ANNUAL REPORT 2022

A world empowered by space

Innovate UK

CATAPULT Satellite Applications

Contents

Chairman's Statement

Sanjay Bhandari

It has been a huge privilege to begin my term as Chair of the Satellite Applications Catapult at such an exciting time for the UK space sector – and at the heart of such a talented team, dedicated to boosting UK productivity by helping companies big and small harness the power of satellite-based services.

The past year has been full of highlights for the Catapult. Before I joined in August, we had already achieved world firsts in communications, successful commissioning of the Astroscale ELSA-D satellite and the beginnings of a transformational venture with NEOM's space strategy, billed as a $500 billion "future cognitive city".

I arrived in time for the launch at COP26 of the Space Sector Coalition for Net Zero, our own initiative and a landmark event of our Year of Climate programme. I was also honoured to be present when HRH The Prince of Wales visited us in Harwell to learn more about the challenges of space debris, and at the formal launch of the Space Energy Initiative in Westminster in March.

With the expansion of the Westcott Innovation Business Park thanks to £5.7 million in public and private investment, there will be more exhilarating times ahead, driven by our new In-Orbit Servicing & Manufacturing, Living Labs and Drone Test & Development capabilities.

I am also hugely proud that the Catapult Network has confirmed its commitment to Equality, Diversity and Inclusion by signing the shared Inclusivity in Innovation Charter in February. As Chair of Kick It Out, the campaign to put an end to all forms of discrimination within sport, this is a subject close to my heart.

At the Satellite Applications Catapult we all endorse the Charter's core principle that we are stronger – and therefore better able to deliver for our people, our stakeholders and the UK economy – because of the diverse range of skills, ideas, perspectives, faiths, cultures and capabilities that make us what we are.

We are an incredible force for good.

Chief Executive's Statement

Stuart Martin

Through our role supporting industrial pioneers and thought leaders, there is much to celebrate as we look back over the past year.

The publication of the UK National Space Strategy in September represented a sea change in the UK's approach to space. It was the first time all government stakeholders have come together behind a single and ambitious new vision for the sector, committing to putting space at the heart of delivery for a wide range of policy objectives. This included the fight against climate change, and the transition to Net Zero; meeting the needs of 21st century transport infrastructure; enhancing our national security and resilience; improving public services in healthcare, the environment and communications; and enabling exports, and inspiring our future workforce.

Ambitious indeed, and it is against this backdrop that I am delighted to be reporting on the progress we have been making in support of these vital initiatives. Throughout this report, organised in accordance with our horizontal delivery teams (Geospatial Intelligence, Ubiquitous Connectivity, Access to Space and Emerging Technology) and vertical markets, you will see examples of the many ground-breaking projects we have been involved with over the past year.

One of our most ambitious and forward-looking projects, for example, the Space Energy Initiative is covered under Emerging Technology. After a couple of years of gauging interest and building momentum, the concept was officially launched in Westminster in the autumn with widespread support from all corners of the sector. This programme, and the potential to use space-based solar power as part of our future energy mix, is now being routinely covered in the media, including by the BBC and Financial Times.

Looking more broadly, we have worked on many pioneering new projects with our Top 40 "High Potential Businesses": those whose growth has been accelerated by Catapult support, including support to Astroscale's world-first debris removal mission referred to by Sanjay. We had our best year ever for helping businesses raise investment, exceeding our annual target of £250M in the first quarter alone. We have also launched 11 Space Enterprise Labs around the country to spark better national and regional collaboration. All achieved despite the ongoing challenges of Covid.

But now we must look forward, as we prepare for our next five-years of funding with Innovate UK.
The next grant period is due to commence in April 2023, and to secure that we must continue to be bold. Whilst the past 9 years have demonstrated significant success, the potential for the future is even greater.

Whilst the UK space sector is growing, other parts of the world are growing faster. We need to seize the opportunity of the new UK National Space Strategy to accelerate the scaling up of our industry so that we can retain and grow our share of the global market. As a nation, we need to become the world's best adopters of space-based applications and services, so that we can harness the strengths of our financial institutions to lead the industrialisation of new and emerging space technologies, like quantum communications and low-earth-orbit navigations and timing.

The Catapult has a critical role to play. We need projects and programmes to be bigger, more inclusive and with greater impact. We need to evolve to rise to these greater challenges, with larger and more ambitious programmes to accelerate the growth of the sector.

The Catapult is playing a vital role in setting the UK up as a global powerhouse for space innovation, translating research into real-world impact, and creating growth from business and services as they thrive. There is much to look forward to.

The Year in Numbers

10
Academic collaborations

57
Industry collaborations

167
SMEs supported 2022

148 partnerships in **69** Projects completed

190
Total employees

Amount raised by companies that the Catapult supported
£247M

Geospatial Intelligence

From tackling climate change to fighting slave labour, the Catapult's projects have real-world impact. They are helping us position the UK in a global leadership role.

EO to Tackle the Planet's Biggest Challenges

The Intelligent Earth Institute is a partnership between the Catapult and the University of Oxford with a bold ambition – to place the UK at the forefront of global leadership in resolving the planet's biggest challenges, including climate change. It is harnessing existing research, machine learning and EO capabilities, bringing together the best minds in each to increase collaboration and create solutions at scale. We secured £100k from the University and have now designed funding pitches to appeal to public and private sources.

Missions will maximise real-world impact, from advising governments so they can improve policymaking to supporting industry to use new AI/ML tools. To trial its approach the Institute (soon to be renamed the Intelligent Earth Institute) has conducted two mission-shaping workshops, on OneHealth (at the intersection of human, animal and plant health) and SATCAT (AI aboard satellites for disaster response). Work is underway to design its first mission, on biodiversity.

Driving the adoption of EO

We are working with UK government to evaluate EO use and demand across the public sector in collaboration with the Geospatial Commission, the expert committee setting UK strategy for the best use of geospatial data. This is aimed at eventually consolidating government use of EO. We have also worked with DEFRA on strong input into the COP26 UN climate change conference. The Catapult was a key member of the KTN Space/Geospatial Virtual Pavilion at COP26, curating a break-out event on space, geospatial intelligence and nature. During this time, we have been also been analysing satellite data imaging pricing to ensure we can offer robust advice to our

Critical to Net Zero

With lithium an essential component of rechargeable batteries for mobile phones, laptops, digital cameras and electric vehicles, our GI team has developed new methodologies to support lithium prospecting. We are doing this through the geological interpretation of EO spectral data. This project under the Innovate UK Energy Catalyst's Lithium in Bolivia (LiBol) programme supports the need for critical minerals required to transition to Net Zero.

