:: ANNUAL REPORT

2019.

A world empowered by satellites

We work with Innovate UK

CATAPULT Satellite Applications

Contents

Our Mission

"To innovate for a better world, empowered by satellites."

At the Satellite Applications Catapult our Mission, Vision and Approach reflect the way we work, our goals and our aspirations.

Our mission

"To innovate for a better world, empowered by satellites."

Our vision

"To be a world-leading technology and innovation company, helping businesses of all sizes to realise the potential from space. By embracing a pioneering, agile, collaborative and entrepreneurial spirit, we create valued partnerships to deliver game-changing results."

Our approach

- **We're innovative** – we challenge accepted and traditional solutions and stimulate new ideas to grow future markets
- **We're collaborative** – we're motivated by what the end-user needs to achieve.
- We're inspirational – we aim to nurture and support a new generation of entrepreneurs.
- **We're driven** – we focus on raising the international competitiveness of the UK and growing our global market share.

The Space Sector in the UK

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UK Space Sector

Over the last year, the space sector in the UK has continued to grow and diversify, demonstrating that it is an industry worthy of special focus by government and investors. The latest report on the Size and Health of the UK Space Industry forecasts its total income as £15.5 billion in FY2018, with overall growth continuing to outstrip the general UK economy.

£5.7 billion

Space sector direct contribution to UK gross domestic product (GDP)

£300 billion

Wider UK GDP underpinned by satellite services, including telecommunications, navigation and Earth observation

Sector growth

Space industry growth stands at 7.5% per year[1], even with the uncertainty surrounding Brexit. The sector remains optimistic with respect to near-term income growth, expecting to outperform the economy as a whole over the next three years and predicting increases in income, jobs and exports.

Key to growth in any industry is the emergence of new companies, which is why we engage in activities specifically designed to stimulate and support start-ups and spin-outs. These include launching a Business Incubation Centre at Westcott, providing workspace at Harwell through our Co-Space facility and the many networking opportunities on offer at Harwell and through our Centres of Excellence.

Over six years[2], the number of organisations involved in space-related activities in the UK has grown from 234 to 948, including an additional 39 brand new companies per year on average. Total employment increased to 41,900 – this represents a 4.3% per annum growth rate, which is more than triple the employment growth rate of the overall UK economy[3].

Growth also comes from expanding into new markets, which is why we have teams dedicated to looking at Emerging Technologies and Exploring New Markets, along with wider opportunities for applications exploiting Geospatial Intelligence and Ubiquitous Connectivity.

Research and development

Research and development is a vital requirement for growth in this industry. Across the sector, R&D expenditure has grown 16% per year, now standing at £566 million – this is an equivalent of 10% of direct gross value added (GVA), six times higher than the UK average.

We enable and support R&D for businesses of all sizes in the space sector through a number of initiatives and facilities, including our growing Disruptive Innovation for Space Centre (DISC), the In-Orbit Demonstration (IOD) programme and the new 5G Step-Out Centre at Westcott.

Global reach

Our aim is to accelerate the growth of satellite applications and contribute to the UK capturing a 10% share of the global space market by 2030.

UK space sector exports grew to £5.5 billion, accounting for more than 37% of sector income. Our work in projects across the globe is supporting this export growth, including projects in Asia and Latin America.

In addition, we are seen as a global leader in areas such as the use of satellite in 5G, for which the Westcott 5G testbed is going to be used for a major pan-European project.

Source: London Economics; Size & Health of the UK Space Industry 2018: A Report to the UK Space Agency. All figures are for 2016/17, the latest for which data is available.

1. Excluding direct-to-home broadcasting.
2. Since the 2012 edition of the report.
3. UK non-financial business economy only.

Chair's Statement

At the Catapult, we regularly evaluate the outcomes of our work to ensure we are on track to deliver on our stated vision

> **to be a world-leading technology and innovation company, helping businesses of all sizes to realise the potential from space.**

We're supported in our internal assessments by regular external, independent evaluations of our activities, of which the latest shows the strong positive impact we are having and indicates directions for the future.

It's gratifying to see that our contribution is considered critical by those who engage with us, many of whom are investing more in R&D, collaborating more across sectors and introducing new products, services and processes. Now, to grow this further, we have identified a number of new priorities for the coming year:

- We plan to grow our regional presence to deliver sector growth and benefits to downstream customers.
- We will identify and support scale-ups with very high growth potential.
- We will increase our international focus, bearing in mind the need to be agile, try different things and establish new relationships that will position the UK space industry in the best place for future success.

Alongside these, we will continue activities designed to stimulate the demand for satellite applications and open new markets. Ubiquitous connectivity, geospatial intelligence, artificial intelligence and machine learning are all expected to enable fundamental shifts in many industries. Our growing expertise in these critical fields – directly and through links with academia – will allow us to be even more transformational.

We know that we need to increase our impact in the coming year. The good news is that our highly skilled and dedicated team are exactly the people needed to make that level of difference, as you can read in this annual report. Hence on behalf of the Board, I can say that we are proud of our achievements to date and eagerly looking forward to the next 12 months.

Tim Sherwood

Chief Executive's Statement

When the Satellite Applications Catapult was established in 2013, our team knew how exciting the space sector was, but it's probably safe to say we were in the minority. Now, six years later, space has captured the global imagination far more than even we predicted. And we're proud to have played – and to continue to play – our part in ensuring the UK is on track to capture a significant share of the ensuing market.

This increased focus on space is not just because 2019 marks 50 years since man first stood on the Moon, although that's a nice coincidence. Instead, the explosion of entrepreneurship in all aspects of the space industry, along with the growing awareness of the impact space and satellites have for every one of us, is piquing interest from multiple industries and governments, all keen to explore what space can do for them.

