// Annual Report 2018

A world empowered by satellites

We work with Innovate UK

CATAPULT Satellite Applications

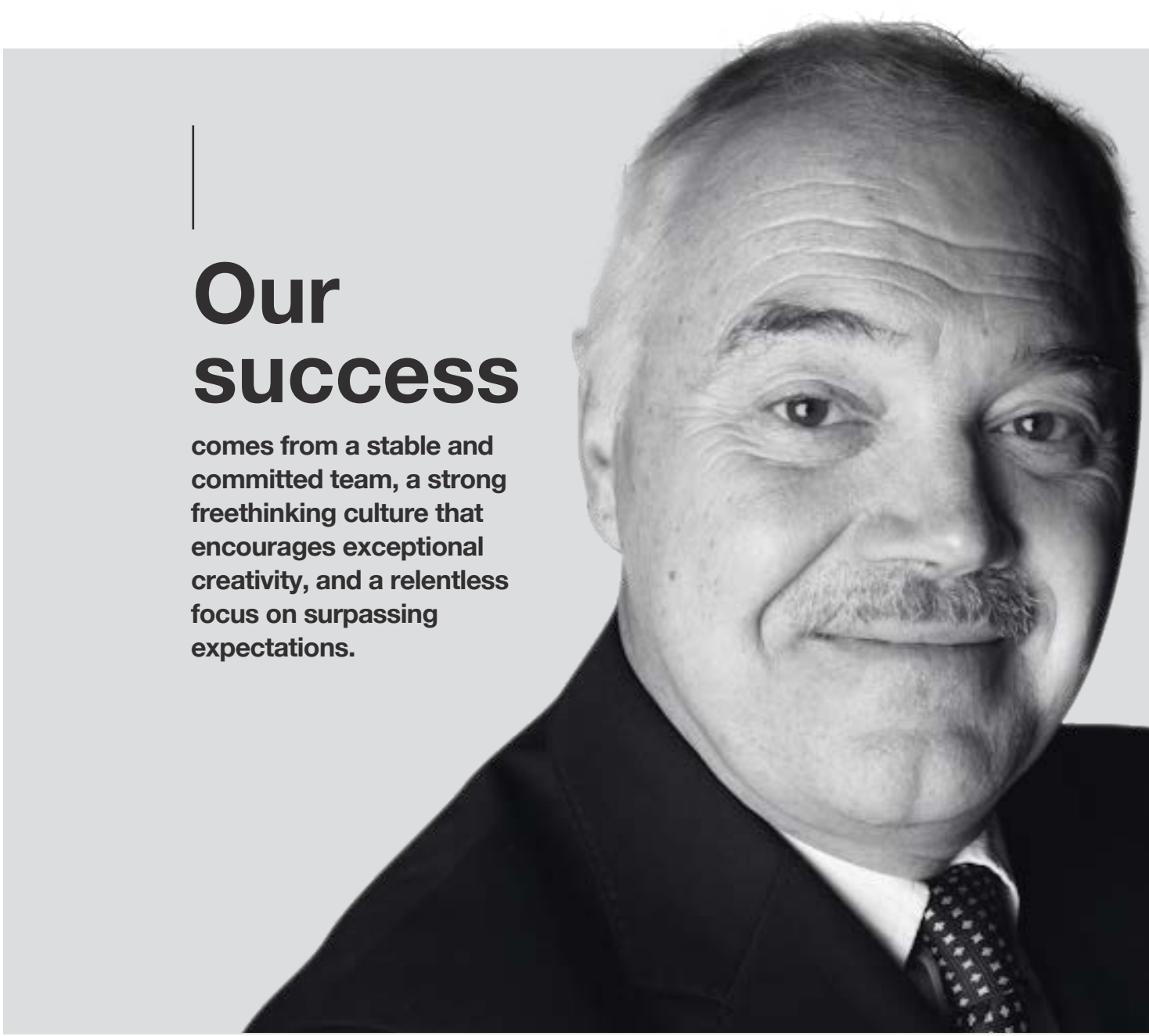
Table of Contents

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.

A world empowered by satellites

Chairman's Statement



Our success

comes from a stable and committed team, a strong freethinking culture that encourages exceptional creativity, and a relentless focus on surpassing expectations.

This year has been a key milestone in the life of the Satellite Applications Catapult as we completed our first 5-year term in March 2018. From a standing start 5 years ago, we have achieved a transformation in the innovation landscape for satellite applications.

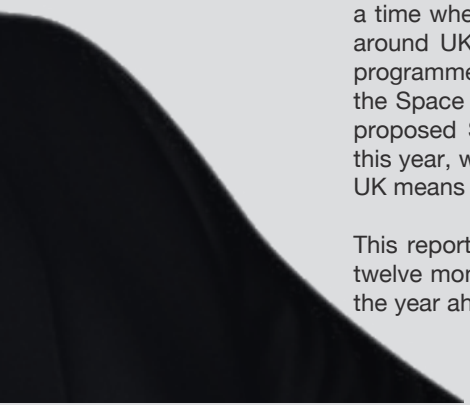
Collaboration has been the key to bridging the research and business gap to create a successful technology and innovation company. We are now recognised as a vital component of the UK space landscape, but more broadly, we have proved the positive role that Catapults can play as a 'translational infrastructure'. Proof of our success was the independent review of our first term, which noted that we are now considered a critical part of our ecosystem.

As we move into our second 5-year term, our key indicators now reflect the exponential growth across the sector. In particular, external investment in companies the Catapult has supported was over £27m this year, an important marker for the potential seen in space from outside the sector.

We have generated over £33m collaborative income, with this year representing £13m of this total (39%).

We have generated £10.6m of commercial income, £3.9m this year (37%)

We have helped our business clients secure £51.6m of funding, with £27.4m of this in the last year (53%)



As the success of the sector grows, it is also vital that we maintain confidence and momentum at a time when industry is experiencing headwinds around UK involvement in the European space programme. Our activities and plans support the Space Growth Partnership and align with its proposed Space Sector Deal, published earlier this year, which will send a strong signal that the UK means business.

This report highlights the successes of the past twelve months and outlines key programmes for the year ahead. As you will see the Catapult has a clear vision about how best to support this need and is ready to do so.

Our success comes from a stable and committed team, a strong freethinking culture that encourages exceptional creativity, and a relentless focus on surpassing expectations. This is a tough combination to establish. On behalf of the Board and the whole Catapult team, I can say we are all extremely proud of what we have achieved, and we look forward to even greater opportunities ahead.

CEO's Statement

The world is in the early stages of a new digital revolution, with space technology increasingly at its heart. Satellites are now critical infrastructure, as fundamental to the global economy as the energy grid or the internet. Whether monitoring global weather or keeping the world's population connected, located and informed, there is virtually no aspect of modern life satellites do not enhance.

This year we created a new delivery plan for our organisation until 2023. It summarises the state of the market and our strategic objectives, and how we will break down the barriers to the growth of the sector. It will also be the yardstick by which we are measured. In it, we make commitments to ensure that our second 5-year term is even more successful than our first. It will guide our deeper exploration into the dynamic, innovative Space ecosystem and stimulate new opportunities and challenges.

To enable us to deliver the scale of impact that is needed, we have attuned our organisational structure to meet the growing demands of the sector. We are realigning our market and technical approaches, ensuring a balance between these two axes to best support our ambitions for growth, both for the Catapult and the UK space sector. Strategies in our market and technical value streams have robust pathways to impact and support their respective communities.

We are also developing new facilities and capabilities to underpin this. These include a range of 'transformational initiatives', such as the Disruptive Innovation for Space Centre (DISC), which, with support from Innovate UK and the Oxfordshire LEP, is already starting to make an impact for UK businesses, with much more to come when the Phase 2 facility is opened at Harwell. We have also made significant progress in building a new 5G test-bed and business incubation centre and establishing these in a new 'Space Cluster' at Westcott in Buckinghamshire. These are large-scale concepts in response to specific challenges or opportunities that we have identified in the sector, and each will deliver major returns in their own right.

This year has also been marked by a range of significant successes for the Catapult, and a step-change in the number and value of projects we are working on collaboratively with the space sector and wider industry. These include the UK Space Agency's International Partnership Programmes (IPP) in Peru, Malaysia, Indonesia, Colombia and Fiji, the Solomon Islands and Vanuatu, and the launch of our successful spin-out companies, Oceanmind and Orbital Witness.

In collaboration with our partners within government, academia and business we continue to inspire innovation and support the development of commercial products and services across UK businesses. Through the exploitation of satellite applications, together we can deliver new benefits to society and grow the satellite applications sector sustainably for even greater success.

The Year in Numbers

THIS YEAR

£13m in collaborative income — **34%** YEAR 2016 TO 2017

£3.9m in commercial income — **26%** YEAR 2016 TO 2017

£27.4m million raised in investments by businesses we supported — **55%** YEAR 2016 TO 2017

CREATED 4 SPIN OUT COMPANIES

ENGAGED WITH **494** BUSINESS

ACHIEVED AN AVERAGE **54%** UTILISATION FOR CATAPULT RUN FACILITIES

CONDUCTED ACTIVITIES WITH 62 UNIVERSITIES

5 YEARS

Businesses we have worked with have raised **£51.6m** in funding

WE HAVE OPENED 5 REGIONAL CENTRES OF EXCELLENCE

HARWELL SPACE CLUSTER, 80 ORGANISATIONS, EMPLOYING OVER 750 STAFF

ECONOMIC IMPACT - FY18

Energising the Market	YTD	Target
Non-Space Organisations	523	400
Non-Space Project Partners	45	8

Empowering the Technology	YTD	Target
Projects eligible for R&D tax credits	20	20
Registered IP & Licences	4	4

World Class Facilities	YTD	Target
Facilities Utilisation	54%	50%
Facilities Income	£0.6M	£0.5M

UK Focus	YTD	Target
Activities with Universities	62	50

Enabling Business	YTD	Target
Business Clients (paying)	144	121
SME Clients (paying)	62	81
Businesses Engaged (Total)	519	450
Businesses Engaged (SMEs)	362	360
Spin Out Companies	4	4
Scale Up Companies	7	3

Sources of Finance	YTD	Target
Collaborative Income	£13.0M	£11M
Commercial Income	£3.9M	£4.0M
External order backlog	£10.5M	£10M
Funding raised by business supported	£27.4M	£25M

Space Sector
Business Highlights

Our success is measured by the success of the companies that we work with.

Space Sector Business Highlights

Orbital Micro Systems is a US technology company looking to revolutionise weather forecasting using small satellites. OMS are working with us through our In-Orbit Demonstration programme and are strongly growing their UK presence, including a major partnership for data analysis with Edinburgh University.

Hummingbird Technologies, in just three years, has grown to be the biggest player in the UK, providing crop management tools that aid precision farming. Now with 35 staff, the company has expanded into Brazil, Russia and Ukraine. Through a collaborative project the Catapult helped enhance their services by offering radar imagery to complement imagery from drones on their platform. This Dyson-backed company has raised over £3.25 million of seed funding.

OceanMind uses satellites to shine a light on illegal, unreported and unregulated (IUU) fishing. On 2 July, the business unit spun-out of the Catapult with 11 staff. The Spin-out exemplifies the purpose of the Catapult; combatting a major global challenge with the aim of developing sustainable services with a viable international market.

MeVitae worked with us through our Satellite ACE programme (ACcess for Everyone), creating a data-driven cognitive recruitment system that makes intelligent and personalised hiring decisions. We are applying their AI technology to our Data Discovery Hub, providing easier access to EO data for the businesses we support. MeVitae raised £500k this year and also participated in our SPINtern programme and networking events.

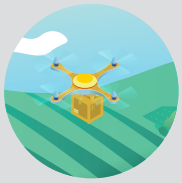
OpenCosmos, a Harwell-based company, provide simple and affordable space missions. Providing a one-stop-shop mission package for our In-Orbit Demonstration Programme, they now have access to sufficient facilities to achieve their target of five to 10 launches this year. The company have successfully raised £5.4m and were named as a leading global innovator in the 2018 Disrupt 100. They plan to increase from thirteen to an anticipated 50 staff by the end of 2018.

Global Surface Intelligence have participated in a Business Sprint with the Catapult, through which the Catapult has helped them move from a project business to a product business. They are embracing automation and machine learning to maximise the intelligence they derive from satellite data.

KisanHub has raised over £2.5m VC investment, we supported them in a technical sprint in 2014 and have since made several introductions to partners. The company's platform allows farmers to track and analyse data on soil and water balance, and local weather data among other elements for each of their individual fields. In early 2018 the company raised £1.75M helping to expand their team and further develop the platform.

Clyde Space was an early partner in projects with the Catapult. In an acqui-merger with AAC Microtec the company was valued at £26.7m. Our strategy analysis and recommendations to Clyde Space last year were instrumental in this decision.