Innovating for Clean Air

Our pioneering work on the Innovating for Clear Air project played an important part in identifying brick kilns in India that are among the world's worst air polluters. Not only is this contributing to reducing pollution, it is also supporting action to end slave labour at these sites.

Ubiquitous Connectivity

Innovations made possible by the Catapult range from detecting cliff erosion to “connected cows”, while another new initiative is helping protect food security - we are delivering proven benefits to UK society and the economy.

Three Times A Winner

Our DCMS-funded 5G RuralDorset project boosting mobile connectivity has won three awards from Connected Britain: 5G Initiative, Sustainability and Removing Barriers. Having completed the world’s first in-field 700 MHz standalone private 5G network, using satellite backhaul provided by our Future Networks Development Centre at Westcott, we have seen real-world successes. These include deploying sensors to detect cliff erosion, 5G-connected buoys to monitor surf conditions and measuring footfall at overcrowded beaches. We are now testing uses in new areas ranging from ‘connected cows’ (remote cattle monitoring) to Hospital at Home and Internet-of-Things public litter bins. We are also exploring how to use this proven project model for connectivity deployment to scale up on a regional, coastal and national level.

Protecting Food Security

With Trusted Bytes, an Innovate UK part-funded project led by the University of Lincoln, we are playing a part in protecting the nation’s food security. UK retail sales of fresh produce (fruit and vegetables) are worth £11bn p.a. but depend on an extraordinary diversity of global and decentralised supply chains. This ground-breaking initiative will improve efficiency and resilience by designing an innovative hybrid satellite and terrestrial comms solution that tracks agricultural freight, logistics trucks and shipping containers.

Other 5G Projects

5G-MOBIX is a multi-million-euro project bringing together 55 partners from ten countries in telecoms, automotive, services and R&D. The aim is to use 5G-enabled innovations for automated vehicle operations across borders and the Catapult has carried out successful demonstrations on the Portugal-Spanish border. The 5G Milton Keynes Connected Communities project has successfully created the world’s first city-based 5G network and led to partners being awarded three bids for further work. See page 22 [case study.]

Backhaul and Radio Access Integrating LEO (BRAIL)

We achieved all our objectives for FY22 with the deployment of testbeds across the UK, and continue to improve our 5G facility at Westcott with the addition of further core networks and base stations.

Access to Space

We have seen an acceleration of activity in the space sector, where investment continues to grow with international input, and we won Royal approval for our pioneering space debris work.

Virgin Orbit

The In-Orbit Demonstration (IOD) programme overcame a series of setbacks to procure a launch from Virgin Orbit in 2022 for IOD-3: valuable lessons have been learned from delays caused by payloads and Covid impact on supply chains. We are now exploring changing needs for IOD with key stakeholders including the Defence Science and Technology Laboratory, British Antarctic Survey, Centre for Earth Observation & Instrumentation, the Department of Transport and many universities. One concept is a new bus and payload model, and we are working with the Catapult's Geospatial Intelligence Value Stream to refine this.

In-Orbit Manufacturing

Our IOSM (In-Orbit Servicing and Manufacture) team continue their mission to develop manufacturing in space. We are collaborating with the wider Catapult network, particularly the High-Value Manufacturing Catapult, to do this. The intention is to devise a free-flying manufacturing capability which goes beyond the International Space Station and would be of value to a future UK Orbital Solar platform, large telescope arrays and factories in orbit.

Lunar and Launch

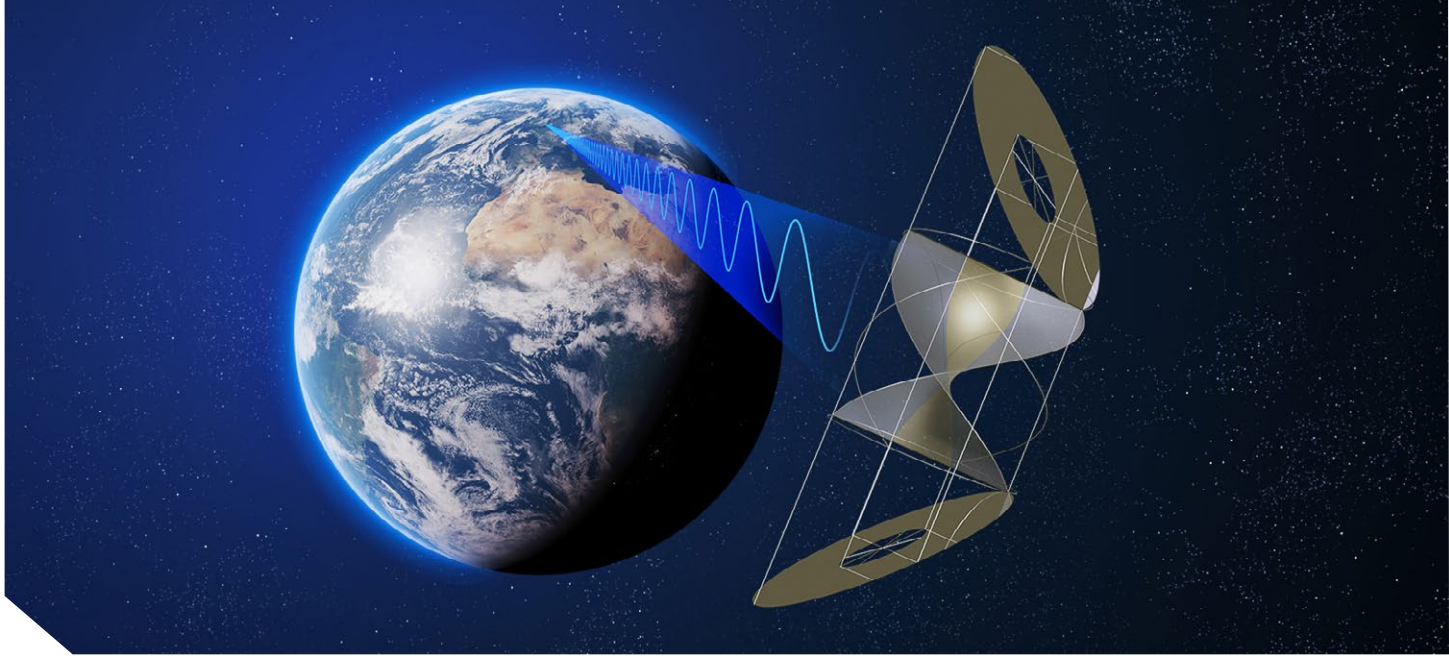
High demand for launch capabilities and spacecraft has seen investment almost double year on year. There is a melting pot of opportunity and innovation, although some companies remain cautious about new technologies. We continue to shape ideas for the UK's commercial activities for the Moon and beyond. Our focus remains on technologies for use on the moon, championing the future lunar economy and bringing new partners to this emerging market.