> **Space is already a national success story.**

The UK government has long realised that a strong space industry is good for the UK economy. As I write, a National Space Council has just been created to provide strategic leadership on space across government. It will coordinate all aspects of the UK's space strategy, investment and use of space through a new National Space Framework – part of a package of measures that should help ensure the UK plays a leading role in this new space age.

Space is already a national success story. In 2016/17, it contributed £14.8 billion to our economy[4], including £5.5 billion from exports, and it was estimated that at least £300 billion – over 10% of the UK economy – was supported by space technology. This year has been successful for us too, with the opening of the Westcott Business Incubation Centre and the successful launch of the first In-Orbit Demonstration (IOD) mission. In addition, the Disruptive Innovation for Space Centre (DISC) at our Harwell site is due to open in mid - 2019, with phase 2 nearly complete and a third building planned due to huge demand.

We have much more to do enable the UK to grasp 10% of the global space market by 2030, based on our core focus of building market demand for satellite applications. To do this, we will ensure we take advantage of the prospects being offered by the commercialisation of space, new businesses in launch and in-space opportunities, while retaining a focus on demand-side innovation and providing support for companies to scale.

4. www.gov.uk/government/publications/uk-space-industry-size-and-health-report-2018

Stuart Martin

The Year in Numbers

New organisations engaged with

753

UK organisations supported that are now exploring international opportunities

54

Collaborative and commercial income for the year	£18.6m
New non-space funding and project partners	35
Number of scale up companies supported	6
Number of jobs indirectly created	450 - 650
Number of products or services supported described as 'new to the market'	81
UK organisations supported that are now exploring international opportunities	54
Number of Researchers in Residence (RiR) engaged with across the UK	6

Our Markets

Our strategy is guided by **three principles**:

Energising the market	Unlocking customer demand and opening new markets to the space sector
Empowering technology	Driving technological advances to help companies bring products and services to market faster.
Enabling business	Connecting businesses of all sizes with the resources they need to grow.

Tackling these requires leadership and support across key markets and technologies; ones that we have identified as offering potential for high growth and global opportunity. In addition, our structure and approach ensure we're always aware of new and emerging technologies and business prospects.

- Access to Space
- Agriculture
- Emerging Technologies
- Exploring New Markets
- Extractive Industries
- Geospatial Intelligence
- Health and Wellbeing
- Intelligent Transport
- Sustainable Development
- Ubiquitous Connectivity

On the following pages, you can read about some of our work in these areas over the last year, including examples of the many projects our experts are involved in. Some of these projects straddle two or more of our market sectors, illustrating a key strength of the Catapult – we are not constrained by predetermined commercial parameters, but instead driven by the needs of end-users and UK companies in a global context.

Access to Space

Access to Space

The most effective way that we can maximise the opportunities offered by satellite data is if we explore and enable new mission concepts, and support businesses in gaining access to space. At the Catapult, we're playing a central role in helping the UK to grow its capabilities in order to provide a complete ecosystem, from components to satellite build and launch, along with in-orbit servicing and mission support.

In-Orbit Demonstration

This year saw a significant milestone in our In-Orbit Demonstration (IOD) programme as the first mission was launched into space. IOD-1 GEMS, with its lightweight weather data payload from Orbital Micro Systems, was dispatched to Nanoracks in February 2019, and then delivered to the International Space Station in April for launch.

The IOD programme enables organisations to demonstrate their technology on CubeSat platforms. Also this year:

- IOD-3 AMBER was upgraded to a 6U CubeSat and awarded to Horizon Technologies for an adapted version of its FlyingFish™ system for tracking vessels at sea
- IOD-4 opened for applications
- IOD-5 TARS will be Kepler Communications' final prototype for its GEN1 low Earth orbit constellation. This partnership will also see Kepler build a UK supply chain for its new satellite constellation with overall service capability for Kepler estimated to be a around £71 million by 2022
- IOD-2 and IOD-6 are progressing and announcements will be made soon. Open Cosmos will provide a one-stop mission package for IOD-6, marking the start of a commercially sustainable service in this field. This follows their use of our new Disruptive Innovation for Space Centre (DISC) to effectively grow its business, which has seen staff levels rising sharply, recruiting 30 people in 2018 and doubling in size every 6 months.

In addition, we've been working with Infostellar to provide enhanced access to our ground station at Goonhilly and plan to extend the IOD programme with more missions.

National In-Orbit Servicing Facility

Servicing satellites and removing space debris is a significant challenge, so we have started working on an in-orbit servicing system based on advanced robotics. The project, led by Astroscale and funded by the Robots for a Safer World Industrial Strategy Challenge will also create a new national satellite operations centre at Harwell.

The new facility will enable UK companies to unlock opportunities in space debris removal, in-orbit satellite servicing and other autonomous robotic applications. The partnership with Astroscale which has already increased its headcount to 17 from 4 is the beginning of an exciting period which includes the creation of the In-Orbit Servicing and Manufacturing Working Group to help position the UK as a major player in this global market.

Agriculture

This year, following consultation with sector stakeholders, we produced a new strategy for our Agriculture market area with a key focus on creating solutions to tackle supply chain impacts related to deforestation, water and carbon. We're particularly excited about our planned Digital Agri-Test Centre at the Westcott Venture Park, which will link into the wider agri-innovation ecosystem. Going live in 2020, it will offer a dedicated testing environment encompassing 5G and the Internet of Things, robotics, UAV (unmanned aerial vehicle) and satellite technologies.

Improving supply chains

We continue to grow our presence in Latin America, where this year we've seen the launch of our COLombian COcoa (COLCO) project. COLCO involves developing an integrated quality control system to monitor the entire Colombian cacao supply chain, covering both production and post-harvest processes.

