

## ● SPACE

UK Space Innovation and Growth Strategy

# Lift-off for UK Space

The UK space industry has recently set out details of how it aims to capture a 10% share of the global market by 2030, creating 100,000 new jobs. RAeS Space Group member, **GEOFF BUSSWELL** MRAeS outlines the recommendations, from a UK spaceport to expanded space applications.

The landscape of the UK space sector has been through an exciting evolution over the past few years, building on the strong growth since the turn of the century (see Fig. 1 opposite). In 2010 an industry-led 20-year vision was set out with the target of capturing a 10% share of the global space economy by 2030, creating 100,000 new jobs. This would grow revenues from the £6.6bn achieved in 2007 to £40bn in 2030. The published recommendations in that vision have resulted in significant steps forward, with the entities created including:

- A UK Space Agency now responsible for all national civil space policy.
- A new European Space Agency (ESA) Centre at Harwell called ECSAT focusing on Applications, Climate & Robotics.

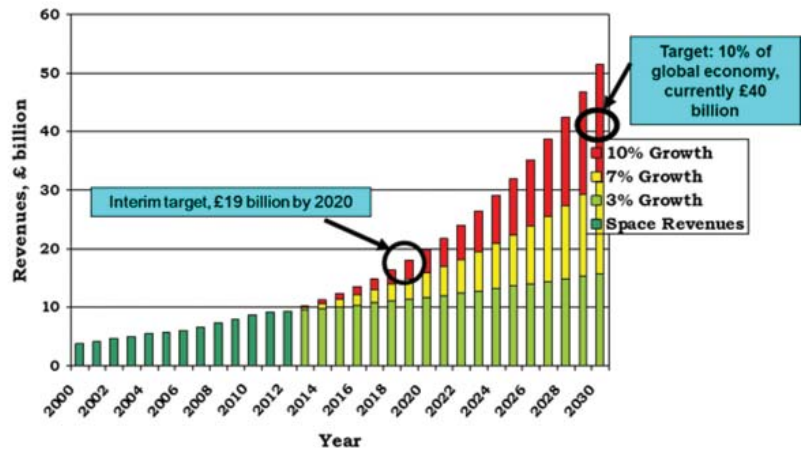
- The Satellite Applications Catapult, a not-for-profit organisation dedicated to the commercialisation of cutting-edge technology and R&D relevant to the space sector, also located at Harwell.

The new, updated vision published by industry takes account of the new entities and investments now in place and identifies five high value market opportunity areas to meet the 2030 growth targets. Five recommendations have been made which are designed to lower the barriers to opening up these markets. The markets and barriers are shown in the Fig. 2 right.

The new vision also breaks down the £40bn target (and the ~£9bn achieved in 2011) in two independent ways; 1.) upstream/downstream; 2.) domestic/exports (see Fig. 3)

Can Reaction Engines' Skylon spaceplane help power a new era in UK space?

Figure 1. In the period 2000-2011 an average 8-5% growth has been achieved in the UK space sector each year. To achieve the £40bn target, the new UK Space Strategy aims to sustain this strong economic performance with 8-1% growth in the period 2011-2030. The strategy also provides an interim target of an 8% global market share by 2020, equivalent to £19bn turnover.



Innovation Growth Strategy 2014

The most ambitious growth is sought in downstream and exports, with targeted ~4-5-fold and 12-fold increases respectively!

## Market analysis

The market analysis performed as a precursor to the strategy identified the impact that space services can have on real-world problems, stimulating economic growth and providing environmental and societal benefits. The figure below shows the five key market segments that have been identified. These are broken down into further focus areas, with 15 of these (shown in red text) identified as high growth — each forecast to exceed £1bn of potential UK revenues by 2030.

A selection of the areas where high growth is forecast is briefly outlined below, providing an insight into how space impacts our lives through remote sensing and satellite communications & navigation.

## Maritime surveillance

A new generation of European and UK radar satellites, such as Sentinel 1 and NovaSAR-S, would enable much more frequent observations of shipping, ice and other maritime objects of interest during both day and night, including during heavy cloud cover conditions (often common in UK waters). Also, signals transmitted from ship-borne automatic identification systems (AIS), which are received by satellite, will continue to allow authorities to track the movement of all ships above 300 tonnes. There is strong British involvement in the build and assembly of such satellites, e.g. from Surrey Satellites. There is ongoing R&D which could enable a particularly interesting application where the AIS data is correlated with radar observations. This would allow possible detection of pirate activity as the radar satellites can still observe the ship in question, even if the criminals have turned off the AIS device.