Royal Visit

A highlight of the year was the visit of HRH The Prince of Wales to the Catapult to learn more about the challenges of space debris. He attended a roundtable at our In Orbit Servicing Control Centre (IOSCC) to garner a broad coalition of support for the sustainable use of space to benefit humankind. The visit secured national coverage in the Daily Mail, Independent, Telegraph, New Scientist and local press, while the Astroscale / ELSA-d satellite controlled and operated by IOSCC has generated fantastic publicity for its mission to capture defunct satellites. This has really helped to accelerate awareness of space debris and orbital sustainability with a wide audience. Studies are now underway with the UKSA that could pave the way for a UK-led mission in 2025 to de-orbit two or more targets from low-earth orbit.

Emerging Technology

From our Space Energy Initiative launched to huge acclaim at the House of Commons to major media interest in our work, the Catapult is playing a vital role in growing the UK's reputation for ambitious sustainable energy policy.



Critical Independence

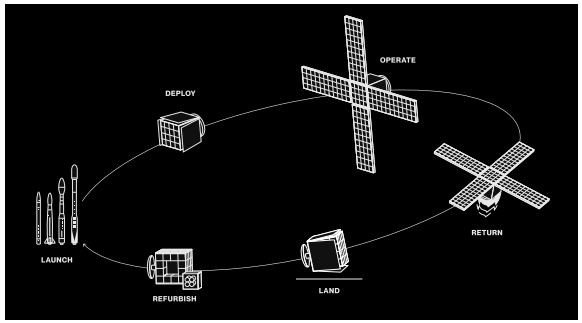
The Catapult was appointed by OneWeb on a major R&D project developing a PNT (Position Navigation Timing) system to make the UK independent in this critical technology. PNT information underpins transport, communications, energy distribution and emergency response. We have successfully demonstrated an effective timing service to key partners including National Physical Laboratory, Ordnance Survey and QinetiQ. This is a substantial achievement aligned with UK Government's ambition to have an alternative resilient PNT system. We are now working with OneWeb to turn this proof of concept into an operational timing service. We are also exploring the development of a standalone LEO PNT receiver able to use any LEO/MEO constellation, therefore widening the appeal of the service.

Space Energy

Thanks to the Catapult, Government interest is escalating in the potential of space to deliver clean energy technology to help the UK achieve net zero. BEIS, UKSA and DIT are an integral part of the Space Energy Initiative (SEI) that we established and now co-chair. Our SEI launch at the House of Commons in March dramatically accelerated progress, with 120 invited guests from the energy, space and finance sectors. Speakers included the Minister for Science and Innovation and the UN Habitat executive director. Membership of the SEI has grown to 42 organisations with a spirit of collaboration and purpose that has impressed ministers. We have an exceptionally capable and experienced Advisory Board, chaired by Mark Garnier MP. Our aim is to see the first operational system deliver 2GW of Space Based Solar Power (SBSP) into the grid by 2040. Growing interest has resulted in interviews with the Financial Times, Telegraph, Express and BBC World News. The Catapult has therefore played a central role in signalling the UK as an ambitious thought leader in sustainable energy and using space for societal benefit.

Microgravity

We have won our first funded work for microgravity, supporting SpaceForge in determining potential new market and product opportunities. We are progressing with community-building workshops bringing together business and academia for microgravity commercialisation, and have pulled together a very exciting international consortium including the HVM Catapult, DLR in Germany and AIMPLAS in Spain to address advanced materials. Our Microgravity Working Group attracted more than 20 people from 12 organisations to its first meeting.



Agriculture

A landmark achievement this year has been opening our Agri Living Lab, while our pioneering projects to increase sustainable supply chain practices – ForestMind and COLCO – have both reached milestones.

Agri Living Lab

The Agri Living Lab (ALL) – opened at Westcott Venture Park with the help of £363k of grant funding from Bucks LEP – demonstrates how satellite-enabled technologies address challenges across the global food system. It brings together agricultural tech and innovation expertise with state-of-the-art testing facilities and real-world trial environments. We agreed a collaboration agreement with Harper Adams University and on 31 March held our first ALL event at Westcott. This targeted 15 tech companies developing solutions in satellite communications, IoT, robotics and machinery, EO data and carbon sequestration, and showcased how they could leverage our facilities and expertise. Our FY23 outreach plan engages with SMEs and large companies to develop tailored programmes to use the Lab. We have already seen impact: JET-Engineering was introduced by our UC team and is using the ALL to upgrade its 5G software and hardware. We are also discussing expanding the Agri Living Lab to the South-West.

ForestMind

ForestMind has been recognised as a key opportunity in line with global sustainability and climate priorities. It is piloting a satellite-enabled deforestation detection service for a Guatemalan coffee producer and Brazilian soy producers. Agreements are in place with Sainsbury's and Union Coffee, and we have also engaged with heavyweight international supply-chain partners, including WWF, Marks and Spencer and Co-op. In future, other factors such as water usage, carbon and more supply-chain challenges can be mapped and tackled. ForestMind allows traders, commodity brokers and retailers to verify deforestation impact claims, make responsible purchasing decisions and demonstrate their commitment to preventing deforestation to their customers and stakeholders.

COLCO

Our three-year Colombia Cacao Control System (COLCO) project has come to an end, having introduced UK-based space sector know-how to nearly 40 organisations across Colombia's cacao sector. Aiming to support the production of higher quality cacao beans, reduce wastage and prevent environmentally damaging practices, it drew praise for its "very modern, very forward thinking" approach. Achievements include data gathering during the major cacao harvest; building a hyperlocal weather forecasting system to protect yields; completing The Land of Dreams, a radio series heard by over three million farmers; and creating a cocoa bean assessment tool that showed a 37 per cent improvement in quality. To maintain relationships and build future success, partners are collaborating directly to develop COLCO products for commercialisation. UK organisations will also gain access to Colombian markets to deliver wider socio-economic impacts.

Health and Wellbeing

Our vision is to support transformational change in healthcare and wellbeing services, using satellite data and applications to address the vast challenges presented by lack of connectivity locally and internationally. Our work in 2021-22 focused primarily on scaling up delivery of remote healthcare solutions and managing or preventing long-term conditions. Use of satellite technology is extremely important as it is well aligned to the NHS Long Term Plan and helps alleviate economic, social and environmental pressures on the health and social care services.

We are confidently able to highlight opportunities not only for reliable connectivity but for the many new applications it makes possible.