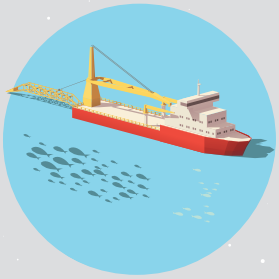













Catapult Programmes

Catapult Programmes

Two key trends present a global economic opportunity for the UK satellite applications sector: geospatial intelligence - an ever-growing demand for data that is accurate, personalised, localised and available globally in real-time, and ubiquitous connectivity – everything connected, everywhere for everyone.

Geospatial Intelligence - We help businesses use the intelligence from the rapidly increasing scale of satellite and related geospatial data to place the UK at the forefront of the fourth industrial revolution. We are also a global focal point for geospatially empowered industries including transport, agriculture, energy and financial services.

Ubiquitous Connectivity - By combining and nurturing the UK's world-leading capabilities, we accelerate UK industry to be well placed, both in capacity and global reach, to meet global opportunities covering telecommunications, aviation, satellites and automotive.

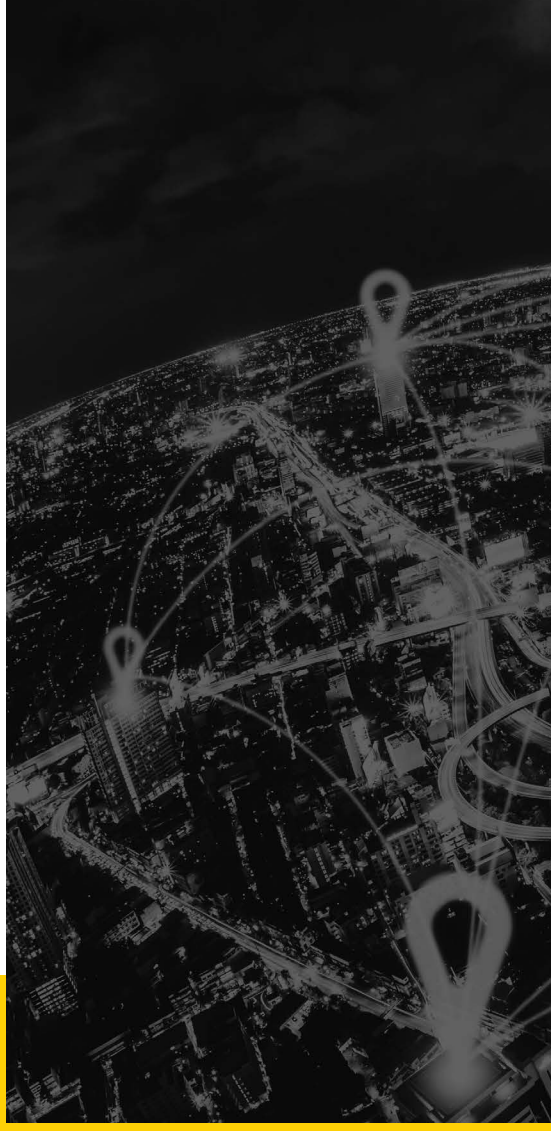
By taking leadership in connectivity and geospatial intelligence to build a space-enabled economy, the UK will capitalise on growing global digital markets such as Intelligent Transport, Sustainable Living, Blue Economy and Government Services. These four programmes are at the centre of the Catapult's strategy and focus on areas of high potential growth for satellite applications. They are designed to help organisations advance existing technology or create new products and services, unlock demand for solutions and demonstrate what space-derived services can make possible. They showcase UK capability in using satellite applications to tackle real-world problems, which opens new markets, drives exports and creates jobs.

Our strength is being a neutral, trusted partner that can work in diverse markets and do anything from innovating and developing technology to facilitating introductions between organisations where we recognise potential benefits.

Many of the projects in our four Market Programmes link to the Grand Challenges within the Government's Industrial Strategy: for example, satellite connectivity, artificial intelligence and big data will be crucial enablers for the health of the UK population and link to the Grand Challenge of Ageing Society. Other projects are closely related to AI and data, clean growth and future of mobility challenges.

Intelligent Transport

Intelligent Transport



Integrated communication and navigation will allow faster, more efficient transport by road, rail, sea and air, generating less pollution and improving connections between communities. The global market for Intelligent Mobility was worth £140 billion in 2014 and will grow to £900 billion by 2025 .

The Intelligent Transport programme is supporting the UK to become a world leader in the 'Future of Mobility'. Our research shows innovative and advanced satellite enabled technologies make transportation systems safer and increase the efficiency of existing transport infrastructure. We are working with partners to deliver ground-breaking solutions to improve road safety, tackle congestion and smooth traffic flow. In turn, this will have beneficial effects on the environment leading to a reduction in air and noise pollution.

As the market transitions towards the use of autonomous vehicles we will see demand for ubiquitous connectivity rise. Companies will continue to use real-time data to inform and manage our transportation systems. However, they are rapidly moving towards using the time spent in-transit to sell, entertain and enhance the customer experience.

We have strong traction from activities to date, our 5G Step-Out Centre will help the Catapult and industry create, test and commercialise hybrid satellite 5G terminals. By demonstrating hybrid connectivity, we have influenced major UK satellite operators, positioning them to optimise the global market for automotive connectivity.

Transport Innovation Programme (North West region)

Over the next **5 YEARS**

We plan to deliver several large-scale, transformative, market-led initiatives that could be replicated globally.

The Intelligent Transport programme is supporting the UK to become a world leader in the 'Future of Mobility'.

Deliver £2 billion in economic growth

20,000 high value jobs.

Logistics

This year we worked with Tructyre Fleet Management on a very successful project to prevent tyre failures through intelligent alerts, during which we recognised an opportunity to extend the benefits further. We created a collaboration with Traffilog UK – a large telematics company whose intelligent platform provides automotive manufacturers, insurance companies and fleet owners with cutting-edge mobility solutions. The idea is that the TyreWatch tyre monitoring insights could be linked to Traffilog's system, providing a potential route to commercialise their product to a wider audience.

Automotive

5G Step-Out Centre at Westcott

This is a joint £1m funded venture between the Buckinghamshire Thames Valley Local Enterprise Partnership (BTVLEP) and the Satellite Applications Catapult, focused on resilient communications. It offers an open and accessible UK test centre for all International Telecommunications Union (ITU) primitives providing total standardised commercial off the shelf (COTS) testing facilities. It also offers test and development OFCOM licences from 700Mhz to 4200Mhz and satellite and terrestrial capabilities.

LightBar

Connectivity anywhere, anytime for mission-critical data and services

The Lightbar Project, in collaboration with Inmarsat and the University of Swansea, will deliver connectivity anywhere, anytime for mission-critical data and services.

This in-vehicle system seamlessly switches between terrestrial and satellite communication networks and prioritises data according to the situation. We aim to provide multiple users with continuous coverage for critical applications used by the emergency services and other professional vehicle operators by 2020. With integration of on-board devices, emergency services will always be able to receive and send data, improving situational awareness and response times.

Supported by the Home Office, LightBar will benefit both the emergency services and the wider UK economy. Ubiquitous connectivity with consistent bandwidth performance makes resilient positioning and intelligent routing data available to dispatch stations. Working to save lives this vital data makes it possible to optimise routes to increase the available work time, reduce drive times and fuel consumption.


LIGHTBAR
POLICE

I_HeERO

From April 2018 a new European Union initiative takes effect called eCall. The eCall system is a satellite enabled automotive technology installed in all new motorcycles, cars and light commercial vehicles sold within the EU. The aim is to bring rapid assistance to motorists involved in a collision anywhere in the EU. The system is activated by the driver or automatically in the event of a serious accident and will then dial the 112 European emergency telephone number. Airbag deployment and impact sensor information, as well as GPS co-ordinates are sent wirelessly to local emergency services.

The Catapult demonstrated the eCall system, to highlight the value of a satellite enabled automotive technology at the Intelligent Transportation Systems (ITS) Congress in Strausberg.

This demonstration came as the result of a collaboration with IMR-Tech (an Australian company). We invited IMR-Tech to attend an **I_HeERO** event and they have subsequently benefitted from Catapult services including business support and providing input into future strategy options for eCall. Since then, IMR-Tech have registered a UK business. We are now working to establish a UK research base for the company. In addition to this we negotiated an opportunity for them to join the SAFE proposal and they have been included in an ESA eCall bid.

The IMR-Tech 'SafeGuard' device provides a Cloud based solution that can be retrofitted to any vehicle regardless of make and model and is currently on sale in Australia. The company is now looking to fulfil opportunities in Asia, Europe, Middle East and the UK.

TyreWatch

Pathway to Autonomous Commercial Vehicles project

The **TyreWatch** solution delivers continuous, real-time reporting on every tyre across entire fleets of commercial lorries and trucks working here and abroad. Tructyre, a commercial fleet management company, who have proactively reduced roadside downtime and accidents, created the concept.

This solution was developed in collaboration with three partners: University of Portsmouth (AI algorithms), RL Automotive (software development and sensors), and the Satellite Applications Catapult (integration of satellite terminal and design of hybrid solution with algorithm to switch between cellular and satellite connectivity) with £1.2m funding from Innovate UK.

Sensors measure the tyre pressure, temperature, speed and location on multi-size and multi-brand tyres. This level of monitoring lowers carbon emissions through the reduction of rolling resistance and fuel burn. A combination of wireless communication and AI alerts notifies the driver and management office of a potential tyre failure. Remedial work can then be scheduled and carried out in safety.

Sustainable Living

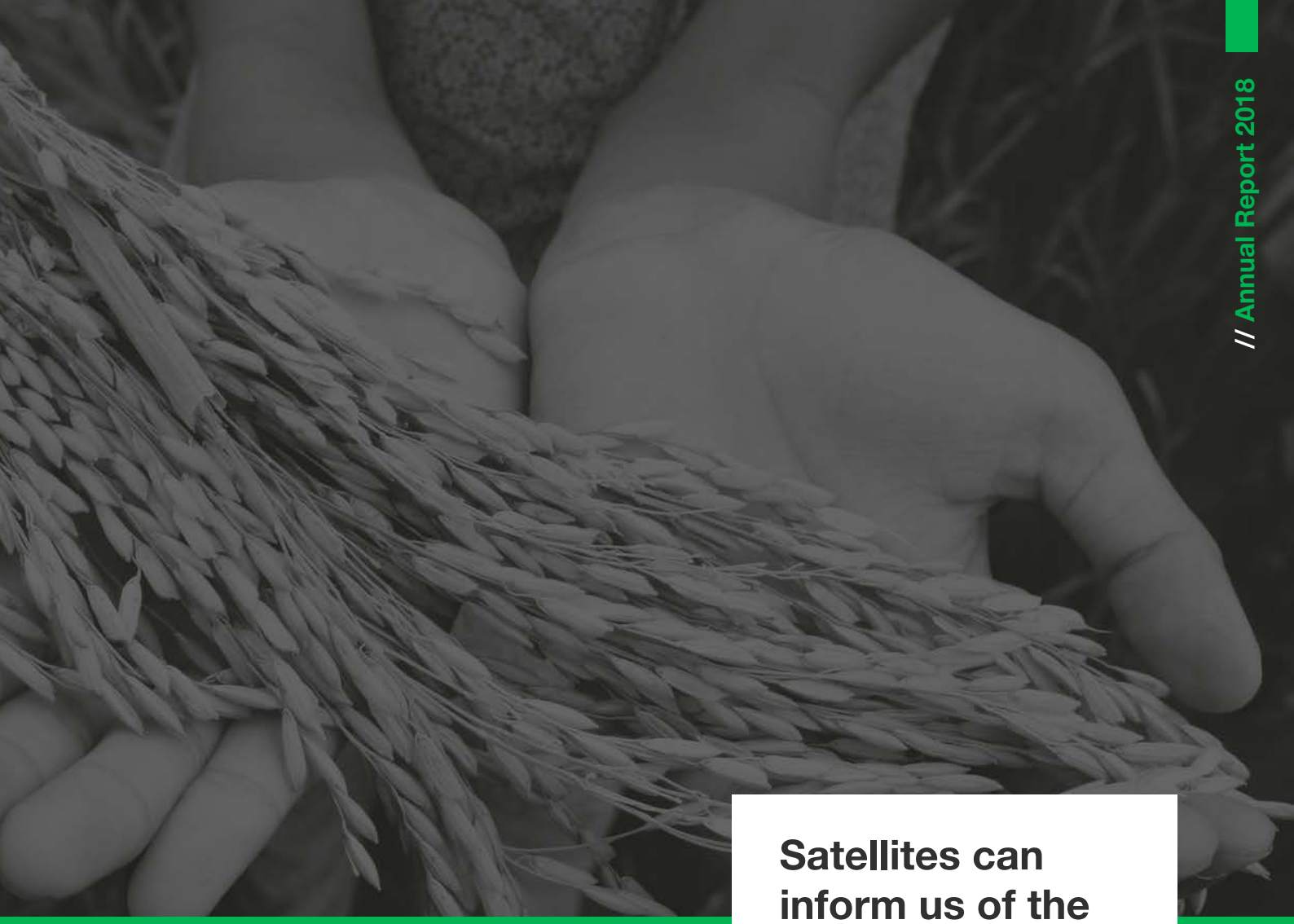
Sustainable Living

Space-enabled services will help us produce food for a growing population and manage scarce resources efficiently and sustainably. Sustainable business models could open economic opportunities worth $12 trillion and up to 380 million jobs by 2030 .