## Galileo public regulated service

Galileo is Europe's new satellite navigation system incorporating several added value features over the

Figure 2. Barriers and opportunities.



Innovation Growth Strategy 2014

US GPS system, including the Public Regulated Service (PRS). PRS provides anti-spoofing capability, encryption and better resilience to jamming for government agencies and emergency services using sensitive and secure applications. UK companies like CGI are helping the European Commission (EC) to build the secure systems involved with PRS, and the UK as a whole (via the Satellite Applications Catapult and others) is taking a lead in stimulating user uptake of the service. Specific applications could involve those in defence, law enforcement, intelligence gathering, maritime safety, peace keeping operations or humanitarian intervention.

## Low-cost access to space

Virgin Galactic is leading the way in terms of commercial suborbital spaceflights for tourists with SpaceShipTwo operations likely to begin in 2014. Virgin is also in the process of developing the LauncherOne system, which is aimed squarely at changing the paradigm of small satellite development. LauncherOne should enable UK companies like Clyde Space and Surrey Satellites to launch when they want at a price that, Virgin Galactic CEO George Whitesides told AEROSPACE: "promises to be the lowest in the industry." The future of a UK-developed spaceplane looks brighter with recent news of the government's £60m investment into the game-changing SABRE technology being developed by the UK's Reaction Engines. SABRE is an air-breathing rocket propulsion system and the cornerstone of its Skylon spaceplane concept which could reduce launch costs by 80%.

## Persistent surveillance

This game-changing technology would allow much more frequent observations of any location on the planet from satellites. A constellation of three or more satellites in geostationary orbit would provide continuous coverage of much of the Earth but each satellite would require an extremely large mirror (~8m) to achieve sub metre resolution. Another option is a constellation of ~50 satellites in low-Earth orbit allowing any target on the planet to be observable by at least one satellite. Cloud cover



SPACEPORTS AND SPACEFLIGHT OPERATIONS CAN BE A SIGNIFICANT CATALYST FOR ECONOMIC, SCIENTIFIC, AND TOURISM GROWTH

George Whitesides  
CEO, Virgin Galactic

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IN 2012 THE UK INCREASED ITS FUNDING FOR ESA BY 25% WHILE MANY OTHER ESA MEMBER STATES WERE REDUCING THEIRS

could be an obstacle to continuous observations in optical bands and therefore a pragmatic solution could be a combination of multi-spectral optical and radar satellites to enable all weather and day/night observations. Such capability is expected to open up a wealth of new applications using satellite data in areas such as security and defence, border monitoring, traffic congestion, disaster response and rising flash flood water levels. There are already exciting plans from innovative startups, like Planet Labs and Skybox Imaging for new Earth observation satellite constellations.

### Climate applications

ESA's Climate Change Initiative is using satellites to measure critical variables that govern the dynamics of the Earth system. Such variables include sea levels and temperature and the prevalence of sea ice at northern latitudes (ocean); land cover and soil moisture (land); prevalence of aerosols and ozone (atmosphere). While new data streams will significantly aid scientific understanding, a new generation of climate-based services that use this data is also expected to be developed by business. These could include information on the likelihood of freak waves for the oil and gas sector or verification of Kyoto-2 treaty compliance for methane and carbon dioxide emissions. Understanding the accuracy of the satellite observations is key and



provides an important export opportunity for the UK, with organisations like the National Physical Laboratory bringing world renowned expertise.

### Rail transport

Train location is mostly derived by technology that only locates trains to a section of the track. By using satellite navigation and communications, every individual train could potentially transmit an accurate location, transforming the way that railways operate by increasing their capacity without laying new track. Also, the ability to measure ground subsidence and forecast landslides can be exploited by using satellite radar data and low-cost *in situ* movement detectors (which know their position to within 1cm from satellite navigation). Ultimately this means more frequent trains for passengers and better knowledge of potential train delays by the operators and infrastructure providers.