Healthy Living Lab

It has been a dynamic year for the Healthy Living Lab, with significant development ahead of our move into Plot 4000 at Westcott Venture Park and exciting projects underway with our first customers. We are now sharing a bespoke space with the Agri Living Lab thanks to funding from the Bucks LEP, giving us an unrivalled platform to demonstrate how satellite technology can enhance healthcare. We are working with NHS Herefordshire & Worcestershire to improve connectivity at Kidderminster Hospital and further afield. Leveraging the Healthy Living Lab brand and concept we are developing clinical entrepreneurship programmes with Hampshire Hospital Trust and Anglia Ruskin University. With NHS Digital we are expanding the Catapult's previous work on BRAIL (Backhaul and Radio Access Integrating LEO) connectivity into health and social care (BRAILMED). We have showcased our capabilities at the Emergency Services Show, Connected Britain and as part of West Midlands 5G's Connected Healthcare Programme. We also recorded a health episode of our In-Orbit Podcast featuring Lord Victor Adebowale and Dr Pritesh Mistry, looking at how digital transformation can help tackle health inequality in the UK.

Digital Ambulance

We have begun work on the Hybrid-ConneX Digital Ambulance of the Future project, a €5.7m ESA-funded initiative to create an always-connected and cloud-based digital ambulance. The Healthy Living Lab will test prototypes in collaboration with NHS partners, Excelerate, Livewire Digital and Vodafone. The aim is to integrate 5G, 4G and satellite connectivity to transform how ambulance services deliver 'see and treat' care, including calling on specialist clinicians to provide treatment en route to hospital. Winning Hybrid-ConneX allows us to work closely with Vodafone and NHS Arden & GEM, providing a compelling offer into ambulance services around the UK at events such as the Ambulance Leadership Forum and BAPCO (Bahrain Petroleum Company).

Capsule Endoscopy

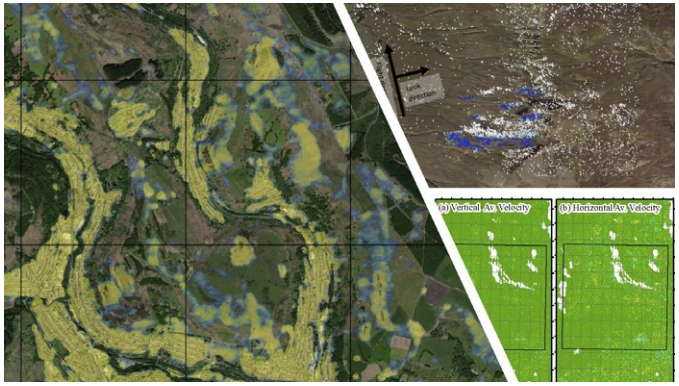
The Healthy Living Lab is working with Corporate Health, West Midlands 5G and NHS Arden & GEM to bring pill-cam technology into the home. These DIY endoscopies allow patients to diagnose bowel cancer from the comfort of their living room thanks to a pill-sized camera that can take 500,000 images as it passes through the gastrointestinal tract, looking for potentially cancerous polyps. Our role has been to highlight the range of connectivity solutions that could/should be considered for this 5G-enabled service, which promises both to catch cancer earlier and reduce NHS waiting lists for diagnosis.

Extractive Industries

The Catapult is generating exciting export opportunities for the UK space sector after signing a game-changing deal with a global engineering company. We have also been pivotal in the award of contracts for a life-saving study.

Global Visibility

The Catapult has become an approved supplier to a global engineering and consultancy firm which through Catapult intervention, will integrate satellite data into the world's first independent tailings monitoring centre. Through this work, the Catapult will provide export opportunities for UK space organisations. We have also introduced the University of Oxford to this engineering and consultancy firm a three-way academic, Catapult and industrial collaboration around tailings research and development.

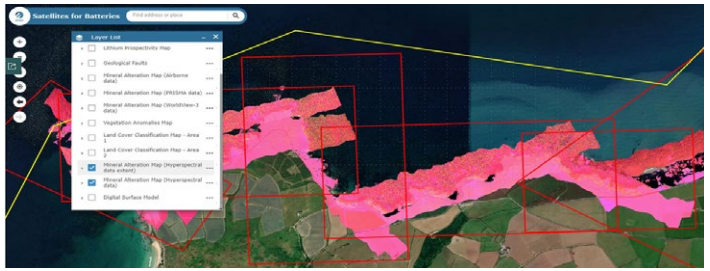


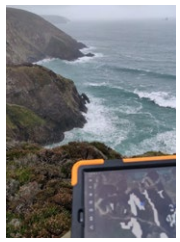
Three Win Coal Study Tender

In September 2021, the Satellite Applications Catapult and The Coal Authority announced the start of a joint project funded by the Welsh Government. This innovative monitoring study of disused coal tips in South Wales, using Earth Observation (Synthetic Aperture Radar) data, tracked changes in environments selected by the Coal Authority. Leveraging the Catapult's neutral trusted-entity status, a competitive commercial tender for the study was awarded to three UK companies: CGG, Terramotion and Satsense. Called the Coal Tips Monitoring Pilot Project, the work is aimed at improving communities and environments and to reduce the risk to public safety.

Satellites for Batteries Success

Our Satellites for Batteries initiative has shown that by combining a range of satellite and ground data with expertise in mining, geology, AI and earth observation, we can identify potential mineral deposits from space. The project involved seven consortium partners: Cornish Lithium, Terrabotics, CGG, Pixalytics, Camborne School of Mines, British Geological Survey and Decision Lab. It was showcased to National Space and Innovation Programme leadership and included as part of the UKSA submission to COP26. It aims to accelerate the extraction of the critical battery metals required for transition to Net Zero and provide jobs to support the Government's levelling up agenda, and we are actively investigating potential sources of funding to progress this important proposition for the UK.





Intelligent Transport

We continued to grow the Transport and Infrastructure Value Stream in 2021 through key technology demonstrators like Brigital and its partnerships in Canada. We also became a key point of reference for institutional customers like the Department for Transport (DfT) and England's Economic Heartland (EEH).

DfT and EEH both looked to the Catapult to explore how future systems and advancements in space technology will shape their strategy in transport and the related agglomeration effects it is expected to have on the wider economy.

The approach we have taken with DfT and EEH is also beginning to generate interest from the private sector with Amey and others expressing interest in us playing a similar consultative role to support them in the future on how space can play an increasing role in their business and interactions with SMEs.

Future of Flight

We have been running an exciting Future of Flight Challenge to test use cases for Urban Air Mobility (UAM) with the aim of accelerating adoption of drone logistics and passenger transport. The project includes simulations and a large real-flight demonstration campaign to assess safety, security, sustainability and public acceptance. This is a new business sector with strong potential to bring seamless freight, emergency, security and mobility services in the near future. The Catapult recently created a BVLOS (Beyond Visual Line of Sight) UAM Support Pack which we offer to SMEs wishing to undertake trials in the UK.

