



# Prosperity from Space

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A PARTNERSHIP STRATEGY FOR THE UK

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# INTRODUCTION



## Space is changing

Almost every week we seem to watch, breathless, as a new breakthrough hits our screens or marvel at the information relayed from constellations of satellites orbiting around the globe.

The UK continues to punch above its weight in this New Space revolution. Our key industrial players, small and nano satellite manufacturers, instrument makers, data scientists and satellite operators are leading the way. Building on our world class science base, international collaborations via ESA and elsewhere and strong institutions such as the UK Space Agency and the Satellite Applications Catapult, the sector is bringing the benefits of space to all of us here on Earth. Whether we are finding our way around, being entertained, communicating on the move protecting our planet or protecting our borders or driving productivity in sectors across the UK economy, space technology is silently delivering for us all - wherever we live and whatever our role in society.

This Industry-led Sector Strategy sets out the ambition of the companies, institutions, academics and entrepreneurs of the UK's space sector to work in an enduring partnership with Government to ensure the UK continues to lead the way. We aim to build and finance great UK businesses, attract inward investment, grow exports, deliver breakthrough research and create high productivity jobs across the UK. We will launch satellites and space missions from the UK and improve productivity, communications and security nationwide.

Those benefits in themselves justify continued co-investment between Government and Industry. Add to that the unique role space plays in inspiring the young scientists and engineers who will drive our future economy, and its ability to remind the world of the leading role the UK plays in all advanced technologies and the case is compelling.

We look forward to working together to deliver a prosperous, forward-looking UK, based on out of this world space technology.

Andy Green  
Chair of the Space Sector Council  
President of UKspace



# BUILDING ON SUCCESS

## Space is a great British success story

It is one of ambition and imagination; where bold thinking has inspired new businesses, opened up new markets, enabled us to track and navigate our way around the planet and map a billion stars. Its driving force is a strong and dynamic partnership between industry, academia and Government, informed by a clear, long-term vision. It is about sharing risk and mutual rewards. Most of all it is a story about *results*.

Britain was there at the beginning, its original space programme commencing in 1952, with a mission launched just ten years later making the UK the third ever nation in space. Having helped define the start of the space era the UK is *still* a lead actor - now shaping the New Space Age: a time of democratized data, mass produced satellites and 'go anywhere' connectivity.

In 2010, business, Government and academia came together to create the Space Innovation and Growth Strategy (IGS)<sup>[1]</sup>. As a direct result, the UK Space Agency was created and a National Space Policy<sup>[2]</sup> published. Regulatory changes helped attract investment. A space cluster at Harwell was established, with the Satellite Applications Catapult and the European Space Agency's ECSAT centre at its heart.

Today, the impact of these actions is clear:

- sector productivity nearly three times<sup>[3]</sup> the national average, with a skilled workforce creating £140,000 of value per person
- year on year growth five times greater than the wider economy since 1999<sup>[3]</sup>
- £415m invested by industry in research and development in 2014-15 alone<sup>[3]</sup>
- 36.4% of turnover generated by exports<sup>[3]</sup>
- 6.5% UK share of the global space economy<sup>[3]</sup> – with Britain firmly established as a world leader in the application of space data
- a sector worth £13.7bn in 2015<sup>[3]</sup> – three times its value in 2000

### CASE STUDY



*Avanti Communications has used its satellite broadband service to support education programmes in East Africa through iMlango funded by DFID and iKnowledge funded by UKSA / International Partnership Programme.*



# BUILDING ON SUCCESS

The strength of the UK Space Sector translates into a wide range of ‘real-world’ benefits. Someone living in the remote highlands of Scotland, for example, can now access state of the art medical facilities as easily as if they were living in the city. Mining companies are prospecting for lithium deposits from low Earth orbit and film fans can tap an app to find out precisely how long it will take them to walk from the pub to the cinema. No one need think about the spacecraft and infrastructure making it all possible with unparalleled convenience and cost effectiveness<sup>[4]</sup>: becoming a seamless part of our everyday lives is the sector’s greatest achievement.

Meanwhile, UK space scientists, the most productive in Europe<sup>[5]</sup>, are leading a number of innovative international collaborations including the European mission to Jupiter and the search for Exoplanets.