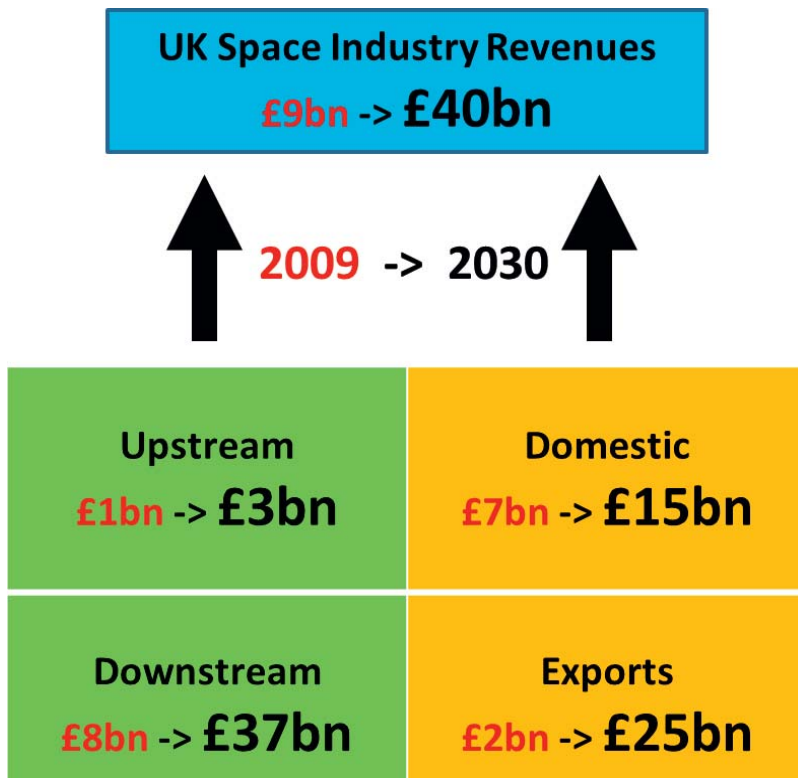
### Smart cities/urban services for local government

Satellite navigation/communication can enable more efficient road and rail networks through cities, and high resolution optical imaging and spectroscopy can be used to determine optimal locations for green energy infrastructure. Also, remote sensing technology from satellites is improving to potentially allow the monitoring of land surface temperature and air quality, and satellite broadband can be used to augment terrestrial solutions to improve on-the-move access e.g. in trains. The Satellite Applications Catapult is already working with the Future Cities Catapult in the UK to investigate the use of space solutions in a new 21st century vision for Milton Keynes.

### Broadband

The main broadband market is international, making this area an export target for UK companies like Inmarsat and Avanti Communications. In developing countries a reliable satellite broadband solution can totally transform a region and enable life-saving medical diagnosis through telemedicine; business to flourish through reliable e-connectivity; or training to

Figure 3. Revenue goals for UK space.





Virgin Galactic's LauncherOne will provide air-launched low-cost access to space.

*2. Make the UK the best place to grow existing and new space business*  
*Barriers: Regulatory*

For global space companies to want to locate, invest and grow their business in the UK, a business environment must exist which optimally promotes innovation enterprise and minimises the burden of regulation, particularly for SMEs and start-ups. The UK Space Agency will create a Space Regulation group to pursue the right balance between processes and growth stimulation, and broadly address four areas: 1.) Outer Space Act licenses which are required from any organisation launching an object into space; 2.) Spectrum allocation agreements, needed for transmission of satellite communications; 3.) Satellite orbit slots, which needs strong lobbying power from the UK on the global stage; 4.) Spaceplanes, as current UK regulation treats any winged vehicle as an aircraft, not at all suitable for the type of experimental vehicles Virgin Galactic will operate. This recommendation has grabbed many of the headlines as it includes the ambition for the UK to create a spaceport by 2018. Virgin Galactic CEO George Whitesides told *AEROSPACE* that: "spaceports and spaceflight operations can be a significant catalyst for economic, scientific and tourism growth. The space industry will benefit from commercial space regulation that enables safe, reliable, frequent and cost-efficient space access."

*3. Increase the UK's returns from Europe*  
*Barriers: Financial, European partners*

In 2012 the UK increased its funding for ESA by 25% while many other ESA member states were reducing theirs. This recommendation urges Government to continue to increase its ESA contributions, as well as create a European Space Engagement plan to ensure maximum growth is stimulated from the ESA spend in the UK. Greater influence in key European bodies is also proposed by seconding key staff from UK companies into ESA and the EC, and by securing more UK

Wearable computing devices, such as Google Glass, below, offer new opportunities for location-based services.

staff in schools. Export potential is also seen within the increasing use of satellites for communications on the move — by sea, in the air and on land.