Increasing demand and global population growth is putting intense stress on our natural resources. Satellites can inform us of the status of the environment anywhere around the world and alert us quickly if anything changes, benefitting both people and wildlife. Satellites can also support industries as diverse as agriculture and mining, boosting productivity and reducing both cost and environmental impact.

By the year 2030

Sustainable business models could open economic opportunities worth $12 trillion and up to 380 million jobs by 2030.



Satellites can inform us of the status of the environment anywhere around the world and alert us quickly if anything changes, benefitting both people and wildlife.

Sustainable Development

Space Enabled Exploration and Monitoring of Cornwall Lithium Resources

This year, we led a project to explore the potential for satellites to detect the presence of lithium in Cornwall. There is a growing global demand for lithium batteries, so our aim was to help reduce the cost of exploration, while also highlighting opportunities for satellite businesses in the mining sector supply chain.

The team integrated Earth observation (EO) data sets to create layered data maps in which geological, mineral, vegetation and thermal anomalies indicate areas where 'lithium brines' (lithium-rich water) are likely to be present below the surface. The resulting 'prospectivity map' will be used by Cornish Lithium Ltd to support its exploration activity.

In parallel, the team developed another map that can act as an environmental monitoring tool, showing priority habitats, flood risk areas and urban settlements. This could provide a cost-effective way for mining companies to provide the independent data required for complying with environmental regulations. The overall benefits may be even broader: for example, this technology could be used to identify the troublesome invasive plant, Japanese knotweed.

There has been strong international interest, with the project team visiting Bolivia to support the 'Great' Campaign. Locally, Cornish Lithium Ltd has already employed three additional people as a result of this project and follow-on phases are expected to contribute to enabling new UK mining activity worth £2.5 billion per year in additional revenues and 5,000 new jobs.

Earth And Sea Observation System (EASOS)

The Earth and Sea Observation System (EASOS) is a world-leading management information and decision-support system designed to tackle issues associated with marine pollution, deforestation and flooding, initially in Malaysia. In 2014 alone, the combined impact of these three issues was estimated at around $12.5 billion globally. We have been managing the EASOS project, supporting the project partners to build new international relationships, which are expected to lead to exports of £12 million per year by FY23.

EASOS is ground-breaking and ambitious, in that multiple government agencies and departments can have access to data across a wide range of applications, all with the same user interface: in Malaysia, 26 have been involved.

May 2018 marked the end of the initial 18-month development programme. The technical requirements have been completed successfully, the service is 'fully live' and EASOS has now shifted into the next phase in which the focus is on ensuring the sustainability of the project's outcomes.

The ultimate aim is for EASOS to be a recognised brand in its own right. An EASOS 'Hub' will support companies in both technology and market 'readiness', opening up previously inaccessible international markets, resulting in jobs and export opportunities for the UK.

The EASOS team has engaged with major national and international companies at several events, resulting in strong interest in Flood Watch in particular. Stakeholders in the mining industry have also expressed interest in the possibilities demonstrated by EASOS, particularly in Latin America.

Mining

IPP Peru - Tailings Dams

Toxic waste and effluent are by-products of mining that are typically stored behind nearby embankments that can be up to 100m high. To save costs, these are often constructed using low-grade mining 'tailings' (ore waste) but their failure rate is relatively high and serious incidents are increasing.

The Catapult is working on a £4 million project to develop a more effective monitoring system for 'tailing dams' using Earth observation (EO) and Global Navigation Satellite System (GNSS) technologies. The plan is to use interferometric synthetic aperture radar (InSAR) combined with real-time, in-situ devices to provide a more accurate and cost-effective way of remotely measuring any movement of these structures.

Once developed, we will work with multinational mining companies and local stakeholders in Peru to deploy the new tools, which will help to reduce damage to downstream ecosystems that many vulnerable communities rely on for water and their livelihoods.

On a larger scale, we believe there could be a global market for an EO-based monitoring system that would help mining companies to reduce their costs and improve their environmental risk management, and at the same time help low-income countries to meet their Sustainable Development Goals (SDGs).

Agri-Tech

CropHopper

Spotting and treating weeds among crops is a key farming objective, but the resolution of cameras on unmanned aerial vehicles (UAVs) isn't good enough to identify weeds early in the season. However, the potential is huge: being able to guide tractors to only spray where necessary can save 30% of chemicals and reduce crop injury by 35%.

We're part of a consortium that is proposing to tackle this by using a combination of data from satellites and ground robots. The robot is CropHopper, which uses a novel jumping mechanism to jump in 5m steps along fields. The data it collects will be used to calibrate low-cost or free Earth observation (EO) images to create more accurate maps that prescribe where to apply any treatment. CropHopper can also spray the weeds, making it the world's first all-day working farm robot.

This project will allow farmers to increase productivity and decrease operating costs by as much as 30%. Crop wastage will be reduced and quality improved, which is expected to cut prices and grow exports. At the same time, there will be environmental benefits, including a decrease in the amount of chemicals that leak into rivers and a drop in the rate of decline of bee populations.

Easy Energy Engager

We are a consortium partner in developing a user-friendly demonstration interface as a proof of concept for Easy Energy Engager; an innovative internet-based service that incorporates satellite imagery to help households and businesses save money on their energy bills. This project is still in progress and not due to close until the end of September 2018.

Blue Economy

Blue Economy

Satellites are essential to deliver connectivity and monitoring services across our oceans and coastlines. The OECD estimates that the Ocean (or Blue) Economy contributes around 2.5% of the world's value-added GVA, corresponding to around $1.5 trillion in 2010.

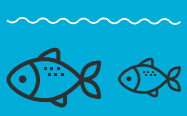
Since the Catapult was formed, we have advocated the potential for satellite-enabled solutions to solve the world's environmental challenges. This has been validated by the UN's Sustainable Development Goals, many of which rely on satellite solutions to monitor their progress. Our flagship example of how we have led the world in this direction is our work in combatting illegal, unreported and unregulated (IUU) fishing. One in five fish are taken illegally from the world's oceans and that illegal fishing costs the global economy an estimated $23.5 billion per year, illustrating the importance of finding a permanent way to tackle this problem.

Having delivered a positive impact in illegal fishing our focus is now on surveillance and connectivity to boost sustainable Blue Economy Growth. We aim to identify and create opportunities that will embed satellite technology and data into services and solutions to support intelligence gathering and the critical infrastructure required to deliver global connectivity. We will also raise awareness of satellite capabilities, and work in collaboration with potential customers and the wider satellite sector to develop innovative solutions.

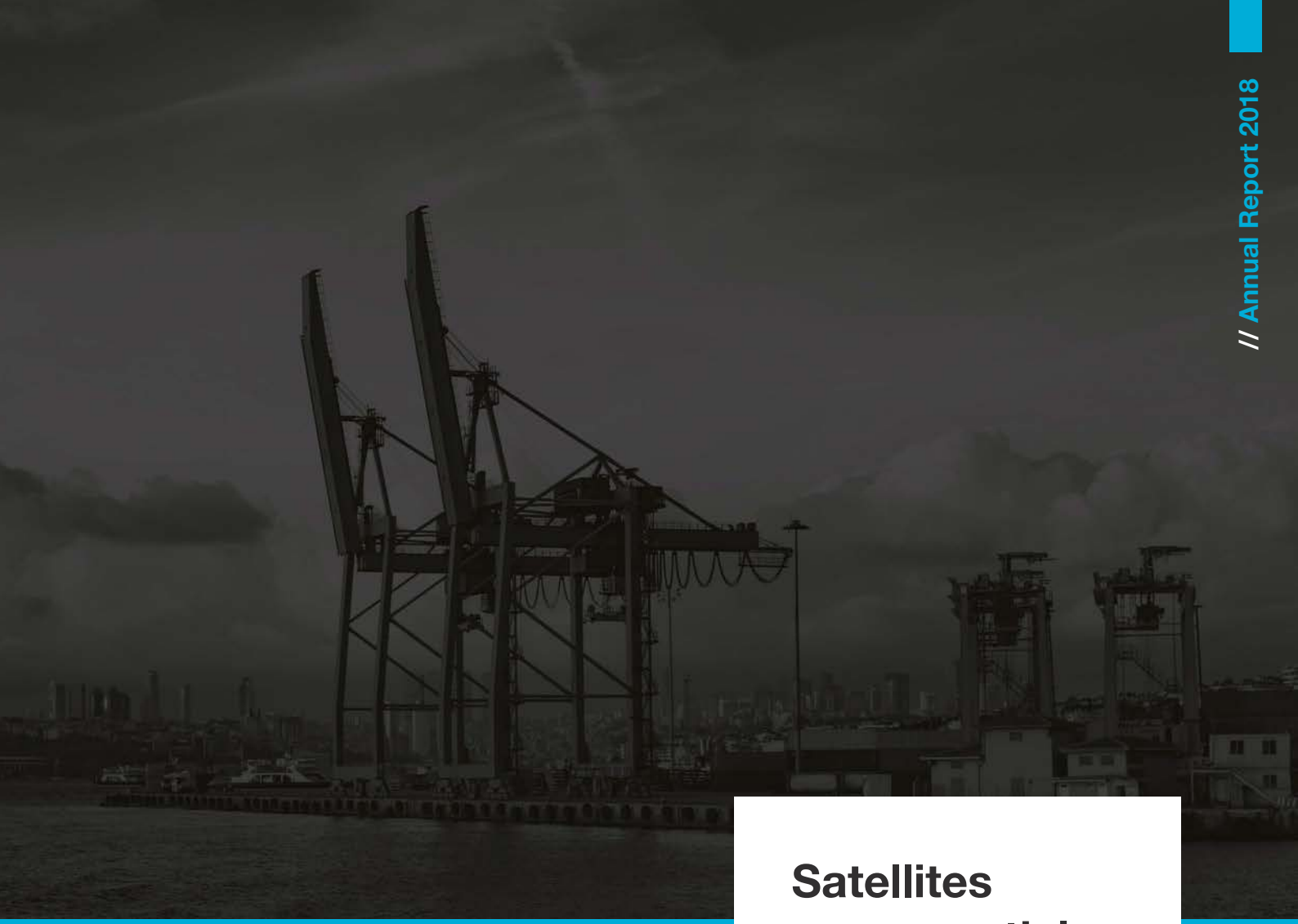
Through our broader maritime activities, we are developing relationships with world leading satellite communications partners that dominate the global Safety of Live at Sea (SOLAS) and the cruise line connectivity market.

// Our focus is now in the following key areas:

Ocean surveillance
enabling improved policing in remote locations leading to reduced environmental and commercial lawlessness



Coastal monitoring
to protect the environment in which specific species grow



Satellites are essential to deliver connectivity and monitoring services across our oceans and coastlines.

The 'Port of the future' will create a framework for more efficient operations through seamless GNSS, and enhanced vessel and asset tracking.

Ending Illegal Fishing

OceanMind Spinout

The OceanMind business unit is now an independent, not-for-profit company with 11 employees. This pioneering new entity will continue its outstanding international contribution to the growing global challenges of tackling illegal, unregulated and unreported fishing (IUU).

Conceived three years ago, OceanMind and The Pew Charitable Trust worked together on a surveillance project in the Pitcairn Islands to establish fishing vessel identities, fishing policy compliance and seasonal trends. This resulted in the UK Government designating St Helena and the Pitcairn Islands as a marine protected zone and gave a commitment to designate Ascension and Tristan da Cunha by 2019 and 2020 respectively.

Since then OceanMind has developed market-leading services and found customers from leading international brands. Their services are based on the observation of fishing vessels, by applying advanced machine learning techniques to the latest satellite datasets. This capability is now enabling organisations around the world to enforce fisheries policies more effectively. Independent third-parties and global supply chains use this vital intelligence and analytical capacity to validate seafood traceability and source more responsibly.

The OceanMind spin-out exemplifies the purpose of the Catapult, which is to combat major global challenges by developing sustainable services with a viable international market.

SEMDAC

Project: Satellite Enhanced Maritime Domain Awareness for Chile (SEMDAC)

As the 10th largest fishing nation in the world, Chile has been fully engaged with tackling IUU fishing for many years, with estimated lost revenues from illegal fishing of $150 million per year.