By supporting improved quality and volume of cocoa production through increased monitoring, certification and localised processing, the aim is that farmers' income will increase. In particular, we're focussing on increasing volume by improving the yield of cacao-producing land, to avoid deforestation. COLCO will also result in:

- better pest and disease control/planning
- reduced spoilage and waste
- improved enforcement of food safety and public health regulations
- enhanced social and environmental sustainability

COLCO is funded by the Newton-Caldas fund via Innovate UK, with partners including the Manufacturing Technology Centre (part of the High Value Manufacturing Catapult), Centre for Agriculture and Biosciences International and Cervest in the UK, and CHCh and the Federation for Cacao Producers, Fedecacao, in Colombia. We're now exploring expansion into other supply chains.

Managing deforestation

Another major project in development this year has been ForestMind – a supply chain traceability concept initiated by Sainsbury's. The Consumer Goods Forum has long pledged to achieve zero net deforestation in its members' supply chains, but to date there has been no neutral entity to provide the actionable intelligence needed to prove compliance. This is what ForestMind will address.

Building on the successful business model pioneered by our spinout OceanMind, which provides similar intelligence to combat illegal and unregulated fishing, ForestMind will be powered by the technology behind the Earth and Sea Observation System (EASOS) and leverage world-leading UK capabilities in geospatial analytics, supply chain policy, traceability and deforestation risk analysis.

We're now in the final stages of agreeing funding from the European Space Agency and the UK Space Agency. When ForestMind is live, organisations in the supply chain will be able to verify deforestation impact claims, make responsible purchasing decisions and demonstrate their commitment to customers and other stakeholders.

Emerging Technology

Emerging Technology

Innovation and disruptive technologies go hand-in-hand with the space sector. Our Emerging Technologies team seek out technologies that can solve industry challenges and create market opportunities, generating impact for the UK economy. We're currently focussing on quantum technologies, propulsion/launch, 5G, artificial intelligence (AI) and universal traffic management, but always exploring new prospects.

Enabling seamless connectivity

There's increasing demand for vehicles to be seamlessly connected to the internet at high speed and low cost. This is being driven by ever-improving autonomy, infotainment, and emergency and location-based services. By 2022, 320 million cars will be 'connected', generating US$155 billion of secure and connected services*.

Our CASSIS 2 project (Colour and Stereo Surface Imaging System) is addressing this by developing, demonstrating and commercialising all the satellite elements needed for vehicle connectivity:

- A compact, light, low-cost, satellite-terrestrial hybrid vehicle terminal based on technology that's scalable to accommodate different applications and price points.
- A flexible, high capacity satellite payload for high bandwidth connectivity.
- Critical services for vehicles, requiring ubiquitous and continuous connectivity.

CASSIS is supported by Innovate UK and the European Space Agency under the Advanced Research Telecommunications Systems (ARTES) programme. The Technology Phase kicked off in January 2019, with product integration and lab tests planned for 2020, and in situ field testing and demonstrations in 2021, stages which further support the development of manufacturing and supply chain provision in the UK.

Reducing Emergency Response Times

Fast response times are crucial following serious car accidents. People who receive treatment within the first 60 minutes have up to a 50% higher chance of survival and there is a significant reduction in long-term disability. That's why the European Union's eCall road safety initiative is vital, aiming to reduce emergency services response times by 50% in rural areas and 60% in built-up areas.

In vehicles with eCall enabled, calls to the 112 European emergency number are triggered either by the driver or the system itself, with GPS co-ordinates, airbag deployment and impact sensor information then sent to the local emergency services.

Our involvement in the I_HeERO project has helped to deliver the necessary infrastructure upgrades to support eCall, which is now mandatory on all new motorcycles, cars and light trucks in the EU. We were involved in demonstrating the benefits of satellite technologies as part of such a system with a view to driving inward investment, business creation and growth across the 11 participating EU Member States and 58 commercial partners.

** PwC; Connected car report 2016; Opportunities, risk, and turmoil on the road to autonomous vehicles*

Exploring New Markets

Exploring New Markets

Enabling the UK space industry to grow to its maximum potential requires looking beyond its traditional markets – and outside our own current market focuses. Our neutral, trusted status allows us to talk to new potential customers and explore different sectors and geographic regions, letting us spot opportunities and decide where to focus next.

Monitoring fishing activity

Monitoring fishing vessels after they left sight of shore was once impossible, but our OceanMind project challenged that notion and successfully proved that it was possible to tackle illegal, unreported and unregulated (IUU) fishing. As a result of this success, in July 2018 OceanMind was spun out of the Catapult as a separate, not-for-profit limited company, with support from DRK Foundation and Pew Charitable Trusts.

Since then, the OceanMind team has doubled in size, with experts in monitoring from all over the world now working alongside them. In its first 9 months, it had a turnover of £1.1 million. OceanMind continues to work with projects such as the UK Government's Blue Belt Programme and has a growing roster of commercial and governmental clients.

OceanMind won the 'SeaWeb Seafood Champion Award for Innovation' 2019 and in January 2019 it received a grant from Microsoft's AI for Earth programme to scale up the use of artificial intelligence in detecting fishing activities.

The Spatial Finance Initiative

By integrating Earth observation data, remote sensing and machine learning with financial systems, it's possible to transform the availability of information in such systems and change how risks, opportunities and impacts are measured and managed by financial institutions. This is 'spatial finance'.

In February 2019, we launched the Spatial Finance Initiative in the City of London. This collaboration between the Catapult, the Smith School of Enterprise and the Environment at the University of Oxford, and the City of London Green Finance Initiative will undertake world-leading research into the opportunities that spatial finance offers, and channel the findings into real-world, finance-related applications.

We are now establishing an Advisory Board, planning a follow-on event and setting up the Initiative's first research project. The team will work closely with the finance community and geospatial and financial services organisations to translate its research into practical and pre-operational products and services.

Raising awareness of the value of geospatial solutions in a market where adoption is currently low is expected to result in job creation and increased revenues for commercial, not for profit and academic organisations in the UK.

Extractive Industries

Extractive Industries

We use satellite technologies to create operational efficiencies for the extractive industries, while empowering local communities and reducing, and where possible eliminating, damage to the environment.