**Location-based services**

Offerings like Google Glass are likely to be part of the evolving use of mobile phones, tablets, etc, with satellite navigation providing key enabling capability. It is expected that such devices will provide seamless access to information as well as taking over many currently paper-bound functions such as rail ticketing. The benefits to the community include significant increases in productivity and better social networking.

**The enabling recommendations**

The five recommendations of the new strategy propose to set in place governance structures aimed at breaking down the barriers to growth in the identified market areas. Each recommendation is summarised below with the relevant barriers identified:

*1. Grow Space Enabled Markets by £30bn by 2030.*  
*Barriers: Take-up of space services; Export and International*

The space industry needs to become much more outward focused and work in a targeted way with customers and end users from the priority market sectors to champion the use of space services. To this end the Satellite Applications Catapult will lead a series of marketing campaigns, supported by the UK Space Industry Trade Association (UKspace) and the UK Space Agency, with the first campaign slated for September 2014. The UK will also double the investment in its National Space Applications Programme by 2015 and create a Climate Services Centre for Europe. The centre will ensure the exploitation of remote sensing data from both government and commercially funded satellites. However, this recommendation must go beyond "business as usual" and fully grapple with the barrier of inserting new technology (i.e. space) into end user business processes to achieve the downstream growth.

Virgin Galactic

Antonio Zugaidia/Wikipedia



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nationals in key ESA staff positions, including at Director level.

4. Grow space exports from £2bn to £25bn by 2030  
Barriers: Exports & international, technology investment

The key message from this recommendation is to develop strategic national programmes in collaboration with other nations (so-called bilaterals) to complement ESA's programmes. To co-ordinate and invest in such programmes to stimulate maximum economic benefit, a National Space Growth Programme will be created which should draw on existing capability and make multi-year commitments to ensure proper planning and continuity. It will also enable the UK to be much more agile should particularly high value opportunities arise. It is recognised that space science can contribute significantly to the UK strategy and a commitment has been made to launch three bilateral missions with nations where the UK can develop future export opportunities. Such projects have a strong history of 'spin-out' benefits; for example technology designed to measure water vapour on Mars is now being used to measure food production and industrial gas emissions. They also have the potential to capture a new generation of skilled individuals into the sector. Some see this recommendation as an attempt to emulate China's use of space programmes to win major business deals in foreign countries, such as in the oil and mineral extraction sectors.

5. Stimulate a vibrant regional space SME sector  
Barriers: Skills, financial, Harwell & regions

The dominant growth in the UK economy in general is expected to come from about 15,000 small companies with current headcounts of 50-100 people. Space sector support for SMEs is therefore



Severe flooding in the UK saw London activate the International Charter: Space and Natural Disasters to access space imagery including satellite data from SSTL's Disaster Monitoring Constellation (DMCii).

seen as critical to achieving the £40bn target. The Satellite Applications Catapult will lead the provision of a comprehensive 'one-stop shop'; of measures for SMEs, including access to finance, business management tools, skills, training and mentoring. However, it is recognised that 95% of all space sector jobs will be far from the Catapult in Harwell and therefore regional centres of excellence will be created with Harwell acting as an interfacing gateway. To ensure an adequate supply of skilled graduates, several initiatives are recommended some of which have already begun. Highest profile among these is a National Schools Challenge to engage school children in the flight of Britain's first ESA astronaut, Major Tim Peake, to the ISS. The sceptics may see this as largely 'business as usual' with little to indicate that it will lead to a dramatic change in economic performance.

ESA astronaut-in-training Major Tim Peake is inspiring the younger generation to think about space careers

## Status and conclusions

The Government is planning a formal response to the November 2013 strategy in this month with very positive feedback already received from Science & Universities Minister David Willets, who said there was much to admire in the new document and referred to it as: "forward-looking and ambitious." This rhetoric has been backed up by action with the recent Autumn Budget Statement announcing significant progress on recommendation 4, viz. £80m allocated over five years for 'bilaterals aimed at emerging space nations' which should "help export prospects."

Outlining the plan is an important first step but difficult challenges lie ahead in its management and delivery which still need to be addressed. Will the private sector make the investments to complement government's increased spending on space? Who will lead the export drives that are forecast to provide most of the sought-after growth? The road ahead to 2030 should be an exciting time for the UK space sector as it attempts to tackle these issues and make a major impact on the global stage.



UK Space