Our Future of Flight projects are driving demand for the Westcott Drone Test and Development Centre and we are seeking commercially funded projects as well as other funding opportunities.

We are working with the MoD on drone projects to eliminate over 90% of helicopter flights carrying out last-mile re-supply. These promise both significant costs savings and reduced noise pollution. We are engaging with Greener NHS on medical deliveries, and the Catapult has become a leading member of the Drone Industry Action Group, responsible for creating government policy on the use of drone technology. Upcoming engagement events will focus on industries with the widest array of potential drone applications.

Brigital Expansion

Brigital harnesses satellite technology to deliver improved safety for bridge users and maintenance workers through remote risk monitoring, especially on high-traffic bridges and in remote locations. We are engaging with government institutions and engineering/construction firms, and our work in Canada has expanded to cover not only bridges but rail and maritime infrastructure.

We are leading the commercialisation of Brigital across the EMEA region, including collaborating with the Singapore Land Authority and The Three Cities Project in Australia. In line with the UK's defined Critical National Infrastructure, we are engaging organisations in transport and logistics, maritime, nuclear and consultancy services.

The Catapult has received investment offers to contribute to the commercial spin-out of the project and is creating a legal entity to offer infrastructure owners/managers both early warning of potential problems and affordable maintenance.

New Markets

Our pioneering work on Spatial Finance is showcasing the Catapult's unrivalled expertise whilst opening up business opportunities for UK space sector enterprises.

Spatial Finance

It has been a productive year. The Catapult launched its global asset-level databases for the cement and steel industries, work that will inform climate decisions and new environmental research. This project was part of the Spatial Finance Initiative, in collaboration with Oxford University and Alan Turing Institute, and the data has been downloaded 454 times between the launch in July 2021 until the end of July 2022; from across the finance and geospatial industries, not-for-profits, academics and others. It will inform insurers' climate risk assessments, corporate decarbonisation strategies and benchmarking to penalise polluting businesses. The next step will be creating open datasets for other high-impact industries.

We also launched our first State and Trends of Spatial Finance report to generate demand for geospatial services from the financial sector. It was picked up by specialist media, and we were also invited to present to 90 staff at Bank of America. The databases and report were both launched at an event that provided a stage for UK startups and larger businesses (Sust Global, Naturemetrics, TransitionZero, GHGSat, Acclimatise/WTW) to showcase their products and capabilities to an audience of 440 delegates.

Contributing to the BEIS consultation on Climate-Related Financial Disclosures was a great opportunity to demonstrate the value of geospatial and EO datasets; we are engaging with the City of London Corporation and the Financial Conduct Authority; and our market expertise is being increasingly recognised by the geospatial sector. An example is our work with Ordnance Survey around commercial opportunities in the sustainable finance market. The Catapult is also well placed to take advantage of increasing interest in robust monitoring of carbon offsetting.

Net Zero

In a very busy year we have made Net Zero a fundamental part of Catapult strategy, embedded into all our future projects. We have also taken the lead in a coalition that will both support the space sector to decarbonise and help other sectors reach Net Zero thanks to satellite technology.

Raising profile at COP26

Our presence at the UN COP26 climate change conference, thanks to partnerships with Innovate UK KTN, the Geospatial Commission and UKSA, raised the Catapult's profile as we worked together to increase global understanding of space capabilities to monitor the effects of, and drive action to mitigate against, climate change. Events throughout the year culminated in multiple activities at COP26: we showcased the Catapult's CommonSensing project in a dedicated session at the Blue Zone Pavilion, creating media and business opportunities for new markets; we were a core partner at the virtual Space and Geospatial Digital Pavilion; we hosted a plenary session on Nature and we generated commercial interest with our paper, "How the Space Sector can Respond to the Glasgow Climate Pact". Our Year of Climate programme was nothing if not ambitious – running through COP26 and beyond, aiming to shift industry expectations as to how satellites can drive transformative climate change solutions.

Centre for Greening Finance and Investment

As a founding partner of the Centre for Greening Finance and Investment, we supported the launch in Leeds of the National Green Finance Innovation Network. The Network helps connect and support UK businesses seeking to increase the use of climate and environmental analytics by financial services across the world. Our presentations and workshops showed how space technology and data can help financial institutions and organisations make better informed decisions.

Hack the Planet

Our Hack the Planet competition drew 80 entries, garnered media reach of more than 40 million worldwide and linked us directly with the Commonwealth Secretariat's Blue Charter on ocean, climate and energy. The entirely virtual competition, organised by the Catapult and the Commonwealth Secretariat, successfully stimulated new ideas around ocean sustainability incorporating satellite data and technologies. UK team Plastic-i won with Mapping Ocean Plastics from Space, combining data from multiple high-resolution EO satellite constellations with machine learning to create a highly specific map of floating ocean plastic, offered open-source and updated daily.

Net Zero Strategy

In a pivotal year we have made Net Zero a fundamental part of Catapult strategy, embedded into all our projects going forward. We published our Net Zero Strategy, committing the Catapult to Net Zero by 2030, then led the formation of a Space Sector Coalition for Net Zero to support the entire space sector to decarbonise. This will continue to educate the sector to work collectively towards a low-carbon future. Its mission is also to accelerate the transition to Net Zero in other sectors through space technology, co-developing impactful solutions and creating strong partnerships so that they can be widely adopted. We have designed a new purpose statement, trained all Catapult staff, hosted universities and held two webinars on how space tech and innovation can both deliver energy solutions and gather the data to tackle climate change.

International Development

The Catapult is developing strong relationships with key organisations within the international development and humanitarian sector to win joint opportunities that will allow us to introduce more of the UK satellite community into their projects.

We have carried out extensive engagement with governments and business around the world. Our Geospatial Capabilities Framework continues to ensure work funded by the Foreign, Commonwealth and Development Office (FCDO) is passed through to the EO/Geospatial supplier community. Projects have included contracts to identify solar-powered water pumps in Yemen, assess agricultural change in Libya, and analyse urban development in Niger.

Within the FCDO we have been working with the Number 10 Innovation Fellows to promote satellite capabilities and how they can support a more rapid and effective response to international humanitarian crises. We completed a global FCDO-funded demonstration of the Pandemic Early Warning System in India, a joint project between the Catapult and innovative AI provider SpatialApps. We also supported an FCDO project monitoring the conflict in the Tigray region of Ethiopia, particularly agriculture and economic assessments.

We have showcased Catapult projects to the World Bank, Red Cross in Geneva and World Food Program among many others. We worked with the London School of Hygiene and Tropical Medicine on assessing COVID-19 mortality and assisted the Commonwealth Secretariat with Sentinel imagery when a container ship caught fire and sank off Sri Lanka. A key role for the Catapult is to act as a neutral, trusted entity in all our engagements within FCDO and the broader international development sector.