Avoiding Disasters

The Brumadinho tailings dam disaster in January 2019 Brazil was devastating. However, it was not an isolated occurrence. There have been 185 similar events recorded in the last decade, 11 of them resulting in serious failure.

There is a compelling rationale for major changes in the regulatory frameworks relating to extractive industries, and the implementation of new standards and practices to avoid more incidents. Satellites, combined with complementary data and advanced processing, can help drive this change.

A number of stakeholders are already moving in this direction. We are working with them on a range of initiatives to provide situational awareness and reduce the risk of failures in future. One example is the UK Space Agency funded project DAMSAT, which is being led by HR Wallingford. This project is providing a proof of concept of an economical way to remotely measure displacements of tailings dams and other mining infrastructure.

Operational monitoring

In Colombia, we are leading the GAIA SPACE project, developing a secure environmental monitoring service for strategic decision-making. It will provide frequently updated data and alerts of mining activity to regulatory and enforcement authorities to increase operational efficiency and coordination.

Funded through the UK Space Agency's International Partnership Programme

(IPP), GAIA SPACE is being designed and developed by a multidisciplinary consortium of UK and Colombian partners. These include academic institutions, not-for-profit innovation companies, environmental sustainability consultants and technology development experts.

Improving stakeholder trust

Social License to Operate (SLO) refers to the acceptance or approval by the public of a company's practices and procedures, which for the extractive industries includes local communities approving of mining operations in their hometowns. SLO gives communities the power to delay or even stop mines already in operation.

When this happens, it is often caused by a lack of trust and communication between the commercial mining companies and local stakeholders, which may include communities, non-governmental organisations (NGOs), multilateral banks and governments. We're exploring how to redefine social engagement using satellite data (commercial and open), analytics and web tools to create a transparent, visually intuitive and quantified baseline identifying the status of an area of interest prior to any mining activity and investment.

In turn, this is enabling UK businesses to enter this global industry and to become more confident in their reliance on accurate satellite data.

Geospatial Intelligence

Geospatial Intelligence

Geospatial intelligence is a key technology focus for the Catapult, with huge opportunities offered by the application of artificial intelligence (AI) and machine learning to geospatial and other 'big' data. It cuts across many of our market areas, as well as being a focus in its own right for our experts who use it to solve existing challenges and to create innovative products and services for UK companies to exploit.

Artificial Intelligence and Machine Learning

Artifical Intelligence (AI) and machine learning hold enormous potential for 'good' when used alongside satellite data, but much of the UK's AI expertise is held within academia. In 2018, the Catapult collaborated with the University of Oxford and the European Space Agency (ESA) to establish Frontier Development Lab (FDL) Europe – an intensive, eight-week summer sprint for researchers to develop new tools using AI and space data to solve major real-world problems and encourage them to consider careers in the sector.

Small teams with specialisms in AI, data science and space were supported by ESA and other partners to produce workable ideas with potential for future development. Catapult experts provided guidance, plus access to ground truth maps and high-resolution data that would otherwise be costly and difficult to obtain.

One team applied machine learning to satellite imagery to quickly produce maps of buildings affected by flooding, generating interest from UNICEF. The second developed a system for detecting and mapping informal settlements using only low-resolution Sentinel-2 imagery. The aim is that both will now be developed into functional tools.

Orbital Witness

Promoting entrepreneurship is crucial for the Catapult. Our 10% Time Programme lets staff validate a business idea with our support in return for part-ownership when the company is spun out. Orbital Witness is one such idea, combining space technology with traditional real estate law, identifing legal risks associated with property transactions. As well as raising over £1.2million in Series A funding in the last year and winning grants from Innovate UK and the European Space Agency, it has also signed contracts with major companies in the legal, insurance and retail sectors.

NovaSAR

Launched in September 2018, NovaSAR-1 is a small synthetic aperture radar (SAR) mission that was designed for low-cost programmes. The UK has access to 15% of the acquisition schedule of NovaSAR and we're assisting the UK Space Agency in managing this quota via the Sentinel Data Access Service (SEDAS). 2019 saw us add extra storage to the Climate, Environment and Monitoring from Space (CEMS) facility to store the data, which will be available via the SEDAS portal. NovaSAR data applications include Precision Agriculture, Forestry, Disaster monitoring and Security.

Health and Wellbeing

Health and Wellbeing

Even in a relatively small country such as the UK, access to healthcare varies significantly across rural and built-up areas. Satellites offer the chance to alleviate some of the challenges faced by providers including the NHS, particularly in managing long-term conditions and providing emergency response. We are targeting both of these, looking especially at early intervention and diagnosis, and remote monitoring and consultation.

Improving remote diagnosis

Healthcare is another sector where artificial intelligence (AI) offers huge potential, as exemplified by the AI in Diagnostics for Gastrointestinal Diseases (AID-GI) project, in which we are supporting SME Corporate Health International.

This video capsule endoscopy programme started with trials in Scotland, with the aim of improving diagnostic accuracy for lower gastrointestinal diseases by applying machine learning to aid the analysis of internal imagery. Notably, it seeks to quantify the benefits to all stakeholders, including patients, clinicians and the NHS, and make recommendations on how the solution can be implemented and any changes to existing healthcare guidelines.

Within this £1.6 million Innovate UK-funded project, we're helping Corporate Health to ensure that all the data can be accurately and efficiently shared over satcomms links where alternatives are not available, extending the diagnosis options to everyone.

NHS Arden & GEM Partnership

We recently formalised our partnership with NHS Arden and Greater East Midlands Commissioning Support Unit (Arden & GEM) to further our joint work on embedding satellite technology within digital healthcare.

We have already successfully collaborated with NHS Arden & GEM on initiatives to manage long-term conditions, including chronic obstructive pulmonary disease (COPD) and diabetes, and they worked with us on the AID-GI project. Now, we will pursue a range of initiatives through this partnership, including an 18-month ESA-funded project looking at air quality, which is a major threat to health in the UK – some 40,000 premature deaths each year can be attributed to air pollution. We will also be working on a demonstrator for ambulance connectivity.