Globally, the space sector is evolving at an ever increasing rate. Nations around the world are ramping up their space capabilities, including in space science, while private operators are changing the dynamics of the industry and new technologies lowering barriers to entry – slashing the cost of building and launching satellites. Each of these developments represents an opportunity – and a challenge – for the UK.

A variety of initial actions have been undertaken to bolster our long-term ‘industrial competitiveness. In 2017 Government awarded £99 million to the Rutherford Appleton Lab (RAL) to fund the National Space Integration and Test Facility at Harwell and £50 million to the UK Space Agency (UKSA) for spaceports in the UK. In March 2018 the new Space Industry Bill passed into law and one month later Reaction Engines, the Oxfordshire based developers of the SABRE engine, a revolutionary ‘air breathing’ rocket offering the potential for space planes and ‘one stop to orbit’, secured a further £26.5m from investors including Rolls Royce, Boeing and BAE Systems.

Important as these moves are, if we are to grow, and not merely defend, Britain’s share of the global market, we need to do more. That is why the UK space community has created a strategy to capitalize on the opportunities presented by rapidly maturing new technologies:

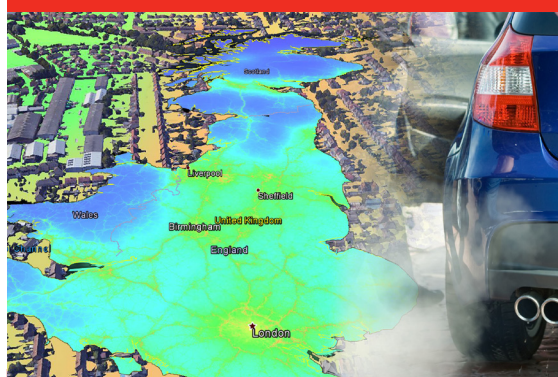
**-combining our capabilities in space data and artificial intelligence (AI) to drive productivity growth and connectivity** in space-enabled sectors of the UK and exports

**-making the UK a hub for new commercial space services** that attracts new entrepreneurs, stimulates the development of innovative products and increases investment for SMEs and start-ups

**-developing new global partnerships for science and exports** to underpin new export campaigns and new opportunities for UK excellence in space science and missions

This document provides the context for these ambitions and summarizes the strategy to realize them.

## CASE STUDY



*With Space for Smarter Government Programme support, EarthSense Systems has published MappAir® – the first high resolution nationwide map of air pollution.*

## CASE STUDY



*AgSpace and IPF UK have more than doubled in size in 4 years, bringing together agronomists and farmers providing shared digital tools, including the use of Synthetic Aperture Radar data from space in crop growth models as a world-first. Their services generate an average 22% yield increase to the farmer.*

# A FAST MOVING MARKET

As the Government's Industrial Strategy<sup>[6]</sup> recognizes, every sector and every part of society will be touched by the revolutions brought about by Artificial Intelligence, autonomy, digitization and robotics. To a greater or lesser degree, they will be enabled by space: demands for data and connectivity will skyrocket<sup>[7,8]</sup>.

In Britain alone, space-derived services already support industries contributing £250bn<sup>[3]</sup> worth of economic activity. With so much of the developed world about to be reordered by the fourth industrial revolution, the opportunity for the UK space sector and entire economy is vast.<sup>[9,10]</sup>

It helps that Britain was a 'disruptor' before the term became over-used. We have innovated to become European leaders in key digital processing and satellite payload technologies, and also developed the concept of the small satellite, appropriating technologies from other sectors to enable modular, scalable production at low cost.

Airbus provides 25% of the planet's telecommunications satellites and leads some of the most complex science and exploration missions in the world. Surrey Satellite Technology Ltd. (SSTL), the pioneer that 'changed the economics of space' is building 22 payloads for the Galileo navigation service, with 12 more on the way. Meanwhile, Earth-i, a small business in Guildford, is busy turning a former SSTL experiment into Europe's first video from space service, offering high definition video data and insight to customers in logistics, finance, resource management and other knowledge intensive sectors. In Scotland, AAC Clyde (formerly ClydeSpace) has become the number one supplier of shoebox sized 'cube sats' and even sells some of its technology online.

The emergence of a new breed of highly ambitious, privately funded operator is creating an inflection point for the entire sector. Our highly evolved and innovative space ecosystem is attracting many of them to the UK, where they will co-exist with established key-players such as Inmarsat, Avanti and Thales Alenia Space-UK.

