes which meet UK needs. By doing this, it will be able to secure roles in the delivery of those programmes which play to national strengths and ambitions.

The UK Government can enable industry to play a full part in ESA technology programmes by maximising national funding which then allows industry to increase its contribution through additional company funded R&D. This allows industry to generate large-scale technical and commercial benefits. This leads to an overall benefit for the UK which is far larger than UK-only research and demonstration activities. Industry

will task the NSTSG with identifying those European technology opportunities that offer the highest economic impact.

The UK has not invested significant sums in rocket launchers or human Space flight. This narrower focus — on commercial systems, earth observation, navigation, robotic exploration, important science — has allowed the UK to participate in programmes that offer the greatest economic and social advantage to the UK and that offer best value for money. By following the same philosophy, we expect that the UK will achieve a much greater return from any additional monies by exploiting a better position, including leadership, in these programmes that would be taken forward anyway.

Breakdown of Selected European Space Budgets* for Space, 2005
Millions of Current US Dollars



Source: Data adapted from European Space Technology Platform (ESTP), Strategic Research Agenda, V1.0, June 2006
*Only those countries with budget > USD 25 Millions

Number	Action	Timeframe
A15.1	Government and Industry should work together to ensure better co-ordination to the next ESA council of ministers to allow better planning for new programmes	January 2012
A15.2	The UKESA should take a leading role in defining future ESA programmes that support UK policy directives	January 2012

Recommendation 16

A Space Leadership Council should be established and chaired by the Secretary of State for Business, Innovation and Skills and the President of the UKspace trade association. This Council should be tasked with overseeing the progress of implementing the recommendations and actions in this report. These actions are summarised in the Space Innovation and Growth Action Table included in this recommendation.

We are aware that several previous reports on Space have not been fully implemented, and so we are determined that this report will make a real difference. We envisage that the proposed Space Leadership Council (SLC) should implement the specific recommendations in our strategy. Industry recognises that the UKspace trade association should be substantially strengthened in terms of skills, influence and services provided in order to effectively represent industry in the implementation of the report's recommendations. It will need to engage more effectively with all sectors of the industry and with national and local government. It should also increase engagement with society and academia to promote the value of Space as an engineering profession.

Historically, other industries have been able to advise government and present their issues more consistently, at a higher level and with more effect, than has Space. UKspace will therefore benefit from working more effectively with A|D|S and Intellect to improve the way it promotes Space in the UK.

Number	Action	Timeframe
A1.1	Define the National Space Policy that establishes the UK's likely public sector needs from Space, highlighting where early action by Government and Industry can deliver national and economic benefits	Jan 2011
A1.2	The UK Government should recognise Space as a key high-technology industrial sector alongside aerospace, life sciences, biotechnology and defence and resource appropriately	Jan 2011
A1.3	Industry to specify innovative proposals to requirements	Jan 2012
A1.4	Regular joint Government and Industry review of policy success	Annual
A2.1	UKESA fully operational	Jan 2011
A2.2	10 Industry Secondments to Agency	Jan 2012
A2.3	Two way Secondments underway	Jan 2015
A3.1	Establish the National Space Technology Steering Group	Apr 2010
A3.2	Launch a National Budget with funding	Apr 2010
A3.3	Finalise Technology Roadmaps	Sep 2010
A3.4	Identify increasing budget in line with roadmap needs and industry ability to co-fund	2011
A3.5	Increase annual budget to £100 million (£50 million private R&D matched by £50 million co-funding)	2015
A3.6	Review alternative (disruptive) technology development and funding	2015

A4.1	Industry will set out all projects that will need intervention to proceed	Dec 2010
A4.2	Government to clarify methods of awarding loan guarantees or anchor tenancy that will satisfy city investors	Dec 2010
A4.3	Government to review (in concert with other hi-tech, hi-risk industries) wider financial mechanisms to grow the Space market	Dec 2012
A5.1	UKESA to identify full future Public sector needs and aggregate their use of Space-based EO data	Dec 2010
A5.2	Accelerate the TSB/SEEDA initiative to produce a demonstration satellite to test the most likely payload needs including EO	Dec 2010
A5.3	Joint industry and Government project study to respond with a PFI to meet the aggregated requirements	Jul 2011
A5.4	Offer an anchor tenancy/PFI programme to a UK-based operator for Government EO data	Dec 2012
A6.1	UKESA with academia & industry to form a task force to develop a UK strategy	Sep 2010
A6.2	Develop the strategy with EU partners	Dec 2010
A6.3	Identify implementation plan actions into NSTS, EO data needs and ISIC	Jul 2011
A7.1	Digital Britain team to assess how Space can assist the Universal Service Commitment for Next Generation Broadband	Jun 2010
A7.2	Digital Britain to support the current initiative by Space operators at no Government cost	Jun 2010
A7.3	The UKESA to fund a study by UK industry to respond with a Next Generation Broadband Architecture to allow early development of suitable hardware	Dec 2010
A7.4	Government to propose a complementary Satellite infrastructure to add to fibre optic and mobile networks	Jan 2012
A8.1	Using ESA's independent investigation into low carbon delivery of broadcast and broadband delivery, UKESA to form a team with industry and BIS to propose a strategy of carbon reduction.	Dec 2010
A9.1	Government set up an expert panel to advise the Cabinet Office on the industrial and operational issues of Space-based capabilities	Apr 2010
A9.2	A review of future Space-enabled services to be included in a Strategic Defence Review	Dec 2010
A9.3	Cabinet Office to identify if additional action is required to ensure all Public sector groups and contractors have resilient back-up systems	Jan 2012
A10.1	Convene a group of interested parties from industry and Government to agree Sat-Mob requirements and approach	Apr 2010
A10.2	Group to engage with other relevant EC interested parties, including ESA and various US	Dec 2010

A10.3	Take lead in supporting pan-European PPP with UK-based satellite operator to complement private funding of necessary infrastructure	Jul 2011
A11.1	The UKESA to ensure the Outer Space Act does not disadvantage the UK and constrain future Space tourism or launch activity	Dec 2010
A11.2	Government Departments to maximise the use of MoUs to facilitate international co-operation and UK wealth creation	Dec 2010
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