This partnership follows the announcement in June 2018 that the UK Space Agency would be working with NHS England on a joint initiative to improve patient care worth up to £4 million.

Intelligent Transport

Transport has always been a focus for the Catapult, as more people want to travel more often and more goods need to be moved, both nationally and globally. Satellite technology offers opportunities to improve how we travel and to enhance the monitoring and maintenance of transport solutions, as well as helping to combat pollution. We're currently focussing on using Earth observation data and satellite communications to tackle challenges in automotive, freight and logistics, and infrastructure.

Monitoring bridge safety

There are thousands of bridges in the UK, each of which require regular structural monitoring as a critical element of the nations' transport infrastructure – and the same is true abroad. For this reason, through our Brigital project we're collaborating with the National Research Council of Canada to design a digital decision support tool based on satellite data that can be used to assess bridges and support their maintenance.

Radar satellites can measure ground motion fluctuations with sub-centimetre accuracy. They can also measure movements at hundreds of points on large structures, providing accurate results in near-real time. We're utilising these properties to help build a 3D visualisation tool that will improve the performance and lifespan of bridges at reduced maintenance costs, while also reducing risk and increasing safety.

The initial phase will involve trials on two bridges in Montreal, with the operators' feedback helping us to improve the tool and widen its applicability to several types of critical infrastructure, eventually resulting in a commercial service. The solution will subsequently be offered to governments around the world by a UK partner, which will be sought in due course.

Improving the efficiency of rail freight

In order to grow the space sector, we need to engage with end-users who have not previously taken advantage of satellite-delivered services. One new way we are doing this is through Market Challenge Teams (MCTs) – a concept instigated by the Space Growth Partnership and funded by the UK Space Agency.

We are piloting the MCT scheme, starting with two projects focussed on rail freight and agritech. Through these, we will identify the most effective ways to engage with non-space industry markets and jointly develop solutions for their major challenges.

MCTs will:

- be sustainable organisations
- address new, important challenges in the target markets by working closely with end-user stakeholders
- only undertake work that is pre-competitive in nature and would almost certainly only transpire if facilitated by the MCT.

We have already established governance for the MCTs and have started engaging with the rail sector for our MCT Rail pilot. Following the pilots, future MCTs will be established for sectors such as finance, maritime and civil engineering.

Sustainable Development

Sustainable Development

Satellite technology can offer many ways to help us to manage the impact of a growing global population with its increased requirements for food and energy, along with the effects of climate change and natural disasters. We're enabling collaborations between key players and contributing our expertise to enable sustainable growth and development.

IPP CommonSensing

Small island nations are on the frontline of the devastating impacts of climate change. With nearly a third of the population living on land less than 5m above sea level, they are vulnerable to the threat of rising sea levels, degrading their coastlines, their communities and their livelihoods.

IPP CommonSensing is based on a partnership between Fiji, Solomon Islands and Vanuatu, and a consortium of international partners, working together to support and build climate resilience and enhance decision making through the use of satellite remote sensing technology.

By developing satellite based information services that directly match challenges and needs, the project supports the three nations in their goals to strengthen capacity to access climate finance and report on climate funds; strengthen national and regional climate action policy; and reduce the impact and improve risk management of natural disasters and food security.

The project will also build capacity in-country, strengthening technical skills across the region and placing specialists within Government benefitting both local knowledge and data systems.

Following the successful kick off meetings held in-country in February 2019, the CommonSensing team are now working towards developing and implementing geospatial solutions tailored to the needs of each country.

Illegal Wildlife Trade - WildLabs Tech Hub

The illegal wildlife trade is the largest direct threat to many of the world's endangered species, as well as the livelihoods of local people who rely on wildlife-based economies. It's a huge problem and is a trade valued at £17 billion p.a. Satellite data can help address this, so in 2018 we ran a workshop on 'Technology for Conservation: Protecting Animals in the Wild' in partnership with the Foreign & Commonwealth Office and United for Wildlife.

As a direct result, the WildLabs organisation spun out a Tech Hub with our support, plus that of the Digital Catapult and other commercial, governmental and not-for-profit organisations. This Tech Hub will explore opportunities afforded by geospatial intelligence, satellite communications, drones, artificial intelligence and machine learning.

Since then, we've started working with the WWF (World Wide Fund for Nature) on the development of PandaSat, an animal tracking system based on a constellation of low Earth orbit CubeSats, and have engaged with several companies, including Imperative Space, Archangel Imaging and 1715 Labs.

Ubiquitous Connectivity

Along with geospatial intelligence, the concept of ubiquitous connectivity is central to our work at the Catapult. As a result, this year we launched the Westcott 5G Step-Out Centre to encourage development of new 5G products and services ready for commercial deployment, while continuing to focus on both devices and networks that will provide seamless coverage and fit users' needs as technology develops.

5G-MOBIX

The huge step up in performance offered by 5G mobile networks holds potential for a range of new applications. Hence we are very excited to be involved in one of the largest related global projects: 5G-MOBIX.

Launched in November 2018, 5G-MOBIX is an H2020 project that will evaluate the benefits of 5G for connected and automated vehicles. Trials will take place on roads across EU countries, including cross-border and urban corridors, and in China and South Korea. The project will enable innovative automated driving applications from both technical and business perspectives, as well as considering local legal, business and social aspects.

5G-MOBIX is co-funded by the EU and led by ERTICO – ITS Europe. Of the 46 partners, we are the only one from the UK, with our Westcott centre chosen as the location for the development and testing of key technologies prior to deployment at the trial sites. Our work will create significant opportunities for UK industry and place the UK space sector in a strategic position within the 5G landscape.