One of these is OneWeb, a global telecommunications company, based in London, building a network of 900 low Earth orbit satellites to provide low latency, high speed, affordable broadband. Others include Effective Space Solutions for logistics and satellite servicing in orbit and Astroscale for satellite and debris removal.

Also moving here is Orbital Micro Systems, relocating from Colorado to the fast-growing space-cluster at Harwell, Oxfordshire. OMS is aiming to revolutionize weather 'nowcasting' and forecasting by using a fleet of small satellites to provide information updated every 15 minutes or so, rather than every few hours as is currently the norm with traditional weather-watching spacecraft. Customers such as airlines and shipping operators will be able to use the faster, more frequent weather updates for real-time route planning, cutting journey times and fuel consumption.

Working with Britain's Satellite Applications Catapult, OMS will use an AAC Clyde 'nanosat' to prove its technology and business model to investors. The journey from concept to orbit will take little more than one year; OMS relocated to the UK because no one else in the world can do this.

## CASE STUDY



*SES 12 - the world's largest and most powerful all-electric satellite – built by Airbus in the UK*

## CASE STUDY



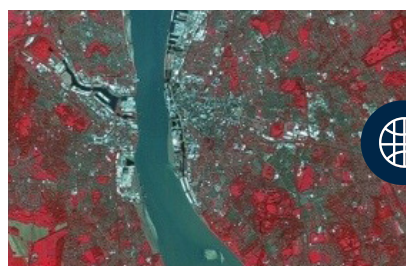



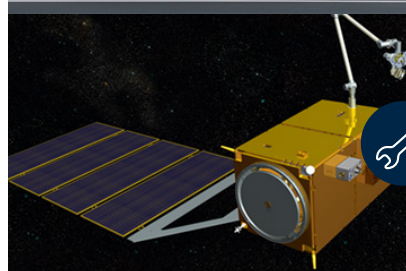



*Inmarsat is partnering with the disaster response community in the Philippines and the UK Space Agency to reduce the impact of natural disasters by prepositioning state of the art, easily deployable satellite communications equipment to empower response to catastrophic disasters*



# THE OPPORTUNITY

The sector has independently assessed the emerging market opportunities open to the UK – potentially worth in excess of £75bn – that will enable us to grow our national share of a worldwide space market predicted to be worth £400bn by 2030.

In this document, we recommend focusing UK national effort on *four* sector market priorities, building on the UK's standout industrial and academic strengths:

	 <p><b>EARTH INFORMATION SERVICES</b></p>	<p>a £20bn forecast market, delivering real-time global awareness, navigation, analytics and security for the advanced data economy</p> <p><i>Image copyright: UK-DMC2 2014 Airbus DS</i></p>
	 <p><b>CONNECTIVITY SERVICES</b></p>	<p>a £40bn forecast market, delivering broadband and 5G for everyone – at home and on the move, on the road, in the air or at sea, anywhere around the Globe</p>
	 <p><b>IN-SPACE ROBOTICS</b></p>	<p>a nascent market potentially transforming the way we use and explore space, including all-new applications for science, enterprise and consumers</p> <p><i>Image courtesy of MDA Space Infrastructure Services</i></p>
	 <p><b>LOW COST ACCESS TO SPACE</b></p>	<p>maximising the value of the UK's <b>spaceports</b> and launch from the UK, a £10bn forecast market, making the UK a home for low-cost launch services and developing platform technologies to promote even lower cost access to space</p> <p><i>Image courtesy of the UK Space Agency</i></p>

This value will be driven by investing in science and engineering technology – areas where the UK space sector and / or the UK's wider technology base is already strong. We must do this as a *partnership* – between industry, universities and Government, to harness the strengths in each. Given this, and the achievements to date, the sector's target, within the IGS vision, of capturing 10% of the future global market by 2030<sup>[1]</sup> is ambitious – but credible.

It is not assured, however. The UK space sector faces a number of significant challenges, including increasing international competition. We must also address the fault lines running through our current way of working, chief of which is the absence of a joined up, UK-focused, long-term national programme that allows us to unlock the full potential of our industrial-academic powerbase.