As part of the SEMDAC project, OceanMind provided the country with new capability by deploying an adapted version of its advanced maritime observation system in an operational trial in partnership with the Chilean Navy (DIRECTEMAR).

OceanMind's fisheries experts used Automatic Identification System (AIS) and Vessel Monitoring System (VMS) data to check for abnormal or suspicious behaviour in two trial Areas of Interest (AOI): Easter Island and the Desventuradas Islands, both in the Chilean Exclusive Economic Zone.

Daily reports provided near-real-time information for each AOI during the 14-day trial, while historical reports allowed the team to ascertain long-term trends. Together these enabled Chile to direct patrol assets more efficiently and verify licensing compliance.

In one region, the team identified a pattern of suspicious behaviour at night, which they attributed to potential illegal squid fishing, allowing patrols to catch IUU fishing in the act. This, in turn, raised awareness of the new, more acute surveillance, deterring further illegal fishing. Overall, such a system is expected to reduce the economic and social impacts of IUU fishing, improve ecological impact and have a positive effect on biodiversity.

Government Services

Government Services

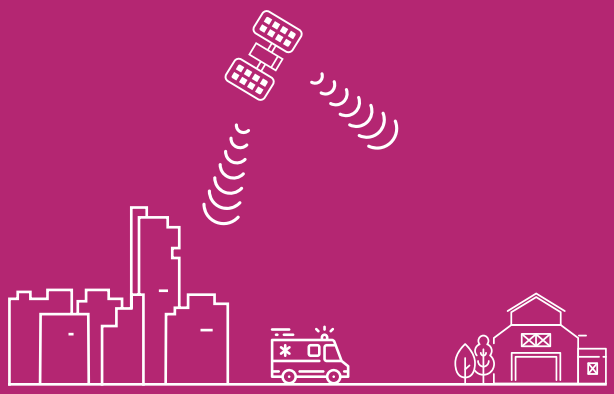
Satellite connectivity and geospatial solutions can be used to create smart solutions that reduce costs and increase productivity. They can help government services – local, national and international – to make informed decisions that impact both people and places.

Satellites can help deal with the emerging issues of an ageing society and the delivery of healthcare services, especially in remote communities. The global digital health market is expected to grow to £43 billion by 2018. One area where satellites are making a major impact is in health and wellbeing, by helping us to deliver improvements in patient care that are sustainable and generate impact for businesses. This is particularly useful in rural areas, where poor connectivity limits access to developments in digital health that support healthy ageing. Improvements for over-65s, the fastest growing, highest cost healthcare demographic (£46 billion) could offer incredible economic benefits.

By the Year 2018

The global digital health market is expected to grow to £43 billion by 2018

Satellites are making a major impact in health and wellbeing, by helping us to deliver improvements in patient care that are sustainable and generate impact for businesses.

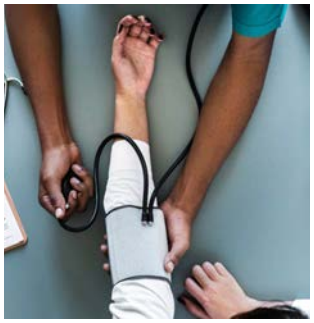


Satellites will help delivery patient care to rural areas, where poor connectivity limits access

Health & Wellbeing

Highlands and Islands Enterprise – Using satellite data for life sciences and healthcare

We have worked with the Highlands and Islands Enterprise (HIE) over a number of years on projects where satellite technology could benefit remote and rural areas. Initially, together with Tactical Wireless, we developed Satellite Ultrasound for Rural Stroke (SURS); portable technology that takes a stream of images that can be sent back from remote areas to a hospital or GP surgery for assessment. This initiative is now being rolled out to more areas of the UK and has located Tactical Wireless in the Highlands, where it is forecast to generate 50 new jobs.



RAPID

Reducing Amputations in Diabetes (RAPID) focused on e-health solutions for diabetes-related foot ulceration. Tactical Wireless used this project to show how the technology offers both savings for the NHS and improved patient outcomes, and as a result of the project's success it trademarked the Omni-Hub product. The project was further developed at the end of 2016 as part of trials funded by Innovate UK.

PillCam

Alongside RAPID, we supported Corporate Health International (CHI), a Danish company, in trials focussing on the use of 'capsule endoscopy', known as PillCam™, for early diagnosis of gastrointestinal diseases. These range from inflammatory bowel diseases (IBD) to bowel cancer; the latter being the only cancer that can be fully prevented if its precursors – polyps – are detected early.

The vast majority of endoscopies are undertaken at clinics with expensive, invasive technologies, but this project showed it is possible to use satellite connectivity to shift the diagnosis process away from clinics and into people's homes. This eliminates travel time and costs, reduces the load on clinics and improves the patient experience. This service is operational today in Denmark and they are now looking at implementing it in the Scottish Highlands. The project influenced CHI's decision to invest in Scotland, where it plans to create jobs from 2019.

Image Analysis via Machine Learning

The next phase of this project falls within the Government's Artificial Intelligence (AI) Grand Challenge. Currently, the volumes of images and of patients requiring screening are unmanageable, but machine learning software can often spot abnormalities more effectively than human operators. As a result, we are supporting CHI to develop more accurate AI for identifying polyps and making recommendations on how to implement the solution.

The benefits of automated image analysis – to patients, clinicians and the NHS – could be huge: economic studies undertaken by HIE estimate savings of over 50%, which would translate to approximate savings of £296 million in the UK alone.

You can find out more about our collaborations with HIE at *https://vimeo.com/207951210*

NHS Healthy New Towns Initiative

We see digital therapeutics using satellite-enabled data as a big market opportunity. One such project that continued during this year is the Healthy New Towns (HNT) programme.

Recognising the importance of the built environment to healthy living and lifestyles, in 2016 the NHS began working with 10 housing developments to rethink how health and care services could be delivered to communities. The focus was on obesity and diabetes, incorporating satellite-enabled technologies to underpin wellbeing and better health management. We believe this project could have a major impact on millions of people's lives as well as saving money, given that the vast majority of the expenditure related to diabetes (£25 billion) could be avoided since most diabetes is a consequence of inadequate exercise and unhealthy eating.

The project produced five reports – two led by the Catapult – with suggestions for how digital therapeutics can be used, including how the health impact of different built environments can be measured and evaluated. We are now looking at funding options to conduct trials of the solutions identified during the project.

MAppEO

We have worked this year with partner Geospatial Insight on a project called MAppEO; a demonstrator platform capable of delivering high value business analytics, powered by Earth observation (EO) technology via lightweight applications. MAppEO has already attracted global client partners across finance, agriculture, natural resources, smart cities and asset management, who are providing insight and user requirements, indicating export potential.

Space for Smarter Government Programme (SSGP)

During the last year we have continued to deliver the Space for Smarter Government Programme (SSGP) with the UK Space Agency. Helping the Government improve its use of satellite data can save public money and lead to new opportunities for UK companies, including increased exports, as they can demonstrate that their services have benefited the UK Government and citizens.

Since SSGP has been running, it has led to projects on topics as diverse as local air quality, NHS mobile medical vehicle efficiency, coastal erosion and flooding, and three operationally ready services have already emerged. Our SSGP team has supported cross-Government groups and worked with several departments, including the Department for Environment, Food and Rural Affairs (DEFRA).

Within SSGP, we have been assisting with delivery of the UK Space Agency's strategic themes of Disaster Risk Management and Emergency Services. We have also supported engagement with the energy sector to explore the possibilities of using more remote sensing, with an initial focus on the nuclear industry and regulators. This year we attended the Nuclear Decommissioning Authority (NDA) Estate Supply Chain Event and later carried out a study and workshop on how geospatial technologies can support radioactive waste management challenges.

Also this year, we delivered a training day on organisational response to disasters in the UK and how the International Disaster Charter and Copernicus' Emergency Management Service could help in these scenarios, which we will follow up with further activities.

Our Technology Strategy

Our Technology Strategy
Empowering the Technology

Our Technology Programme focuses on building the capabilities and facilities that are needed to help our sector grow.

We help companies advance their products by identifying barriers to entry, such as regulation or market accessibility. We also explore emerging technologies to develop a knowledge base for industry, including 'testbed' projects to explore integration with existing products and services, where possible in partnership with other Catapults.

As we do this, we are conscious of two universal trends that are driving the global opportunity for satellite applications and therefore present a significant opportunity for the UK: geospatial intelligence, where information needs to be accurate, personalised, localised and available globally in real-time; and ubiquitous connectivity, where everything is connected everywhere for everyone.

Access to Space

New services based on satellite data often require new platforms. However, building, launching and operating a satellite or mission carries significant risk and takes time, money and a broad range of skills to plan and manage. For SMEs this can significantly hinder the transfer of a brilliant idea into reality – or even prove insurmountable.

However, enabling low-cost access to space presents a huge opportunity. In 2017, more satellites were launched than ever before. The small satellite upstream market – including manufacturing, operations and launch – is estimated at over £33 billion over 10 years, which in turn will enable a £200 billion downstream market. To open this opportunity to more organisations, we manage the In-Orbit Demonstration (IOD) Programme, funded by Innovate UK and the UK Space Agency, which is designed to support and accelerate the design, build and mission launch process.

IOD enables companies to demonstrate new technologies and services by building on our unique combination of facilities within the Catapult, including the satellite Earth station at Goonhilly, our Operations Centre and our Climate, Environment and Monitoring from Space (CEMS) facility. The first mission – IOD-1 – was awarded to Orbital Micro Systems (OMS). The data from OMS's planned Global Environmental Monitoring Satellite (GEMS) constellation will be used by Satavia, a UK company, as part of its decision intelligence platform which is designed to optimise aircraft flight routes.

This year, we announced the payload for IOD-5 as Kepler Communications' final prototype satellite, TARS, ahead of the launch of its constellation of 140 low Earth orbit (LEO) satellites. Kepler's GEN1 constellation is designed to deliver a global, affordable communications network that removes the cost and geographical barriers presented by networks based on terrestrial services and geostationary satellites. It is specifically designed to facilitate the development of products and services that provide affordable access to connectivity for global Internet of Things (IoT) applications.

TARS will be launched in summer 2019, accelerating Kepler's ability to test proof-of-concept services with customers. Kepler will base its European sales and distribution operation in the UK and build a UK supply chain for the new constellation. They plan to work with us to collaborate with UK technology partners to develop new products and services that can exploit the constellation, presenting both economic and employment opportunities.

Also this year we announced the latest IOD mission – IOD-6. This marks a new stage in the IOD programme, as it will be the first mission in which a third-party, Open Cosmos, will provide a one-stop mission package, based on a 6U CubeSat. This move marks a realisation of our ambition to see a commercially sustainable service for mission demonstration, having visualised this since the Catapult's inception.

We have also worked with Open Cosmos on the business side, including running a Business Sprint and sponsoring it as one of two companies to participate in Cambridge University's Judge Business School's SME Growth Business Plan, along with e2E. This year Open Cosmos has successfully raised investment of £5.4 million, enabling an increase in staff from 13 to 50 by the end of the year and investment in facilities to meet its target of launching 30 satellites a year from 2019.

Other companies have also benefited from the IOD programme, which overall serves to energise the manufacturing, service provision and application development ecosystem in the UK. For example, this year Clyde Space, which provided the 3U CubeSat platforms for the first four IOD missions, was acquired by AAC Microtech in a deal worth £26 million. The resulting company, AAC Clyde, is building Kepler's 6U TARS satellite.

National In-Orbit Servicing Centre

Boosting the use of satellite data requires absolute confidence in the satellites themselves, but space is a hostile environment for precision equipment. The biggest threat is from man-made debris. Over 4,500 satellites already orbit the Earth, providing critical services including global communication and positioning capabilities, and a further 15,000 or so satellites are expected to be launched over the next 10 years.

Astroscale Pte Ltd is focussed on resolving this issue by removing orbital debris using advanced robotics. We are working with its UK company to help establish a National In-Orbit Servicing Control Facility at our site in Harwell that will serve as a centre for de-orbiting small satellites as well as servicing satellites. The facility will be a functional mission operations centre that can scale up for simultaneous missions from multiple operators. This is a completely new concept and will establish the UK's leadership in this high-potential market.

As part of the operational system, the new centre will use algorithms developed from European Space Agency (ESA) software and technologies used in the pioneering Rosetta mission. Astroscale plans to use two satellites with Japanese investment to demonstrate the core rendezvous, capture and de-orbit technologies in late 2019.

The National In-Orbit Servicing Control Facility is being funded through a £4 million grant from the UK Government's Industrial Strategy Challenge Fund as part of its Robots for a Safer World challenge.

Since the Catapult's involvement, Astroscale UK has increased its headcount by five, and has plans to appoint more staff later in the process. But the ramifications of this project will be far greater, as it will attract Japanese investment to provide end-to-end service capability that is expected to generate 500 new UK jobs by 2021, including building a UK satellite manufacturing capability.