Supporting Humanitarian Responses

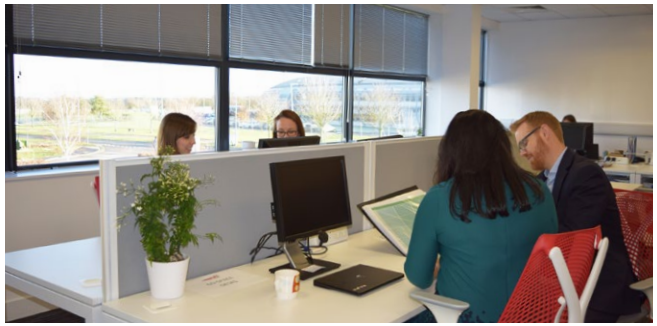
Two recent projects demonstrate the power of satellite technology to support humanitarian responses. The Independent Monitoring, Evaluation and Data Analysis (IMEDA) Programme is improving the effectiveness and targeting of humanitarian delivery. The Cross Border Conflict Evidence and Policy Trends (XCEPT) programme is enhancing data and evidence on some of the world's most protracted conflicts. As part of IMEDA the Catapult supported the development for the UN World Data Forum of an ArcGIS StoryMap which received widespread publicity. Our international development and humanitarian experiences have also opened the door to more organisations providing data and/or services using satellite-enabled geospatial data and technologies into the sectors.

Strategic Facilities

The Catapult's best-in-class facilities are an outstanding resource for UK space sector companies big and small, national institutions, universities and international trailblazers.

Disruptive Innovation for Space Capability (DISC)

The standalone DISC facility on Harwell Campus continues to house a range of facilities to support the design, manufacture and testing of products for deployment into complex environments. With access to equipment and expertise, teams are enabled to take an R&D project from proof of concept through to full-sized prototyping, with sufficient scaling to undertake end-customer validation. Over these past 12 months, DISC supported customers wishing to use and access the technical facilities. The environment combining a Vibration Table and Thermal Oven became operational in 2020 and has already been used by numerous organisations on a short-term basis. National service offerings with collaborations in the North-East of England, Buckinghamshire and Hampshire are also currently being explored.



Westcott Space Innovation Business Park

The Westcott Space Innovation Business Park aims to become the UK centre for the next generation of propulsion systems, small satellite manufacture, in-orbit servicing, and downstream service applications for Health and Agri-tech. With Buckinghamshire LEP and Wescott Venture Park, we have developed a strong partnership to drive this exciting vision forward.

Job-Creating Growth

We have achieved some notable wins in our mission to enable the set up and job-creating growth of space-sector SMEs. Our first Westcott Expo was a huge success. Interested companies toured our facilities and subsequently Excelerate Technologies joined the Westcott Space Cluster. Another major boost for the site was the arrival of satellite communications provider OneWeb. These two businesses have now signed a partnership deal to provide satellite connectivity services to first responders, government agencies and public sector organisations across the UK and globally. Looking to take their own Westcott facility, three more companies have moved into the Westcott Innovation Centre: drone business Skyports, which will operate its aircraft nearby, AVS UK and URA Thrusters. We continue to create an attractive ecosystem for other companies to locate their operations at Westcott.

To help SMEs develop from discovery through to live deployment, we will be delivering tailored packages of support to help high-potential businesses secure finance and grow. This will exploit our in-house expertise in User Centric Design services, and technological R&D. Another scheme being finalised to give eligible companies the ability to use the Catapult's facilities, called the Westcott Incubator and Accelerator initiative will be funded by the Buckinghamshire Local Enterprise Partnership and supported by Bucks Business First.

Skills Show

More highlights from a busy year include hosting the Buckinghamshire Skills Show, where we told thousands of children and those looking to change career about the different skills needed within the space sector; we attended the Space Tech Expo in Bremen, Germany, where we marketed Westcott as a destination for international space companies, generating demand for relocation; and Westcott Innovation Centre hosted local MP Greg Smith for a business roundtable.

Finally, we are awaiting a decision from the Department of Levelling-Up, Housing and Communities on the Catapult's £30m bid for a DISC Skills Academy at Westcott.

Regional and Academic Engagement

Our regional space ecosystems linked to one another, to Harwell and to the wider community, provide a unique front door to the space sector for any entrant anywhere in the UK. Alongside UKSA, we are leading and coordinating local connectivity, insight and delivery of this space ecosystem and providing targeted business support combined with local leadership activities.

Space Park Leicester

We have achieved an impressive milestone with the launch of our Space Commercialisation Engine (SCE) at Space Park Leicester. This is a physical hub where technologists, academics, entrepreneurs and investors work closely together to bring EO-enabled ideas quickly to market. The SCE is an important tool for accelerating EO products and services. Since launching SCE in October 2021, we have engaged with 30 businesses, conducted 11 diagnostics and kick started full SCE support with five companies. The SCE provides a fail-fast, agile and cost-effective way to rapidly test the viability of technology against real-market challenges, as well as providing new IP and licensing opportunities to industry.

Space Park Leicester is led by the University of Leicester in partnership with Leicester City Council and the Leicester and Leicestershire Enterprise Partnership. Leicester's ambition is to become a world-leading centre for satellite data services and the rapid manufacturer of satellites. The presence of the Catapult adds credibility to this goal, as well as building the local skills base and contributing to the region's economic growth.

Growing the UK Space Ecosystem

Our Regional Growth Collaboration project with UKSA delivered a programme of activities to grow the UK space business ecosystem in all regions. They included 1-2-1 technical support from consultants in the areas of Earth Observation, Satellite Communications, Position Navigation and Timing, In Orbit Servicing and Manufacturing, and Launch and Propulsion; alongside technical knowledge and business experience, the team opened doors to an extensive industry network. By year end, we had supported over 40 companies.

We conducted Legal Structure and Leadership Strategy Workshops on ambition, governance structure and focus with the Cornwall and the South-West Centre of Excellence, North-East Centre of Excellence, Oxford-Cambridge Arc, South Coast Centre of Excellence, Space Hub Yorkshire, Space Wales and West of England Space Hub.

We tagged 786 organisations using a taxonomy which provides granular description of capabilities, identifying new organisations in 11 LEP regions which have been added to the UK Space Capabilities Catalogue. A comprehensive report on the UK-wide ecosystem has been commissioned from Red Kite Management Consulting. Analysis of space sector market trends informed a series of UK Supply Chain Stimulation Workshops to connect stakeholders and catalyse activity around high potential areas. A UK Space Supply Chain report was also commissioned and published.