LightBar

Mobile communications outside urban areas can be unreliable, with some rural areas having little or no coverage. This is of particular concern for the emergency services, which is why we are leading a project to develop technology that provides full and uninterrupted coverage for emergency vehicles by using satellite communications where necessary.

The technology, which seamlessly swaps to satcomms when required, will be installed within the lightbar systems of emergency services vehicles and can be retrofitted to existing vehicles. It will not only provide hybrid connectivity but also resilient positioning and improved 4G communications, all in a flexible, small form factor design. As well as 'blue light' emergency services, the system is targeted at 'amber light' services, such as rescue and recovery, and utility vehicles.

The LightBar project is being funded through a €2.7 million Innovate UK grant from the European Space Agency's Advanced Research in Telecommunications System (ARTES) programme. The first phase will be demonstrated by Surrey and Sussex Police in late 2019.

Our Facilities

Our Facilities

The Catapult has a broad range of facilities that we have developed to support our strategy and to help create market opportunities for industry. These include technical and other workspace options at Harwell, our ground segment facility at Goonhilly, our expanding Disruptive Innovation for Space Centre (DISC) and the new Westcott Space Cluster.

In 2018/19 more than 110 organisations benefitted from using these unique facilities, with more than 800 bookings during the year. Both utilisation and commercial and project income have increased over the past 12 months by 33%, and we envisage similar growth over the next financial year.

Westcott Space Cluster launch

In October 2018, we launched the Westcott Space Cluster in collaboration with Thames Valley Berkshire Local Enterprise Partnership, Westcott Venture Park and other stakeholders. We plan to grow Westcott over the coming years, but it already incorporates a number of key facilities:

- Business Incubation Centre – offers tailored, specialist business and technical support for up to 20 early-stage businesses working in the areas of rocket propulsion, 5G communications and autonomous systems/UAVs. It is already home to eight innovative technology start-ups. This Centre is part funded by the European Regional Development Fund.
- 5G Step-Out Centre – a unique 5G facility to test and develop new services and products using the latest wireless applications service equipment and satellite data without the need to invest in expensive infrastructure. The centre has a specific focus on mobile applications and the control of autonomous vehicles, including UAVs, providing a controlled environment within which to verify safe and reliable operation under a variety of real-world conditions.
- Innovation Centre – supported by Buckinghamshire TVLEP, this will provide office accommodation plus a multi-functional and reconfigurable engineering facility designed to support the development of production lines for space hardware and related systems. The planned completion date is April 2020.

Disruptive Innovation for Space Centre (DISC)

Our DISC facility refers to a range of facilities that use novel and disruptive technologies to support the growth of UK companies in our sector. This includes end-to-end design, modelling, test and production facilities to help companies develop new products and services.

As a result of the interest in DISC, we are in the final stages of completing a brand new, bespoke facility, funded by OxLEP with a grant from the Local Communities Fund.

This year, we have specified and installed advanced clean rooms and flexible laboratory and manufacturing spaces for






constellation spacecraft, in-orbit manufacturing services and disruptive technology development capabilities. Now in the final commissioning stage, the facility is already fully booked for the coming year, set to support a range of UK SMEs and attract international organisations to Harwell and the UK.

By providing facilities for UK organisations, we overcome one of the barriers to rapid growth in a market which is often expensive to enter. The provision of facilities such as DISC is a core part of our work in the UK, and reflecting that, we have already submitted proposals to expand the DISC network with DISC phases three and four.

World-class facilities for the benefit of the UK space sector

Through DISC, teams can start with a Research and Development project and take it through to a full-sized prototype, manufactured at sufficient quality and quantity to enable validation by customers.
Electron Building, Harwell

Organisations of all sizes, including SMEs, can work within the heart of Harwell's space cluster in our
Co-space office, or use our conference facilities to reach out to the space sector.

Customers using our videowalls in our meeting rooms have benefitted from a recent upgrade, keeping the Catapult's visualisation suite at the cutting edge of technology.

Oxford Space Systems is one of a number of companies that has spent time based within our Electron Building to develop its business and secure long-term funding and customers. This year, Oxford Space Systems had successfully grown to a level that allowed it to secure its own space within the Campus and continue to expand.

The UK Space Agency also works alongside us at the Catapult, and this year it increased its space within the Electron Building, allowing it to expand its recruitment activities in Harwell.

Enabling Business Growth

Through the Partnerships and Engagement team we support organisations of all sizes and maturity by providing a range of enabling services. These include Business Growth, Service Design, Technical Expertise, Collaborative Projects and Funding Opportunities.

We work collaboratively with an array of diverse organisations, including UK Research and Innovation, the UK Space Agency and the European Space Agency as well as businesses on the Harwell Campus and across the UK through our regional and academic networks.

Within our Harwell Facility our 'Co-Space' provides a vibrant, entrepreneurial environment that can be used by organisations, end-users and academic researchers from within the space industry. Co-Space clients can use the facility to work together to develop new satellite-based services, technologies and applications, and also get access to valuable networking and business growth events. Where required, technical and business experts from the Catapult can offer mentoring support.

All Co-Space users can join the wider space community by attending some of the regular networking/pitching events which are hosted at a number of our facilities including the Satucinno event in Harwell, and the Space Innovators event in Westcott, both of which are very well attended.

We also offer a 'Business Sprint' programme, designed and developed to support businesses at critical stages in their development of innovative satellite-based solutions. From start-ups still looking at concepts to large and well-established firms, we offer organisations the chance to work with our experts and contacts, adding value as they work to develop commercial strategies, establish clear routes to market and prepare for external investment.

International engagement

The international space sector is undergoing a transformation. The industry is increasingly less dependent on major government contracts for large-scale infrastructure and is moving instead towards commercial services provided by privately funded organisations. This rapidly growing global market is where the potential for sector growth primarily lies – and UK industry is ideally placed to exploit this revolution.