# THE CHALLENGE

The commercial achievements and ambition of the British space sector have not gone unnoticed; China, France, Germany, Spain, Italy, Netherlands, India and others are studying our example, copying aspects of it, such as the Catapult model, and re-investing in their own domestic space programmes<sup>[11]</sup>. Not only does this mean a greater number of sellers vying for customers globally, it is increasingly difficult for UK firms to access these countries home markets. Nor can we be complacent about our historical advantages in finance, innovation, technology, software or data-expertise; for example, France too has a thriving digital sector and this is driving strong growth in the country's tech investment scene.

In addition, private capital is emerging as a game-changer<sup>[12]</sup> with the likes of SpaceX and its investors building a fully commercial launch programme. Governments are taking action to incentivize entrepreneurs to invest.

The decision to leave the EU creates particular need to raise our game and avoid complacency. The UK must develop new and enduring international partnerships to boost exports. We also need to stimulate investment into UK businesses *and* draw global business to Britain.

We must also take full advantage of the potential for Government to act as 'anchor customer' using smart procurement for infrastructure services, as this will enable our domestic sector to gain first mover advantages and improve its export potential.

However, in addition, we must also recognise that heightened competition will expose the fundamental weakness of our current approach; i.e. the absence of a robust, joined-up domestic National Space Programme to sit alongside, and amplify the benefits

from, our participation in European space institutions. Without this the sector has had to adopt an 'ad-hoc' or reactive rather than strategic approach to future investments.

A far more effective route would be for Government to work even more closely with industry and academia on a long-term plan focusing the power of tools such as inward investment mechanisms, export support, and R&D investment on the development of new and high growth markets.

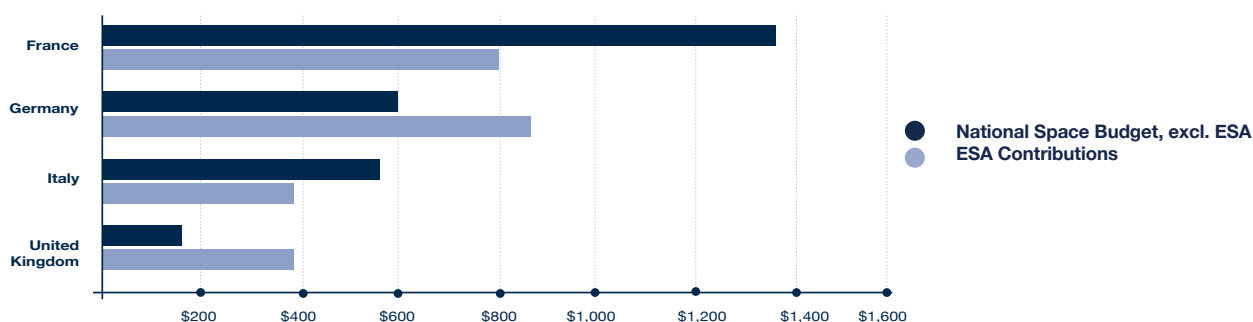
What is proposed here, therefore, is a domestic space programme to run in tandem with, and benefit from, our ESA contributions\*. This will enable long-term plans to be achieved e.g. pursuing market opportunities and providing the predictable basis against which industry can reliably take on risk and invest. It will attract R&D funding and help increase both efficiency and capability by dovetailing Government and private investment. This is how the sector will respond to the challenge from abroad and grow its share of the global market.

Whilst already directly employing over 38,000 people in the sector (in 2015), in order to achieve its growth ambitions UK space needs to recruit and / or train an additional 30,000 employees. This is likely to be a conservative figure.

These workers will need to be skilled in mathematics, physical sciences and engineering, at a time when other high-tech sectors will be looking at the same resource pool across the UK.

The challenges may be formidable but the sector is not discouraged. Rather, it is energized by the opportunities ahead and looking to build on the remarkable foundations laid down in recent years.

**SPACE SPENDING BY NATION, 2015 (Millions of USD)**



Source: OECD



# THE STRATEGY

Based on the IGS ambition and its success, the UK space sector has come together in a Space Growth Partnership, directed by the Space Sector Council, to deliver its proposals and propel British space technology, services and applications to new heights.