A joint UKSA Regional Skills Workshop was the first time we had gathered representatives from the Space Skills Advisory Panel with regional/local space hubs and clusters across the UK. More than 50 people attended to understand, map and align local activities around skills growth in the space sector with national endeavours. As a follow-on we received funding from the Gatsby Foundation to deliver Skills Value Chain Workshops for the sector.

Arc for Space Initiative

Our Regional Growth team continued to work with Cranfield University, Open University, University of Cambridge and University of Oxford on developing the Arc for Space Initiative. Four strategic missions targeting global sustainability will bring together academia and industry partners. They include sustainable finance (using data and advanced tools to drive climate action through financial transactions) and intelligent spacecraft (pioneering intelligent spacecraft and ground systems for sustainable use of earth orbits.)

Following the successful conclusion to the regional growth project with UKSA, the Catapult will work with UKSA to develop a multi-year plan to shape support for regional growth. Furthermore, the Regional Growth team will cultivate deeper relationships with the National Space Partnership and the new Space Directorate at BEIS after it was praised for delivering a two-way regional briefing.

Space Enterprise Community

The Space Enterprise Community is the new name for our virtual innovation Space Enterprise Network. Launched in March 2021, a year later there were more than 750 members from 164 organisations registered on the platform, with c.100 project/funding opportunities and 120+ space sector events listed since its inception. This digital space for the sector to get together and participate in discussion is growing all the time. One event focused on improving visibility of local expertise and excellence across the UK to boost collaboration and growth. We were pleased to see representatives from some of the newer space hubs such as West of England, West Midlands, and Yorkshire.

Regional Space Hubs

Our three existing Centres of Excellence – North East, South Coast and South West – are finalising their plans to transition into Space Hubs after a contract extension from March 2022 to March 2023 was agreed.

Space Enterprise Labs

We launched Space Enterprise Labs (SELs) in 11 locations across the UK, providing physical spaces for better collaboration nationally and regionally. These unique and connected innovation spaces, most within universities, are situated in Daresbury (Liverpool City Region), Edinburgh, Exeter, Glasgow, Harwell, Leeds, Leicester, NETPark (County Durham), Penryn (Cornwall), Portsmouth and at Westcott. Plans are underway to set up SELs in South Wales, North Wales and Belfast.

SELs meet changing needs for virtual working. They operate in collaboration with existing space organisations and academic institutions, democratising access to the space sector regardless of location. Another aim is for SELs to attract new entrants to the space sector through market and technology demonstrations.

Space Cluster Development

We completed assessments for three new space clusters: the Leeds/Yorkshire region and North West clusters, as well as an extension of the Surrey/SE cluster. We will continue to support these areas to grow space-based activity.

Pipeline Stimulation Programme

The Catapult's Pipeline Stimulation Programme (PSP) is a series of international activities to identify opportunities for innovation and impactful collaborations globally. Stimulating jobs, growth and greater value between the UK and other countries, it has grown to include Brazil, India, Colombia, Turkey, South Africa and New Zealand. We are looking at a wide range of potential applications of UK satellite technology including supply chains, agriculture, connectivity, sustainability and climate resilience. The UK-Brazil PSP has mapped geospatial and digital sourcing and environmental data. This will both benefit Brazilian agriculture and help UK agri-tech companies extend their commercial offer through access to otherwise unavailable data. The enthusiasm of our partner Embrapa (the Brazilian Agricultural Research Corporation) has been impressive and we have identified nearly 80 opportunities for collaboration, with 54 interested UK organisations wanting to work with them. The UK-India PSP is now in phase 2, exploring opportunities for UK plc in sustainability, enabling connectivity and health in India. We are developing activity in New Zealand and Australia focused on agriculture and satellite/space-enabled applications, specifically within Ubiquitous Connectivity. In South Africa we are focusing on GI/EO applications in sustainable agriculture such as land management, deforestation and habitat monitoring to identify high-level challenges and opportunities for the UK. Commissioned by the UK Foreign Commonwealth and Development Office, we are collaborating with the South African National Space Agency and UKSA.

PSP has prompted excellent collaboration with other Catapults and Innovate centres: in Brazil with Agrimetrics, one of the Innovate UK AgriTech Centres; in India with the Digital Catapult and Connected Places Catapult alongside DIT/UKSA/EIS; and in Colombia with the High-Value Manufacturing Catapult.

Kingdom of Saudi Arabia - World-Class Innovation

KSA has set out its goals for social and economic transformation in the Vision 2030. A major part of the vision is in the creation of the new city of NEOM, a net-zero "city of the future" with a total budget of US$500 billion. We are contributing towards this transformational city by implementing their space strategy for NEOM. This work is proof that the Catapult model is seen as a world-class exemplar for innovation.

We are commissioned to advise and shape on all aspects of space, facilitating delivery over the next five years in disciplines from satellite and launch vehicle manufacturing to ground operations and use-cases for LEO (Low Earth Orbit) constellations. We have developed a design for the largest space teleport in the world with an underground facility capable of developing satellite ground segment innovation as well as hosting live satellite services for LEO, MEO, GEO and deep space; secured a partnership with OneWeb to host their gateway in NEOM that will cover East Africa, Middle East and Pakistan for the next ten years; and delivered a "Journey to Mars" programme plan for innovation within NEOM's future Space Development Centre.

The NEOM space strategy will become part of Saudi Arabia's space programme, leading to investment in innovation with international partners. We hope our involvement will lead to further collaboration opportunities for many UK innovation and supply chain companies. Our intention is to extend and develop new relationships to work within NEOM and surrounding markets in all aspects where the Catapult operates, including future communications techniques, development of living labs and deep space communications.

Business Support

We have exceeded expectations for finance raised by companies we support and have seen intense activity around the high-potential businesses on our Top 40 list.

Westcott Business Incubation Centre (BIC)

We have continued to deliver business and technical support to dynamic early-stage startups. Working with the Catapult Business Strategy Team, User Centre Design Team and our technical teams the BIC has helped companies refine their technical approaches, develop their customer targets and decide their value propositions. The Catapult, UKSA, DIT, KTN and regional space centres are also developing a map of the UK supply chain (the UK Space Capability Catalogue) to understand the pinch points and identify key companies we should nurture.

Successes reported by BIC-supported companies include £1.2m seed investment secured by Dark Horse Technologies (now Omega Crop) for its technology to improve crop yield predictions, and a £650k ESA contract secured by Protolaunch to de-risk its engine technology.

Finance Raised

The target set for the whole year was achieved in Q1, while performance in Q4 has also exceeded expectations. London-based EO thermal imagery company Satellite Vu raised £5m and transport data provider Valerann raised £13m. In the South-East, semiconductor manufacturer EnSilica raised £0.75m and Welsh space tech firm SmallSpark Space raised £1.8m. D-Orbit UK has signed a €2,197m contract with ESA for development and in-orbit demonstration of a “Deorbit Kit” as part of ESA’s Space Safety Programme. The Catapult is supporting D-Orbit with market research and commercialisation.