Ubiquitous Connectivity

More than half the world's population have no connection to the digital grid. Even in developed nations, connectivity outside towns and cities is often unreliable. Yet in order to benefit from developments such as the Internet of Things (IoT) and autonomous vehicles, everyone needs access to digital communications everywhere – we need ubiquitous connectivity.

In places where terrestrial communications are poor or non-existent, satellites offer an ideal solution – and sometimes the only one. It is possible to offer seamless and reliable integration with terrestrial systems so that in many cases people don't even need to know what communications system they are using.
By 2025, 27.2% of all automotive use cases will use satellite connectivity .

Enabling ubiquitous communications, including hybrid terrestrial-satellite systems, presents challenges for UK policy makers, as well as for those developing the technology, setting standards and raising market awareness. Even so, the UK is well placed to be a leader in this field, and we make sure our activities support and advance national and global opportunities in this area.

Westcott Business Incubation Centre, Innovation Centre and 5G Testbed

One of the key enablers of ubiquitous connectivity will be 5G, which we will be concentrating on at our new 5G Step-Out Centre (SoC) at Westcott in Buckinghamshire – the only licenced 5G testbed centre in the UK currently focused on integrating satellite and ground-based connectivity. Here, companies can rapidly prototype, test and commission new services and applications in a secure, controlled environment under conditions that represent the real world, without having to purchase specialist equipment and infrastructure.

By 2025, 27.2% of all automotive use cases will use satellite connectivity[1].

The team at the Westcott 5G SoC will work closely with other national 5G centres and the 5G Innovation Network, which has been set up by the Government to bring together and promote the 5G technological ecosystem that those centres create. This will ensure that all those who engage with the Westcott 5G SoC will benefit from knowledge exchange across the broader 5G community.

Alongside the 5G testbed centre is the new Westcott Business Incubation Centre (BIC), which will provide support for early-stage businesses and entrepreneurs in 5G communications as well as rocket propulsion, drones and autonomous systems, and associated services. We are one of the organisations supporting the Westcott BIC, which is funded through the European Regional Development Fund. Two companies have already engaged with the Centre, which will eventually support up to 20, helping them to improve commercialisation, increase turnover and productivity, and create jobs.

Westcott Venture Park will also be home to the Westcott Innovation Centre. This is being set up to stimulate ground-breaking, open innovation, provide an exciting ecosystem for collaboration between industry and academia, and support new business opportunities emerging from the expanding UK space sector. Here we will build on Westcott's long history as the UK's main rocket test and development site, and extend this to other growth areas such as unmanned aerial vehicles (UAVs) and integrated communication networks. These opportunities will stimulate the local economy significantly by delivering £20 million additional revenue per year and 120 high value jobs by 2022. The building is in the planning phase and will be open by the end of 2019.

Geospatial Intelligence

Data needs context to be useful, and therefore valuable. That context often comes from location-based information. Collected over time, location-based data can provide a historical record to help us

analyse change, respond to disruptive events and forecast future trends. Navigational services based on satellite data are also critical. These all come under the field of 'geospatial intelligence' – one of our primary focuses as we move forward into our second five-year funding period.
The global geospatial analytics market is currently worth $37.2bn and forecast to grow 17% annually from 2016 to 2024.

Satellites deliver huge volumes of data which, when combined with terrestrial information, can provide businesses and governments with incredible new levels of insight. This has potential applications in many areas, including urban planning, flood control and emergency response, as well as commodities tracking, carbon trading and ecological management. Often, extracting information from the data in a timely manner is key: machine learning techniques are ideal for this, and so this is one of the areas where we have been active this year.

Satellite Ace

The Satellite Ace project was initiated to update our Data Discovery Hub, making it an even more intuitive platform for developers to access satellite data. It will provide a greater range of datasets and will allow non-specialist users to access and search the most relevant satellite datasets, based on specific use cases.

The Data Discovery Hub allows UK organisations (academia, commercial and government) to access free and commercial satellite datasets. This latest enhancement will provide increased knowledge and awareness of the variety and depth of satellite imagery. It will unlock new markets for services from organisations that have not previously considered using satellite imagery or understood its benefits, and foster inward investment to make the UK a more attractive environment for non-UK businesses.

We worked on Satellite Ace with MeVitae, a start-up that specialises in using AI and big data to support HR teams in recruitment, using its machine learning and natural language programming (NLP) expertise and services to enrich our search platforms. We had initially supported MeVitae with financial planning as its services use European Space Agency algorithms, but quickly identified that its capabilities could have real value within the satellite and space sector.

Due to the exposure MeVitae received by engaging with us in the Satellite Ace project, it has secured extra direct investment of £500k and received £1.5 million funding for additional projects in the space sector over three years. It will also increase its staff from three to 15.

Machine Learning – the Labelling Tool

During the last year, our team developed a tool to create training sets for machine learning algorithms which would enable Earth observation (EO) data to be exploited in an automated way, taking humans 'out of the loop'. Our involvement had two aims. The first was to simplify the creation of labelled satellite imagery for machine learning methodologies by removing manual aspects of the task. We also wanted to foster an inter-disciplinary EO and artificial intelligence (AI) community, which will help the UK geo-information industry to retain its market-leading position.

Our work in AI aims to accelerate the development of AI and EO technologies to interpret current changes in the world and predict likely future evolutions. The objective here was to address two of the most significant blockers: a lack of training data and access to well-defined user requirements.

Our team worked with four commercial end-users to create training datasets focused on real-life user requirements, including damage assessment for disaster management and classification of buildings.

Applying AI to EO will enable novel automated applications, at scale, across all markets and all steps of the processing value chain. There is a major opportunity for the UK here as several UK research groups are already leaders in the AI field. Helping to accelerate them into the satellite domain will benefit the UK, leading to job creation and income opportunities.

The Labelling Tool project has generated business growth for all the project partners, safeguarding jobs, and increased productivity and knowledge sharing within the field. All partners have benefited from the connections and relationships forged as a result of this project and the tool itself will empower future R&D activities.

Building Platforms & Capability

We engaged in another technology project this year that sought to make it easier for free satellite data to be exploited; this time focussing specifically on Sentinel-2 data.
Our experts were part of a team that developed a common set of standards and methods to enable the Government, businesses and academia to access Sentinel data that is calibrated and geo-corrected, known as Sentinel-2 Analysis Ready Data (ARD).

Through workshops and online collaboration with the UK's Earth observation (EO) and geographic information system (GIS) communities, we established common pre-processing requirements that could reduce the burden of complex and time-consuming calibration and validation, turning 'raw' unprocessed data into a state that can more readily be analysed. The ARD data can then be arranged in 'layers', with each layer representing the same scene at a different time, resulting in what is known as a 'datacube'. This approach makes it easier to monitor changes over time.

The outcome is a fully open source and readily accessible Sentinel-2 ARD tool that can be accessed via the Catapult's Sentinel Data Access Service (SEDAS) portal, along with all relevant UK Sentinel-2 ARD up to the end of June 2017. This means that non-specialist users can now access the Sentinel-2 EO data in a format and structure that is ready for analysis, making it easier for them to develop new products and services to sell commercially.

The development work we have done will be used in further projects, such as those within the UK Space Agency's International Partnership Programme (IPP). Another legacy of this project is that we will continue to feed back UK requirements to, and collaborate with, relevant international organisations, such as CEOS CARD4L Group, and we aim for this to provide a sound foundation for future operational systems.

Facilities

Facilities

The space industry is changing rapidly. Increasing numbers of satellites are due to be manufactured and launched, including ever larger constellations of satellites. More organisations will require access to satellite imagery and data, and processing needs will increase too. The many new services being enabled by the increasing volumes and quality of satellite data will also require new hardware to be developed.

There is a huge opportunity here for the UK to capitalise on these changes and take a lead in evolving processes and business models, embracing industry 4.0. But if we want to anchor supply chains for major global opportunities here in the UK we need to move fast, so we have been developing our facilities and working with other specialist organisations, including the High Value Manufacturing Catapult, to help set up the required supporting infrastructure and ecosystem.

Some of our work this year has been focussed on establishing new facilities, such as the Disruptive Innovation for Space Centre (DISC) here at Harwell and the 5G Step-Out Centre, Innovation Centre and Business Incubation Centre at Westcott Venture Park in Buckinghamshire. Elsewhere we have continued to invest in our existing world-class facilities, including the Goonhilly Ground Segment in Cornwall, the Far Field Antenna Range, our Climate, Environment and Monitoring from Space (CEMS) cloud-based services, the SatComms Lab, the Sentinel Data Access Service (SEDAS) and our Operations Centre at Harwell.

All of our investment, in both time and money, fits within our strategic direction of energising markets, empowering technology and enabling business across our focus areas of geospatial intelligence and ubiquitous connectivity.

Disruptive Innovation for Space Centre (DISC)

One of our most important new developments this year has been the Disruptive Innovation for Space Centre (DISC), established to support SMEs by giving them affordable access to high value prototyping, testing and manufacturing facilities. The first phase opened in June 2017 with support from Innovate UK and we are now looking forward to Phase 2, which will see a world-class 1,200 sq metres facility opening alongside the Catapult at Harwell.

DISC provides end-to-end design, modelling, test and production equipment to help companies develop new solutions for large-scale market opportunities. At DISC, teams can take an R&D project from proof of concept through to a full-sized prototype, manufactured at quality levels and scales that are sufficient for validation by potential customers.

Oxford Local Enterprise Partnership (OxLEP) identified DISC as a strategic initiative that will create market opportunities for industry and increase economic growth, both regionally and nationally, and as a result, we secured £3 million from OxLEP via the Local Growth Fund.

We are working closely with the High Value Manufacturing Catapult to set up DISC, drawing on its in-depth expertise to build a facility that will be available at market rates to collaborative projects, universities and companies developing commercial prototypes, especially SMEs. By engaging directly with SMEs, we identified equipment for Phase 2 that was both high priority and high impact, as it was suitable for multiple planned projects with imminent start dates.

DISC's end-to-end capabilities are being designed for organisations working on a diverse range of new satellite products and services, with an emphasis on downstream activity associated with the use of small satellites as solutions to business challenges. This complements the work being done by our Harwell neighbour RAL Space, which is focussed on big satellites and infrastructure for science.

DISC has already had 24 users. The first tranche of equipment being installed at the new site will benefit further collaborative projects with an estimated combined value of £14.5 million. Twelve SMEs from across the UK will be the first users, working on seven projects that will result overall in economic growth for 21 SMEs. DISC itself will add 11 jobs at Harwell, with an additional 176 staff from SMEs working at the facility by 2024.

"Archangel Lightworks has been prototyping disruptive space communications systems. We accessed DISC's design simulation software which allowed us to better optimise features on early feasibility study work.

"Using the DISC facilities has reduced risk and increased our speed of development without diverting too much budget and resource away from the critical risk areas.

"We regularly engage with Catapult staff and DISC is another confirmation that we made the right choice in locating ourselves at Harwell.

"Disruptive technology development, particularly for space, can be capital intensive. Facilities like DISC that reduce those early barriers are helping to grow an energetic space startup environment in the UK."

Dan Sola,
Archangel Aerospace

"Instead of having to purchase sporadically used assets, we are able to access state-of-the-art satellite development equipment for a fair fee. This is one of the setups that helps us keep our costs down, and thus we can continue providing simple and affordable space missions to our customers."

Bastian Paetzold,
Open Cosmos

Climate, Environment and Monitoring from Space (CEMS) & Sentinel Data Access Service (SEDAS)

Our Climate, Environment and Monitoring from Space (CEMS) environment remains one of our key facilities and has been extremely busy this year, providing valuable satellite data, plus processing and services that many organisations can't afford to run themselves or access elsewhere.

CEMS is a unique, purpose-built service that offers space-based climate change and Earth observation (EO) data and services in conjunction with Infrastructure as a Service (IaaS) cloud-based computing, with specialised data analysis applications and tools. It is one of the foundations of the In-orbit Demonstration programme and holds the datasets for the Sentinel Data Access Service (SEDAS), through which users can investigate, view and download Sentinel-1 and 2 satellite data.

This year we have hosted 45 live environments in CEMS, which are either individual SMEs using the system or specific projects. External users range from SMEs to major multinational companies, along with academic and governmental organisations from the UK and abroad. The combined total data storage capacity for the CEMS user environments and hosted data collections is over 7 petabytes and utilisation is over 95%.

With this level of demand, we are now looking to increase the data storage capacity and refresh the storage systems with more efficient options that would provide significant power savings and increased levels of performance.

Launched in September 2016, SEDAS has over 630 registered users from over 60 countries, plus an additional 5,000 anonymous users accessing the system, working on projects as varied as marine, climate, security and land-based tasks.