Part of our role at the heart of the UK space industry is to open new markets, drive exports and attract foreign direct investment. In the last year, our organisation has been a part of over 40 programmes, projects and events in 26 countries across six continents. We have engaged with 328 businesses internationally and have connected 54 UK organisations with international opportunities in both upstream and downstream capabilities.

Our not-for-profit, government-backed status makes us stand out in the international arena, as does our ability to act as a portal to any satellite capability and to both collaborate on and open routes to market for products and services.

We've helped UK partners identify and nurture international relationships where a collaborative culture is most likely to create sustainable opportunities. We promote UK capabilities and offerings, but also work hard to cement relationships with many institutions globally that, we hope, will endure for the long term. In many cases these relationships have been built upon the 28 projects we have engaged with, 12 of which have been commercial.

We work with key international actors in our sector: the Foreign & Commonwealth Office, Department for International Trade, Department for Business, Energy & Industrial Strategy (BEIS), the UK Space Agency and UKspace. Together, we prioritise the creation of opportunities in, for example, India, Latin America, Asia Pacific, North America, China and the Gulf States with the aim of helping UK businesses to engage there. Where a strong bilateral partnership will be mutually beneficial and appropriate, we have sought to establish a local presence (directly or through agencies) to deepen relationships. We now have two members of staff based overseas, one in Chile and one in China, and have plans to engage with centres in Australia and the Middle East.

Regional and Academic Engagement

Engaging regionally and with academia allows us to stimulate growth in satellite applications across the UK, as well as expanding our expertise and the capabilities that we can offer to business. Through our Knowledge Exchange programme, we have five Centres of Excellence across the UK, jointly funded by the UK Space Agency. We also engage with academia through our Researchers in Residence and Knowledge Exchange Fellows programmes.

Centres of Excellence

Our Centres of Excellence provide an invaluable link between universities and businesses in their regions. They work together alongside the European Space Agency's Regional Ambassador Platform and the UK Space Agency Incubator Network; sharing ideas and opportunities and connecting companies and academics.

Both the South Coast and South West Centres of Excellence, hosted at the Universities of Portsmouth and Exeter respectively, had their contracts renewed this year for a further three years. This second phase will see them focussing on delivery, aligning expertise to tackle local challenges, and identifying funding to allow them to support industry in finding innovative solutions to these challenges using satellite technology.

Researchers in Residence and Knowledge Exchange Fellows

The Researchers in Residence (RiR) programme, funded by UK Research and Innovation (UKRI), was launched in 2017 to accelerate the impact of research funded by the Research Councils, develop new collaborations and nurture the talents, skills and knowledge base of both the researchers and Catapult staff. We now have six RiRs, each with a different thematic focus, some of whom work jointly with other Catapults.

Our Knowledge Exchange Fellows work through a bilateral arrangement with an academic institute to expand our network and expertise. They may work on a project directly or act as an enabler by identifying opportunities for collaboration. Among their areas of focus with the Catapult are solving environmental challenges using big data, using Earth observation data to generate a bespoke sea level rise service and creating an inventory for monitoring city-scale air quality and vegetation health.

In addition, Senior Innovation Fellow Dr Simon Jackman at the University of Oxford brings together researchers with businesses and the Catapult to develop new collaborations, projects and initiatives, including the Frontier Development Lab.

Evaluating our Impact

Our second evaluation, conducted by SQW Ltd on behalf of Innovate UK, reported in April 2019. The findings were very positive about the Catapult's performance. Over the last year, we were credited with building a strong reputation, and becoming recognised locally, nationally and internationally as a centre of excellence for satellite applications. In addition, it was concluded that we were responsible for catalysing and galvanising activity especially with non-space sector organisations.

There were a number of key factors contributing to the success of the Catapult:

- **Catapult's strategy and leadership** – the Catapult's refined and more focussed strategy for developing markets, technology and businesses by exploiting opportunities for the satellite applications sector (ubiquitous connectivity and geospatial intelligence). The Catapult leadership was viewed positively in setting and implementing the strategy.
- **Catapult staff and organisational culture** – there is unanimous recognition of the calibre of individuals employed by the Catapult, their high levels of technical ability and enthusiasm. This includes the Catapult's networks, knowledge and communications, and it being solution rather than just technology focussed.
- **Cross-sector application of satellite technologies** – the Catapult is seen as being proactive in the application of satellite technology to other sectors (e.g. transport, health, automotive, communication). This was cited as a result of the Catapult's culture, approach and understanding of space and non-space sectors.
- **New facilities, R&D projects, and links to universities** – the facilities have been and are expected to be important going forward at Harwell and Westcott. Complementary to this, the Catapult's ability to identify "good" or the "right" R&D projects, and its links to universities to access expertise were also highlighted. The Catapult was described as being at the heart of any activity, providing the "glue" between universities and companies, large and small.

Methodology and Economic Findings

SQW, our independent evaluators, apply a mixed method approach using two routes to estimate our economic impact on the UK economy, a business survey and an econometric analysis. The two approaches produce quite different results, so SQW provide an estimate that lies between the two results, as detailed below.

The Catapult can be attributed with between **450 and 650 additional jobs and £60 million of additional turnover** (scaled up from the survey results to represent the population of businesses we support).

There were **65 firms that have already introduced some form of innovation** (new or improved products, services or processes) as a result of the Catapult. Of these 36 **estimated that the value of these new products would be £120m over the next two years.**

94% expected to sell these new products or services in international markets.

Of the **new products or services reported, 81% were described as new to the market** – that is, introduced before competitors.

There were 48 companies (24%) in the sample that had, to date, **increased their R&D expenditure** as a result of their engagement with the Catapult. A further **75 expected to raise £230m in the next two years.**

Almost **two thirds of businesses had been introduced to new organisations.**

Half of businesses had improved their understanding and awareness of commercial opportunities in the satellite or space sector.
Around one-third of businesses have improved skills and knowledge and now have better access to data.