The new **Prosperity From Space Strategy** is designed around four clearly-defined, mutually supporting pillars:

## 1. Creating a National Space Programme to unlock increased private investment and:

- building new global partnerships and exports
- maintaining world-leading excellence in the 'stand out' UK industrial and academic strengths
- combining capabilities in space data and AI to drive productivity in sectors across the UK economy

## 2. Creating the right environment for success by securing and building on existing strengths / market position and:

- improving the entrepreneurial pathway and access to finance
- setting up a cross-Government working group to secure high value inward investment
- demonstrating how smart Government procurement can stimulate commercial investment in infrastructure, giving the UK 'first mover' advantage and empowering UKSA to become a procurement agency for the rest of Government, for example by:
  - finding a new mechanism to encourage operators to provide 100% UK communications coverage to support the growth in applications, smart homes, mobile connectivity and Internet of Things
  - developing a UK national capability for producing and using Earth information collected from space to benefit UK businesses and Government
- delivering a globally competitive and progressive regulatory regime

## 3. Investing in people and places by:

- attracting and training up to 30,000 additional skilled people by 2030
- actively encouraging diversity and inclusion in our workforce
- showcasing exciting scientific achievements in space and undertaking 1,000,000 interactions per annum with young people to inspire the take up of STEM careers – benefitting all high tech sectors in the UK
- spreading the benefits around the UK by developing locally led regional technology hubs

## 4. Continuing to drive growth from our investment in ESA, Eumetsat and EU Programmes:

- enhancing the UK's relationship with ESA and maintaining at least the current level of investment
- enhancing the UK's relationship with Eumetsat and continuing our currently planned levels of investment
- fully supporting on-going Government negotiations to ensure future UK / EU partnerships cover current and planned EU space programmes, or identifies commercial and industrial opportunities to address shortfalls in activity<sup>[13]</sup>

# THE STRATEGY

## CASE STUDY: Airbus Foundation Discovery Space



*Airbus Defence and Space, in partnership with North Herts College and North Herts LEP, have opened a facility in Stevenage to enhance STEM uptake in general and enthuse the next generation of space scientists, technicians and engineers.*

Within each pillar are a raft of carefully researched and actionable ideas, closely aligned with the Government's Industrial Strategy and Grand Challenges<sup>[6]</sup>.

### Together they will aim to:

1. Double the GDP of wider UK industrial activities supported by satellite services from £250bn to £500bn by working with space-enabled sectors to deliver a joint aim to increase their productivity and growth
2. Stimulate up to £1bn of private investments in UK space infrastructure using smart Government procurement
3. Create an eco-system that attracts £3bn in inward investment and £500m per annum equity investment in UK-based entrepreneurial ventures
4. Generate an additional £5bn in export revenues from a *Space is Great* export campaign underpinned by new international partnerships
5. Contribute £3bn to the economy from increased investment in research, science and innovation

Space is an R&D intensive sector that requires co-investment from Government. There are some elements of this strategy that only Government can deliver such as creating the innovative regulatory environment needed for all-new activities in space or being the 'anchor customer' of services to incentivize investment in infrastructure.

Industry believes that opportunities, arising from potential Smart Government procurement and a National Space Programme, would allow industry to co invest more than £1bn.

The Space Sector Council, on behalf of the sector, now invites Government to join with us in delivering this exciting future.

## REFERENCES

- [1] Innovation and Growth Strategy 2010
  - [2] National Space Policy 2015
  - [3] UK Space Sector Size and Health Study, 2016
  - [4] Satellite-derived Time and Position : A study of critical dependencies, 2018 - <https://www.gov.uk/government/publications/satellite-derived-time-and-position-blackett-review>
  - [5] Elsevier, International Comparative Performance of UK Research Base, 2016
  - [6] HM Government (2017), Industrial Strategy: building a Britain fit for the future
  - [7] ISCF Proposal: Ubiquitous Connectivity
  - [8] ISCF Proposal: Space data revolution
  - [9] PwC (2017), The economic impact of artificial intelligence on the UK economy
  - [10] Return from Public Space Investments, London Economics, October 2015 - <https://london-economics.co.uk/wp-content/uploads/2015/11/LE-UKSA-Return-from-Public-Space-Investments-FINAL-PUBLIC.pdf>
  - [11] The Space Report 2016
  - [12] Start-up space, Bryce, 2018
  - [13] The United Kingdom exit from and new partnership with the EU February 2017.
  - [\*] "To place the UK space sector on a stronger footing globally we recommend that the UK Space Agency pursues an expanded National Space Programme, alongside its contribution to the European Space Agency."
- Source: House of Commons Science and Technology Committee: Satellite and Space, Third Report of Session 2016 - 17