The largest user of SEDAS is Deimos Space UK, which has completed around 8,000 downloads of data, enabling it to develop a data retrieval engine that provides the most suitable Sentinel data links to download according to the user location, as part of a European project. SEDAS also acts as a demonstration of Deimos' capabilities as it uses the company's ground segment module archive4EO. Deimos has increased its staff by 20 in 3 years and turned over £1.6 million in its third year of operating in the UK.

Enabling Business

Enabling Business

We connect business of all sizes with the resources and facilities they need to launch and grow, opening new routes to market and attracting investment. We provide targeted business support, information and skills, and signposting to finance.

Innovation is a collaborative process. We work with an array of diverse organisations in the UK and abroad including UK Research and Innovation (UKRI), Research Councils, other Catapults, the UK Space Agency, Innovate UK, the Space Growth Partnership, the European Space Agency and our neighbours at the ever-growing Harwell Space Cluster at Harwell Campus. Together we are more than the sum of our parts in terms of the effect we can have on the space sector and the business landscape. We also continue to engage regularly with Government on programme objectives, including the Department for Transport, Department for Business, Energy & Industrial Strategy (BEIS) and Department for Environment, Food and Rural Affairs (DEFRA)

We have supported start-ups and growing SMEs through a number of mechanisms. This year we have witnessed significant growth among many of the SMEs that we have supported, plus the successful spinout of OceanMind from the Catapult.

The Innovation Landscape

We work with industry and regional, national and international partners to commercialise innovation in a way that drives long-term benefit to the UK economy. This includes working collaboratively as part of the Catapult network, and with the wider R&D ecosystem, to enable development of innovative solutions to key challenges. It also involves us taking an active role in removing industry-wide barriers to innovation.

Catapult Network

In addressing our core Programmes, this year we have worked with several of the other Catapults including High Value Manufacturing (HVM), Offshore Renewables and Energy, Transport Systems, Future Cities and Digital. HVM Catapult has been supporting us as we set up our Disruptive Innovation for Space Centre (DISC). Other collaborative projects have included two with funding from the Newton Fund via Innovate UK:

- Newton Colombia – Colombian Cocoa control system project (COLCO) is a joint project with HVM Catapult's Manufacturing Technology Centre which we are leading. This aims to bring together UK and Colombian entities to address the Colombian cocoa sector's need for increased quality and volume in cocoa production.
- Newton India Air Quality Project aims to strengthen science and innovation partnerships and demonstrate progress towards addressing impacts from energy usage and transport, which will improve public health and wellbeing. It also aims to support export growth for UK companies in the environmental sector by enhancing collaboration and trade links.

UK Space Agency and the Space Growth Partnership

The UK Space Agency (UKSA) is responsible for strategic decisions on the UK civil space programme and provides a single, clear voice for UK space ambition. We work with UKSA across the sector, including supporting delivery of its Space for Smarter Government Initiative, and projects within the International Partnership Programme (IPP). The latter includes our Earth and Sea Observation Service (EASOS), funded as part of IPP, which has progressed successfully this year and we will now use as a brand to pull through the best of UK geospatial capability and guide them towards international opportunities.

Along with UKSA, we worked this year with the Space Growth Partnership (SGP) to construct a space sector deal to present to Government. This was outlined in a key report published in May entitled 'Prosperity from Space', which set out the current position and ambition of the space industry. It highlighted the need for continued participation in European space projects and called for an enhancement of the UK's relationship with the European Space Agency, while maintaining "at least the current level of investment".

The Government's Science Minister, Sam Gyimah, gave a statement supporting a Space Sector Deal and we now look forward to working with our partners to deliver its aims and drive growth across the UK.

UK Research and Innovation (UKRI) and Research Councils

Through the formation of UK Research and Innovation early in 2017, we have experienced increased alignment with the Research Councils. We continue to build upon our partnerships with knowledge exchange professionals both in the Research Councils and individual universities. Through projects, we will build new collaborations between the academic base and the organisations we work with.

ESA BIC

Our collaboration with the European Space Agency's UK Business Incubation Centre (ESA BIC) at Harwell continues to generate successful outcomes. We have provided support for a number of ESA BIC incubatees, including Ground Data, which is using its ESA-funded business support hours to work alongside our Earth Observation team. We've also started supporting:

- Deep Planet, which uses proprietary data science and machine learning to interpret satellite images to give insight in the fields of precision agriculture, water and gas monitoring
- Thrive MV, whose plans are to optimise livestock welfare and performance with advanced sensing technology.

MeVitae was another company signposted to us by ESA's Harwell team, initially for financial planning support.

Harwell Space Cluster

Since 2013 we have been the cornerstone for the Harwell Space Cluster which now comprises over 80 organisations, a third of which are inward investors, and over 750 staff.

We attend, participate and inform the monthly Harwell Space Cluster meetings as well as the Steering Board and Space Strategy Group at CEO level.

In June, five companies based at Harwell Campus, including three that have been supported by us, were chosen to feature at the Harwell Campus New Space Showcase attended by His Royal Highness the Duke of York:

- Rezatec launched a mobile app for Mexican farmers (IPP project) and announced an ESA-funded showcase with the Eden Project to promote the benefits of Earth observation data for small-scale land owners.

- Open Cosmos announced its collaboration with us on the In-Orbit Demonstration Programme.

- Oxford Space Systems announced £6.7 million in additional funding, bringing its total investment to £10 million.

Until this year, both Rezatec and Oxford Space Systems had been based in our Harwell Campus building but their continued success means they have now grown out of the space that we could offer. Rezatec moved into new global headquarters elsewhere on the Campus in March, having expanded from five employees when it joined us in 2012 to 37 employees and raised several million pounds investment, including £2 million in February. Oxford Space Systems moved into its new Harwell headquarters in June 2018, gaining access to an on-campus clean room for flight hardware assembly and space for its 29 employees.

Access to Finance

Early in our development, we identified the lack of access to finance for UK-based firms in the

space industry as a key challenge, as this severely limits the ability of companies to commercialise their applications.

We were therefore pleased to be a key partner in establishing Seraphim Space Fund (SSF), led by Seraphim Capital and supported by the space sector, which completed its second close at £70 million in September 2017. We continue to contribute to the fund, with a particular focus on stimulating a range of financial and other benefits such as raising the quality of propositions, attracting entrepreneurs from overseas and helping to build an ecosystem by making early stage firms 'investment ready'.

Our Head of Business Strategy, Conor O'Sullivan, who was seconded to the Seraphim Space Fund part time from December 2016, has now joined permanently, where he will continue to manage the strong relationship that we have developed with the Fund.

In March, we backed Seraphim Capital's launch of the Space Camp Accelerator, the UK's first dedicated accelerator programme for start-ups in the space technology sector. Space Camp will help the best space tech start-ups secure funding, achieve scale and foster close working relationships with industry leaders.

Six start-ups will join each round of the programme, which will run twice a year. Each company will participate in a Catapult Business Sprint activity, in which we will provide business diagnostics and a road map for improving their likelihood of success by better understanding customer needs, competitive advantage and the requirements of delivering a profitable offering. We have already hosted the first six SMEs at Harwell, providing them with a series of one-to-one discussions with key technical and business specialists. They included KisanHub, an SME that we supported with a Technical Sprint in 2014 and multiple introductions since: the company raised £1.76 million in December 2017, enabling it to expand its team and further develop its platform.

Overall, we have supported many space sector companies in accessing finance. In total, in financial year 2017/18, we helped businesses raise £27.4 million of investment to help their businesses grow. We continue to work with the investor community to raise awareness of space SMEs and the high growth opportunities within space applications and technology.

- Oxford Space Systems (OSS) secured £2.1 million investment in May and a further £6.7 million in June from institutional and private investors including Longwall Ventures. It hopes to raise a further £1.3 million in its latest investment round. OSS worked with us through various business support and collaboration activities, including a Business Sprint focusing on investment readiness.

- Hummingbird Technologies has grown to be the biggest player in the UK in the provision of crop management tools for precision farming. Now with 35 staff, it has expanded into Brazil, Russia and Ukraine. A consultancy project with the Catapult helped enhance its services and we also supported it with market advice ahead of one of its fundraising rounds. The company has raised over £3 million of seed funding, plus grants from Innovate UK and the European Space Agency.

- Bird.i, founded in January 2016, was the first spin-out from the Catapult and we are now a shareholder. The growth of Bird.i has been supported by several grants, including Innovate UK's Emerging & Enabling fund, and two successful rounds of seed funding. The most recent investment, led by Accelerated Digital Ventures, saw an additional £2 million in Series A funding. The company employs 15 staff with plans to scale up its operations further.

- Open Cosmos was an early user of the Catapult's new Disruptive Innovation for Space Centre (DISC), using DISC to effectively grow its business. It aims to increase its team from 13 in January to 50 by the end of 2018, and has a target of launching 30 satellites per year from 2019. Contracts from the Catapult and the European Space Agency, among others, plus a Business Sprint earlier this year, contributed to successful completion of a £5.4 million Series A funding round to support its expansion.
- Geospatial Insight received investment of £3.5 million in August, having worked with us on several projects.

Our support can extend further than access to investment capital. In December, Clyde Space, which provides satellites for our In-Orbit Demonstration programme, completed an acqui-merger with Swedish company AAC

Microtec, raising £26.7 million. Our strategy analysis and recommendations to Clyde Space last year were instrumental in this decision. In another example, TyreWatch, which provides a tyre pressure monitoring system for trucks and commercial vehicles, was spun out of Tructyre in May 2018, following an Innovate-funded project within which we contributed business development and funding bid expertise, plus software development.

Other businesses we supported in raising investment this year include:

- Global Surface Intelligence, a Scotland-based SME that provides data on the amount of carbon stored in and absorbed by trees and vegetation. It raised £193,000 in December 2017.
- Sofant Technologies is a pioneer in miniature smart antenna technology. It raised £766,000 in December 2017, following our support providing information and market forecast numbers for a grant proposal.
- Helix Technologies is an SME that produces compact ceramic antennae for use in a range of telecommunications and navigation applications: it raised £625,000 in January 2018.
- DryGro, an SME developing technology that allows crops to grow in desert environments, raised £120,000 in November 2017.
- e2E Technologies, a satellite telecommunications company we are sponsoring to take a scale-up course with the Judge Business School at Cambridge University, raised £1.5 million in October 2017.
- Smart Antennas Technologies, an SME developing an antenna which can receive Bluetooth, GPS and Wi-Fi signals rather than requiring separate antennae, raised £55,000 in Nov 2017.

Business Creation

Many of the businesses that we engage with have already been set up, with our involvement being focussed on supporting them to grow and achieve specific milestones. Sometimes, though, we engage as a business is formed or even identify the opportunity to create a new business from a project that we are involved in, such as Bird.i, the first Catapult spinout, and OceanMind, which was originally a project with The Pew Charitable Trusts, then became a Catapult business unit and was finally spun out into a separate, legal, not-for-profit entity in July.

Orbital Witness

Orbital Witness is a ‘space tech’ meets ‘legal tech’ start-up that is redefining legal due diligence on property transactions. Following in the steps of Bird.i, Orbital Witness was formed via a unique opportunity offered by the Catapult to promote entrepreneurship, through which staff can use 10% of their time to test, validate and present a satellite-based business idea in return for part ownership of the eventual spin-out company. The scheme allows staff to pursue their ideas while working within the supportive environment at the Catapult, with successful spinouts receiving financial investment and business support from us.

The company was created by three Catapult staff: Ed Boulle, Will Pearce and Francesco Liucci. Ed and Will have now left the Catapult to work at Orbital Witness full-time

Having deployed its real estate intelligence platform with lawyers and insurance specialists, Orbital Witness is now conducting analytics on key property datasets, such as Land Registry title documents, with the vision of creating ‘legal risk scores’, akin to credit risk scores, for all property and land in the UK. This will revolutionise the property transaction process as it will provide lawyers, conveyancers, insurers, property developers and mortgage lenders with an instant legal risk assessment of land and property in the UK.

Orbital Witness has:

- Seen 40% month-on-month growth in the use of its product.
- Demonstrated time savings of at least 10 times on repetitive tasks conducted in legal real estate due diligence.
- Signed a multi-year software deal with

a leading London law firm, plus a sale in the insurance industry. Software trials are ongoing or due to start at other major city firms.

- Graduated from the PropTech stream at Geovation as one of the first three PropTech start-ups.
- Won the Airbus Defence and Space Global Earth Observation Challenge (selected from 150 startups worldwide).
- Raised pre-seed funding of £57,800 in February.

Disclosure Oxford

Disclosure Oxford plans to provide high accuracy, asset level environmental, social and governance (ESG) market intelligence to institutional investors and large fund managers.

Our Visualisation and Software Engineering Team selected mining sites globally as case studies to perform analysis of water risk related parameters over time, with the aim being to provide end-to-end automation of the processing pipeline to produce data that can be utilised readily by a GIS demonstrator.