In the view of three stakeholder consultees:

"The Catapult has been an essential, critical part of the outcomes. Without it there would be an essential part of the jigsaw missing. They link well to other stakeholders; and the way they operate is important – open and collaborative.

"The Catapult has gone from being a 'sector discussion' organisation to being one focused on outcomes and supporting these – new and growing businesses, new technology developments, new products and services".

"[The Catapult provides a]... fast and low-cost way of getting tech into space".

The stakeholder feedback suggests that the Catapult has progressed significantly over the past two years. It has become an increasingly important part of the landscape and is making a growing contribution to the economy and the sector. The Catapult has performed well in supporting businesses, contributing to policy and raising awareness. Across the stakeholders there was a clear message that the Catapult has added value to the sector. Without it there would be less business activity and less commercial focus.

At a national level the space sector might not have been as high up on the strategic agenda of universities, local businesses or UK government in the absence of the Catapult. Stakeholders were confident that there would have been fewer businesses engaged in the sector. There was also a general view that the Catapult has provided a more commercial focus to research and a better understanding of what businesses want, helping to produce useable outputs.

Key Performance Indicators

Our Key Performance Indicators (KPI) form an important part of our broader monitoring and evaluation framework and we report on these quarterly to Innovate UK, our Sponsoring body. In 2017/18 a set of cross-Catapult KPIs were agreed, including indicators such as Technology Progression Level i.e. progress towards commercialisation, match funding from businesses etc. Below we report on those KPIs that we have reported on from FY13/14 to FY18/19.

KPI Name	FY14	FY15	FY16	FY17	FY18	FY19	Total
New organisations engaged	1,138	799	906	826	647	753	5,069
New non-space organisations engaged	-	-	428	621	523	535	2,107
New non-space funding & project partners	-	4	4	9	24	35	76
Number of businesses engaged - SMEs	-	259	323	367	362	650	1,961
Number of businesses engaged - SMEs - New	85	209	218	201	202	276	1,191
Number of spin out companies created	-	2	2	2	4	1	11
Number of scale up companies supported	-	-	-	-	7	6	13

Financial Highlights

The Catapult benefits from Innovate UK grant funding, which underpins the Company in its role within and for the UK space sector. The Company, along with its trading subsidiaries (together, the "Group"), leverages this grant funding, and achieved £18.6m of collaborative and commercial income in the year (2018: £16.9m).

For the year ending 31 March 2019, the turnover and operating profit were as follows:

	2019	2018
	£'000	£'000
Innovate UK grant funding	10,820	10,252
Collaborative and commercial income	18,626	16,900
Turnover	**29,446**	**27,152**
Operating profit	**916**	**1,072**

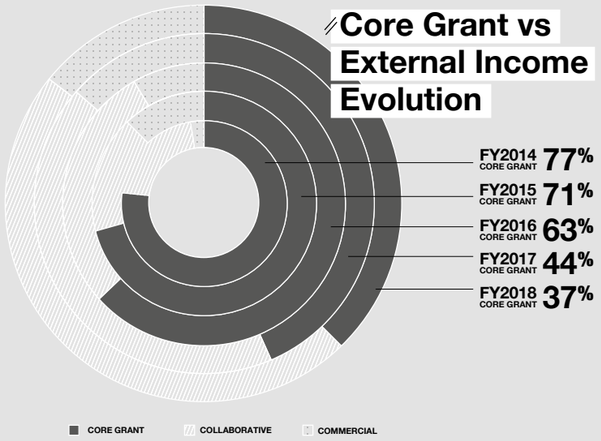
The Group has adopted the performance model of grant recognition under FRS102, with the whole capital element of grant income being recognised in the year it is incurred. This results in large operating profits during periods of capital investment and operating losses when depreciation exceeds investment. The Group's 'normalised' operating surplus for the financial year totalled £461k (2018: £969k). As a not-for-profit research organisation, any surplus is reinvested in pursuance of the Group's strategy.

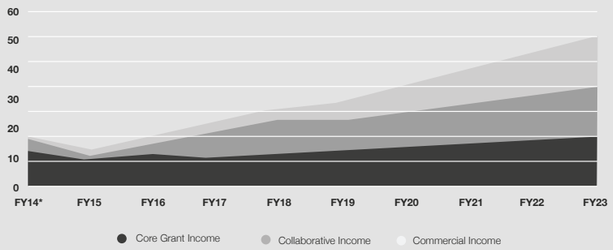
The consolidated statement of financial position as at 31 March was as follows:

	2019	2018
	£'000	£'000
Fixed Assets	10,824	9,962
Net current assets	2,451	2,096
Net Assets	13,274	12,058
Reserves **Profit and loss account**	**13,274**	**12,058**
Total funds	**13,274**	**12,058**

Financial Review 2014 - 2019

Over the past six years, the Group has generated £62m of collaborative and commercial income, growing from £3.8m in 2014 to £18.6m in 2019. Income from collaborative and commercial sources in 2019 represents 63% of our total income, with the Innovate UK grant comprising the remaining 37%. The evolution of the Innovate UK core grant income compared with income from collaborative and commercial sources is shown in the chart below:





The future

We expect the point at which two-thirds of our income comes from outside of our core grant income will be in 2021, in line with expectations from our original delivery plan. The actual income achieved to date, together with the forecasts from our latest delivery plan, are shown opposite.

CATAPULT
Satellite Applications

The Company is registered in England and Wales under company number 07964746 with its registered office at Electron Building, Fermi Avenue, Harwell Science and Innovation Campus, Didcot, Oxfordshire, OX11 0QR.

Directors
The Directors who served the Company during the year were:

Timothy Sherwood
Stuart Martin
Simon Acland
Chad Anderson
Lucy Edge (appointed on 19th July 2018)
Susan Hunt
William Hutton
Dr Vanessa Lawrence
Lynne Patmore
Ruy Pinto (resigned on 2nd April 2019)
Richard Tuffill (appointed on 19th July 2018)