Our Business Strategy team met with three high-level market stakeholders in the mining and investment community who have validated the business proposition and provided feedback and suggestions for the next stage of development. The company is currently working on its go-to-market and scale-up strategy.

Networking & Workshops

In every industry there is huge value in networking and sharing knowledge, and the space sector is no different. We run a range of networking events and workshops at Harwell and elsewhere, and the Centres of Excellence also host such events regularly.

Satuccino

Our Satuccino events at Harwell are highly regarded by the space community, with 70 to 80 delegates attending every month. Each one includes speakers from industry, our clusters and our partners who share their knowledge and experience, ranging from national and international organisations such as the UK Space Agency and ESA to start-ups and SMEs.

We've also started running Pre-Satuccino Workshops and Meet the Experts sessions to offer additional business support opportunities. The latter enables businesses to meet Catapult staff for a 1-on-1 session such as speed mentoring on business strategy and new markets, or support from our Earth Observation or Technology team.

A further extension is the Satuccino Extra-shot, hosted by our Centres of Excellence, with the aim of creating new business links beyond Harwell. These help grow our business community and expand our network by providing an opportunity for local organisations to hear about regional activities and business across the UK and vice versa.

Workshops and other Networking Events

The Catapult together with the South Coast Centre of Excellence (CoE) organised the 8th Regional Networking Event at Chilworth Manor, Southampton, for all CoE, Innovation and Knowledge Exchange Fellows. This event brought together our knowledge exchange partners from across the UK to share updates, insights, and the latest developments from across the regions.

Two exciting workshops were held during the event, led by partners of the South Coast CoE. Delegates worked together to focus on identifying potential solutions for the challenges arising from Smart Port Cities and Pollution (led by Southampton Marine and Maritime Institute) and Satellites for Safety (led by Lloyd's Register Foundation).

Airbus, provided a keynote presentation on the roadmap of future satellite development and high-altitude platforms. Local partners were invited to technology demonstration sessions to share their latest products and services supported through satellite data and technology.
Sentinel-2 Analysis Ready Data: Standards and automated production – We hosted a workshop in London with Defra and Aberystwyth University with partners from the Department for Environment, Food and Rural Affairs' Earth Observation Centre of Excellence and Aberystwyth University. The event brought together Earth observation and GIS experts from

academia, industry and government to explore a proposed standard for Sentinel-2 Analysis Ready Data (ARD).

Applications of Satellite Technology in the Mining Sector – This workshop, held at Goonhilly Earth Station, provided an opportunity for a wide range of stakeholders in the Cornish mining sector to discuss how satellite technology could provide a platform for new collaborations. The workshop was organised in collaboration with the Cornwall Mining Alliance and Camborne School of Mines. Speakers included CGG, British Geological Survey and the Universities of Portsmouth and Exeter.

Exploring Opportunities in South Africa – Together with the UK Space Agency, we hosted an event for UK businesses using satellite data to explore new opportunities in South Africa. More than 40 SMEs took part in one-to-one sessions with the high-level South African delegation. The delegation included the South African High Commissioner to the UK, the CEO of the South African Space Agency (SANSA) and representatives of the British Embassy in South Africa.

Exploring Opportunities in the USA – We held a workshop with the Space Growth Partnership to help UK companies explore the opportunities of exporting to the US and signposting relevant organisations.

Aquaculture Challenge Workshop: The Scottish Centre of Excellence in Satellite Applications, in partnership with Highlands and Islands Enterprise and the Scottish Aquaculture Innovation Centre, hosted an event to explore how data from space can help the aquaculture industry. This workshop brought together the aquaculture industry with satellite data and technology experts to discuss the potential benefits and opportunities for using data from space.

New Scientist Live – Our Satellites 4 Everyone initiative was presented as an interactive touch screen demonstration on the European Space Agency stand. The general public really engaged with the demonstration and were particularly interested in the UBO pocket cube programme. As a result of the event we have arranged to conduct UBO pocket cube workshops in seven schools during 2018.

Tackling Urban Challenges Using Environmental Data workshop – Working with Imperial College London and the Greater London Authority, the Catapult brought together business leaders and academics from the space and environmental sectors, to develop a response to the Greater London Authorities (GLA) consultation on the Mayor of London's Environment Strategy, to explore new ways of collaboration focused on air quality, extreme weather resilience, and flooding. With speakers from the GLA, EDF Energy, Air Worldwide (Catastrophe Risk modelling), Earth Sense (Air Quality), Ambiental (Environment Consultancy), University of Reading and the National Physical Laboratory, the participants contributed their expertise to the consultation, and also created new links between academics and businesses.

DIT/FCO and Colombian Agri-insurance workshop – We hosted a workshop for a delegation of Colombian Agri-Insurance delegates who wanted to showcase how satellite applications are being used in the UK to support the agricultural sector and how this could apply to Agri-insurance. Several Agri related SMEs including Agvesto, Climate Edge, Deimos, Environment Systems, EOSphere, Geospatial Insight, Global Parametrics, GSI, IPF (AGSpace), Map of Agriculture, Precision Decisions, Rezatec had the opportunity to talk about their solutions and services and discuss possibility of working collaboratively in future.

Earth Observation Showcase – Emerging Applications Powered by Innovative Technologies Workshop – With over 120 participants, the aim of this workshop was to foster links between cutting-edge Earth Observation (EO) instrumentation specialists and users of both the data and downstream applications coming from these technologies. The main focus was on the changing EO landscape from both an upstream and a downstream perspective, looking at current and upcoming technologies and applications, and considering market trends and how these might evolve by 2030.

Satellite Data Revolution and Tech at Level39 – The Catapult joined forces with Level39 at their Members' Meetup event in London. We brought together Level39's tech community with the Catapult's space applications community of experts within the areas of FinTech, Health Tech

and Smart Cities. The aim of the event was to explore how satellite data can be used in a range of innovative ways not traditionally thought of. More than 100 participants and more than 10 pitches produced many positive conversations and future business relationships.

Use of Sensors and Communication Devices in Agriculture Workshop – The Satellite Applications Catapult, along with Agrimetrics, CENSIS, and Agri-EPI Centre, hosted a workshop in Glasgow at the Scottish Centre of Excellence in Satellite Applications to present the current farming practices which involve data gathering and processing. The workshop aimed to describe communications technologies used to transfer in-field data to the Internet. The results have been published and shared with the Agri-Tech community. More than 60 companies attended.

The South Coast Centre of Excellence hosted a workshop on Navigation and Communications in Marine Autonomous Systems workshop at the National Oceanographic Centre and another on Intertidal Monitoring Zone.

Guest lectures – In November our Head of User Centred Design Joel Freedman and EO Specialist Mina Syriou hosted a workshop at the University of Southampton for students completing a remote sensing course, with one student attributing their first-class honours degree to an idea they developed following the workshop.

Satellite 101 – Thirty PhD students were offered a one-day training course at the Catapult on the use of Earth observation data, funded by University of Oxford, featuring lectures and hands-on training elements. Feedback from the students was wholly positive and we plan to offer further similar events.

Regional & International Engagement

Regional & International Engagement

Within the UK's space sector, we have a vital role to play as a neutral, trusted entity that can enable engagement between multiple parties, both nationally and internationally. In order to grow the sector, we need to engage with organisations of all types and sizes, inspiring new ventures and collaborations, and reaching as broad an audience as possible.

Engaging with universities can help UK industry gain a competitive advantage. We continue to work with university departments and individual academics across the UK with the aim of enabling academic research and expertise to be exploited in order to realise new products, services and innovation in the space sector. We also share business challenges with the scientific community to inform future research.

Engaging regionally allows us to stimulate growth in satellite applications across the UK. Our five Centres of Excellence provide an invaluable link between universities and businesses in their regions. They work together as an effective network; sharing ideas and opportunities, and connecting companies and academics.

All of this comes under our Knowledge Exchange programme, which has been particularly busy this year.

Academic Engagement

We run a number of focused, collaborative activities to get the most from our relationships with universities. To date we have established relationships with over 150 university departments across the UK. We also have bilateral arrangements through our Knowledge Exchange (KE) Fellowships and engage directly through workshops and PhD student support.

Our KE Fellows may work on a project directly or act as an enabler by identifying opportunities for collaboration. For example, earlier this year, a £3 million, EU-backed scheme was announced to help companies in Wales exploit the spatial intelligence market, as a direct result of an opportunity recognised by former KE Fellow Rebecca Charnock from Aberystwyth University. The scheme will see the University collaborate with QinetiQ to lead the Geographical Data and Earth Observation for Monitoring (GEOM) programme, and work with up to 25 companies on a range of projects that will lead to new products and services, and the creation of additional jobs. The two organisations also plan to set up a National Spectrum Innovation, Engineering and Experimentation Centre in Wales that could create up to 1,000 job.

Current KE Fellows include Simon Jackman, Senior Innovation Fellow at University of Oxford, who has been involved with several projects including:

- Smart optics for satellites with Surrey Satellite Technology Limited, following an introduction by us.
- Developing labelled datasets for machine learning, funded by Innovate UK, working with Digital Globe, deepomatic and a team from the Catapult on a system that can be used with crowdsourcing to extract features from satellite imagery. This has expanded the connections and knowledge base of all project partners, generating business growth and safeguarding jobs.
- A mining waste project for Peru using the skills of University of Oxford economic geographers and hydrologists at HR Wallingford to address problems when tailings dams break.
- Animal Dynamics, a spin-out from the Oxford University Zoology Department, using the mathematics of flight by birds and insects to develop novel drones. Simon introduced the company to our team at Westcott, and it has now established a presence there.

Other KE Fellows include:

- Dr Claire Neil is a Research Fellow at the University of Stirling. We are funding her

Natural Environment Research Council (NERC) Knowledge Exchange Fellowship, which aims to develop satellite remote sensing as an official data resource for systematic monitoring and assessment of water quality.

- Dr Anna E. Hogg is based in the Centre for Polar Observation and Modelling (CPOM) at the University of Leeds. During her Sea Level Rise from Space project, satellite Earth observation data will be used to measure sea level variability, in order to generate a bespoke sea level rise service that will aid management of the UK's coastline.

Academic engagement works in other ways too. For example, eight Catapult staff have been STEM Ambassadors this year, involved in activities on the Harwell Campus and at schools ranging from presentations to demonstrations, and manning stands at career fairs with the aim of inspiring students from Key Stage 4 upwards.

ESA Regional Ambassador Programme

Following a call from the European Space Agency (ESA) in September 2017, our Centres of Excellence were successful in applying to join the UK Ambassador Platform Network. They have appointed five Regional Ambassador Platforms (RAPs) to act as brokers between ESA and individuals, companies, agencies and organisations in the UK who can be supported by ESA Business Applications. Each RAP will actively seek out new regional customers/ user communities and develop space-enabled businesses, services and applications.

Researchers in Residence

The Researchers in Residence (RiR) programme is a new initiative that was launched this year to help increase connections between the UK's research base and all of the Catapults. Funded

by Research Councils UK, RiR will enable academics from universities and other eligible research organisations to spend time embedded within Catapult teams, either through visits or residencies.

We set up and managed the RiR application process on behalf of several of the Catapults. The aims are 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.

Dr Eloise Marais, a Research Fellow in Environmental Health Sciences at the University of Birmingham, joined us in February 2018 through the RiR programme. Eloise will work with both us and the Future Cities Catapult on a Tool for Recording and Assessing the City Environment (TRACE), an inventory that planners, stakeholders and environmental consultants can use to monitor city-scale air quality and vegetation health.

Space Placement in Industry (SPIN) internships

Since 2013, over 170 young people have benefitted from the UK Space Agency's Space Placement in Industry (SPIN) internship programme, which provides practical experience in a workplace. This year we welcomed eight 'SPINterns' to the Catapult and held the SPIN Induction Day, attended by over 75 people including SPINterns, host companies, university lecturers and members of the International Space University (ISU). Attendees enjoyed presentations from space sector organisations and had tours of the facilities at the Catapult and RAL Space.

UCL Strategic knowledge exchange partnership

The UCL Strategic knowledge exchange partnership is currently under development as we end the financial year. Joint workshops have defined focus areas for collaboration. We intend to establish a secondment programme of UCL academics to the Catapult over two years, to translate the outcome of research to impact.

Inspiring Innovation in Space

In September 2017, we hosted an 'Innovation in Space' event with Airbus Group Endeavr Wales and the Welsh Government to encourage open collaboration between SMEs, academia and industry from across the space sector in Wales. Around 50 businesses and academics attended to hear about opportunities to boost innovation and growth, and foster new collaborations, and to find out more about the Airbus Challenge 'Go to Market' geographical information systems (GIS) applications.

At the end of the event we held one of our Satuccino Extra Shot events to give delegates the opportunity to engage with attendees at our Harwell-based Satuccino – our monthly networking event for the space community. As a result, a number of new collaborations were fostered both within Wales and between Welsh organisations and those at Harwell Campus.

Windfarm Autonomous Support vessels Project (WASP)

Following its Marine Autonomous Vessels event last year, our South Coast Centre of Excellence worked with attendees on a new collaborative project which subsequently won funding of £900,000 from the Industrial Strategy Challenge Fund. The Windfarm Autonomous Support Vessels Project (WASP) will benchmark the technology challenges facing the sector in the transition to autonomous support operations. It will then chart a roadmap for the phased introduction of robotics and artificial intelligence (RAI) systems for the supply of spares, asset surveillance, security patrols and crew transfers.

Tackling Urban Challenges Using Environmental Data

In collaboration with Imperial College London and the Greater London Authority (GLA), we brought together business leaders and academics from the space and environmental sectors to develop a response to the GLA's consultation on the Mayor of London's Environment Strategy. New links were forged between academics and businesses to help tackle the many environmental challenges that London is facing, including air quality, extreme

weather resilience and flooding.

Space Enabled Healthcare and Wellbeing

In May this year we organised a 'Space Enabled Healthcare and Wellbeing' event in Cardiff to understand how digital technologies, including space, are driving change in healthcare service provision. The workshop looked at how we can establish and maintain a vibrant community in Wales for satellite-enabled healthcare and allowed delegates to explore opportunities to use space-enabled technology and data to revolutionise diagnostics and treatment.

Cambridge University SME Growth Programme
We sponsored participation by two companies in the Cambridge University Judge Business School SME Growth Programme this year; a 6-month programme that focused on strategic growth.

e2E, a partner of our North East Centre of Excellence, benefitted greatly from the programme, which helped it to develop its growth plans as it prepares to launch a new product and proceed to a Series B funding round.

The second participant was Open Cosmos, a Harwell-based company that provides simple and affordable space missions. It has since raised £5.4 million in Series A funding and was named as a leading global innovator in the 2018 Disrupt 100 list. Also this year, Open Cosmos was named as the launch partner for our latest In-Orbit Demonstration programme mission.

International Projects

We continue to be involved in activities overseas, building international opportunities and stimulating export growth for UK companies. These have included a number of UK Space Agency International Partnership Programme (IPP) projects, including the highly successful Earth and Sea Observation System (EASOS) which have been covered elsewhere in this report.

Our most recent IPP funded projects include:

- Space-enable monitoring of illegal gold mining in South America
- Common Sensing – a climate resilience platform for three small island developing states
- Tailing Dams – providing dam monitoring capability in Peru

CoLAB Portugal

Through our Knowledge Exchange programme we have been advising the Portuguese Government on the development of its Collaborative Laboratories (CoLAB) initiative.

First Overseas Representative Appointed
We have successfully engaged with a number of projects in Latin America and the Pacific region since the Catapult's formation. As a logical extension to this engagement, this year we appointed Luis Ramirez as our Permanent Representative in Chile.

Luis' role is to strengthen our links with Government, corporations, business associations and academic organisations, enabling us to play an active role in the Pacific Alliance (see below). He will help us to reach out to other Latin American countries and demonstrate the potential for satellite applications in the region, opening up international opportunities for the UK space sector.

Pacific Alliance Innovation Eco-System

Acting on behalf of the Government's Department for Business, Energy & Industrial Strategy (BEIS) and representing the interests of all the Catapults and Innovate UK, we led a study that defined the concept for an innovation eco-system for the Pacific Alliance (Chile, Colombia, Mexico and Peru).

Such an eco-system would provide a huge economic opportunity for UK academia and industry, as it would deliver a single direct market route to countries that together comprise the world's eighth largest GDP. In addition, the secondary market would extend to 95% of the world's population via the bilateral and multilateral trading agreements already developed by the Pacific Alliance.

We looked at which economic sectors and segments would benefit from this approach, especially in its formative stages; these included mining, environmental management and maritime governance, particularly countering illegal fishing.

The Pacific Alliance External Relations Group accepted the report in March 2018 and the final report was handed over to the Colombian Government (as holders of the pro-temporary Presidency of the Alliance) in May. BEIS has also accepted the report and is in discussion with us, as the lead Catapult, on a strategy for the next stage.

We have also met with the Inter-American Development Bank, which agrees with the report's recommendations and has expressed positive interest in providing large-scale grant funding for projects at an Alliance level.

Key Performance Indicators

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.

KPIs are mainly output based and have been defined to:

- Provide timely evidence as to organisational progress
- Drive behaviours likely to lead to the Catapult achieving its objectives
- Provide an early indication of areas not progressing as expected.

KPIs reflect our core objective and purpose to provide translational infrastructure to support the establishment of new industries around emerging technology. For example, by:

- Working alongside the R&D capability in the UK to develop innovative solutions addressing key sector or technology domain challenges
- Working with industry to commercialise innovation in a way that drives long-term benefit to the UK economy.

A common set of indicators agreed with Innovate UK, our Sponsoring body, that each Catapult will report against came into effect from the 1st April 2018. These include new KPIs, such as measuring the progression steps from concept to commercialisation, and the number of projects that include both academia and industry, which help the Catapult operate in the 'right space'. We will report on these next year.

Measuring Progress

Our core grant request of £68m will enable us to deliver annual economic return of £475m per year (direct and indirect) by 2023. By supporting a dynamic supply chain, we will deliver a cumulative £1.7bn in economic value by 2023.

A three-part evaluation approach:

Measuring and monitoring our progress

Our corporate level KPIs are both strategic and operational. These KPIs, have annual targets to 2023 and provide quantitative evidence of our progress. In addition, we set project level indicators for key investments that link to our strategic objectives, these are captured as part of our Benefits Realisation Management.

Benefits Realisation Management

As set out in the HMT Green Book, Benefits Realisation Management is the identification of potential benefits (outcomes), their planning, tracking, and actual realisation. Some of our externally-funded programmes require us to follow specific evaluation guidance, with monitoring and evaluation plans developed and executed. These include for example, projects delivered under the UK Space Agency's International Partnership Programme Fund. We aim to develop monitoring, evaluation and learning frameworks for all our major investments.

Economic Evaluation

External evaluation consultants, SQW, engaged by Innovate UK delivered our first independent economic impact evaluation in August 2017. Overall, feedback across all the stakeholders and from the case studies was very positive - “hard to imagine the sector without them now” and “Satisfaction with the Catapult has been very high, and increases by intensity of engagement with the Catapult”. The Phase 2 evaluation will survey companies in autumn 2018, reporting in February 2019, and this exercise will be repeated in 2020. Part of the evaluation will cover longitudinal case studies to see what effect long-term engagement with the Catapult has achieved in terms of an increase in company GVA and jobs. Qualitative Case studies will also play an important role in evidencing our contribution across the sector as a whole.

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 £16.9m of collaborative and commercial income in the year (2017: £12.8m).

For the year ending 31 March 2018, the turnover and operating profit was as follows:

	2018	2017
	£'000	£'000
Innovate UK grant funding	10,252	9,917
Collaborative and commercial income	16,900	12,822
Turnover	**27,152**	**22,739**
Operating profit	**1,072**	**224**

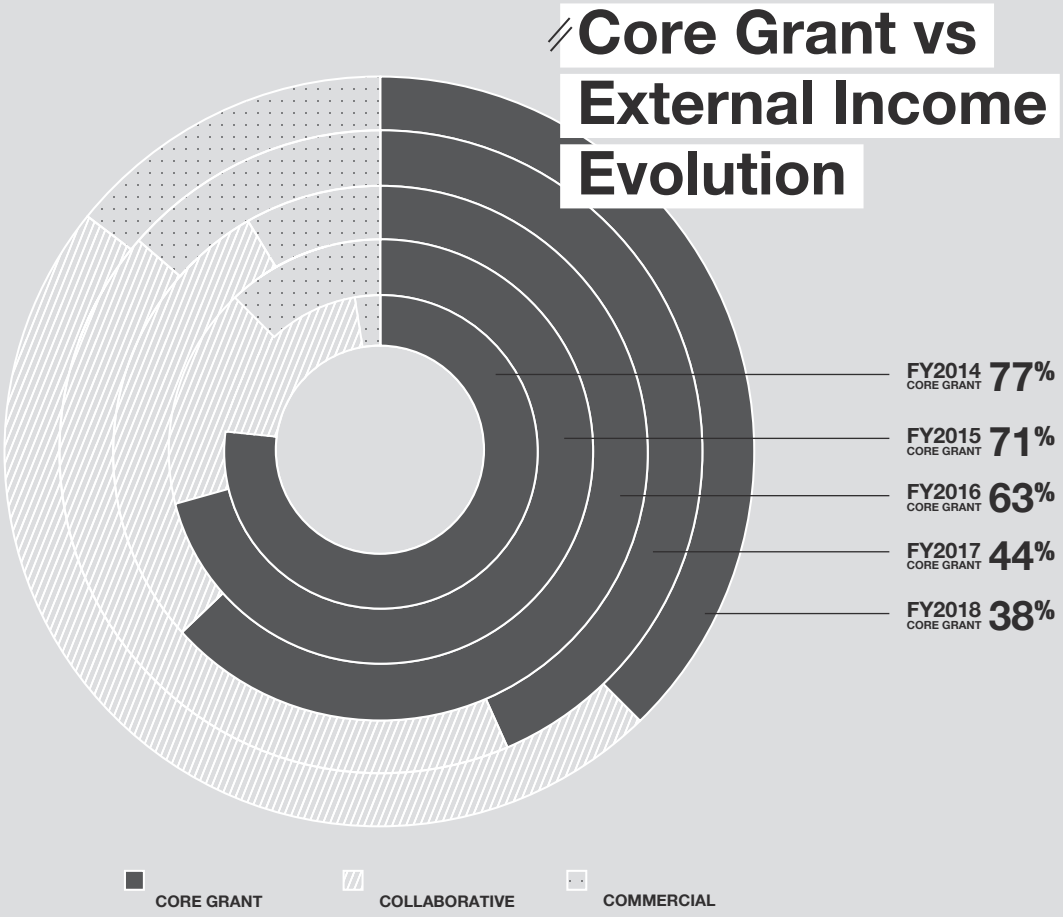
The Group has adopted the performance model of grant recognition under FRS102, with the whole capital element of grant income being recognised in the year it is incurred. This results in large operating profits during periods of capital investment and operating losses when depreciation exceeds investment. The Group's 'normalised' operating surplus for the financial year totalled £969k (2017: £596k). 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:

	2018	2017
	£'000	£'000
Fixed Assets	**9,962**	**9,404**
Net current assets	**2,096**	**1,609**
Net Assets	12,058	11,013
Reserves Profit and loss account	12,058	11,013
Total funds	12,058	11,013

Financial Review 2014-2018

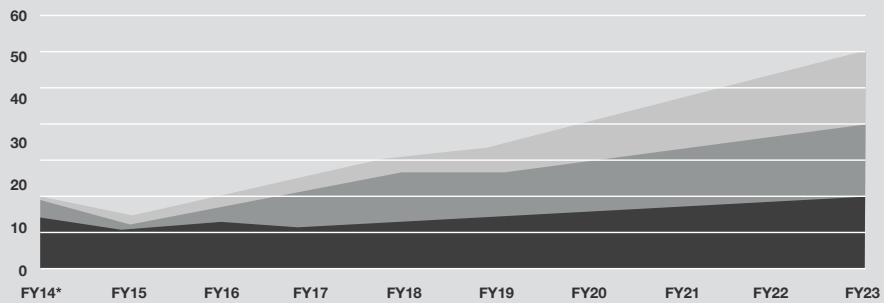
Over the past five years the Group has generated £44m of collaborative and commercial income, growing from £3.8m in 2014 to £16.9m in 2018. Income from collaborative and commercial sources in 2018 represents 62% of our total income with the Innovate UK grant comprising the remaining 38%. The evolution of the Innovate UK core grant income compared to income from collaborative and commercial sources is shown in the chart below:



The Future

We continue to expect the point at which two thirds of our income comes from outside of our core grant income will be in 2020, one year earlier than the expectation from our original delivery plan.

The actual income achieved to-date together with the forecasts from our latest delivery plan are shown below:



Company Information

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
Antonia Jenkinson (resigned 4th October 2017)
Simon Acland
Chad Anderson
Susan Hunt
William Hutton
Dr Vanessa Lawrence
Lynne Patmore
Ruy Pinto

On 19th July 2018, Lucy Edge and Richard Tuffill were appointed as directors of the Company.

Transport Systems Catapult; Traveller Needs Survey; 2015
Business and Sustainable Development Commission; Better Business, Better World; January 2017
OECD; The Ocean Economy in 2030; 2016; OECD Publishing, Paris
Monitor Deloitte; Digital Health in the UK, An industry study for the Office of Life Sciences; September 2015