> **We use Catapult facilities to undertake ‘routine’ antenna testing that we cannot do within Chelton. I believe the Catapult facility is currently the best and most cost-effective available for what we need to do. Far field testing is more difficult, and the Catapult range is an invaluable UK asset.**
>
> Martin Shelley, Engineering Operations Manager, Cobham Aerospace (now trading as Chelton)

> **Having a fully accredited facility such as Catapult is an essential part of the antenna approval process and for the successful roll out of our new antennas. The quality of the work performed by your facility and the reporting received is superb!**
>
> Bilal Awada, Co-Founder & CTO, C-COM Inc.

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 £15.5m of collaborative and commercial income in the year (2021: £11.5m).

For the year ending 31 March 2022, the income and operating profit were as follows:

	2022	2021	2020	2019
	£'000	£'000	£'000	£'000
Innovate UK core grant income	£15,204	£11,901	£12,000	10,820
Collaborative and commercial income	£15,488	£11,539	£11,740	18,626
Total income	**£30,692**	**£23,440**	**£23,740**	**29,446**
Operating profit / (loss)	**£4,348**	**£1,422**	**(£1,284)**	**916**

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 £700k (2021: £514k). As a not-for-profit research organisation, any surplus is reinvested in pursuance of the Group's strategy.

Extracts of the consolidated statement of financial position as 31 March are as follows:

	2022	2021	2019	2019
	£'000	**£'000**	**£'000**	**£'000**
Fixed Assets	£14,972	£10,924	£10,824	10,824
Net current assets	£4,321	£4,075	£2,451	2,451
Net Assets	**£17,581**	**£13,380**	**£13,274**	**13,274**
Total capital and reserves	**£17,581**	**£13,380**	**£13,274**	**13,274**

CASE STUDY:

The Role of Satellites in 5G Connectivity

How the Catapult is supporting the development, integration and deployment of 5G connectivity on a regional and international scale.

The stakes

With expertise in Ubiquitous Connectivity and the ability to showcase the benefits of 5G infrastructure at its Future Networks Development Centre (FNDC) in Westcott, the Catapult has led significant projects that are carving out a strategic position for UK space technologies in the 5G landscape. Terrestrial 5G deployments can fail to match demand in rural areas and border zones, where commercial cellular networks often stop at country boundaries. Integrating satellite communications with terrestrial networks is the answer, bringing resilient and robust connectivity on land, at sea and in the air. As innovation in UAVs and AI accelerates, the need for increased connectivity and bandwidth will grow rapidly.

We have been able to exploit the FNDC for critical staging and testing, supporting deployment of 5G connection points and presenting ways in which satellites can be used.

5G-MOBIX is a multi-million-euro flagship project bringing together 55 partners from ten countries from the EU, UK, Turkey, China and Korea in the telecoms, automotive, service and R&D sectors. The aim is to use 5G-enabled innovations to test automated vehicle operations along multiple cross-border corridors as well as urban trial sites. The Catapult has worked alongside VEDECOM on a CCAM use case at the Portugal-Spain border. We have demonstrated an effective method for integrating different communication networks within the LTE (long-term evolution) and 5G ecosystem. The connectivity architecture, using both terrestrial and satellite networks, builds on the concepts of backhaul or the 'bearer of opportunity' approach. The project is ongoing and is expected to create opportunities for the UK connectivity and automotive industry.

Our 5G Rural Dorset project, described on *page 7*, boosts network availability in an agricultural region with coastal safety considerations, an aging population and no motorway. Connectivity is vital for the police, emergency medical services and the coastguard, but the benefits of our work range from farming to health.

The 5G Milton Keynes Connected Communities project (a collaboration with the Connected Places Catapult) has successfully created the world's first city-based 5G network. It is now delivering a variety of 5G use cases that can be replicated in other local, national and international contexts. These include a use case demonstrating the reliability and safety of remote driving technologies supported by a standalone 5G network or dedicated portion of a 5G network. Another use case focuses on the role of 5G in operating a remote vehicle and transmitting images for security patrols of large venues, such as the MK Dons stadium. The project's promising outcomes have resulted in partners being awarded three bids for further work related to 5G innovation in R&D environments.

CASE STUDY:

The Catapult's Role in Removing Space Debris

How the Catapult is tackling the complex challenges created by space debris in Low and Medium Earth Orbit.

The stakes

The collaboration between the Catapult and Astroscale since 2017 has achieved the first mission to demonstrate core technologies necessary for space debris docking and removal.

In the next 10 years there will be 20,000 satellites orbiting the Earth, providing critical services including global communication and positioning capabilities, but operating in highly populated orbits. There are growing concerns that a collision between uncontrolled space debris and an active satellite could cause global commercial and security risks and lead to a cascading debris effect that makes these orbits unsustainable.

Outcome and impact

The launch in March 2021 of Astroscale's End-of-Life Services by Astroscale-demonstration (ELSA-d) mission placed the UK as a leader in its regulatory, technical and commercial approaches to space sustainability. The mission's ground segment and operations were hosted at the Catapult's In-Orbit Servicing Control Centre, the first mission control centre dedicated to in-orbit servicing. It controlled the spacecraft in orbit and monitored its health in real time, and we developed new capabilities including a Mission Control System, a Flight Dynamics System and an Image Processing System.

Demonstrations included target search, target inspection, target rendezvous, and both non-tumbling and tumbling docking. Each has taken Astroscale a step closer towards delivering commercial debris removal and other on-orbit services. The next step will be a UKSA study to remove two unprepared spacecraft in Low Earth Orbit (LEO), preparing the ground for the UK government to lead an ambitious Active Debris Removal mission by 2025.

The Catapult's partnership with Astroscale delivered a scalable, tailored and re-usable mission control centre to meet the complex demands of advanced satellite constellations. By minimising the high barriers to entry into the space industry it provides the UK with a world-leading capability, unlocking opportunities in space debris removal, in-orbit satellite servicing and other autonomous robotic applications.

Impact has included inward investment from Japan to address global market standards for on-orbit satellite servicing, with Astroscale increasing its UK workforce from 14 in 2019 to 100 people in 2022. We have also brought a new service to market and opened commercial opportunities with the UK Government and OneWeb.

Vital missions

The success achieved to date is important for the UK because it showcases the control and operational capability of space flight. The UK is well placed to capture 20-30% of the global IOS market. By running more operations from the UK, we can demonstrate our ability to contribute internationally to some of the most vital missions coming up in the space industry.

This and subsequent missions aim to open up a new global LEO economy with the UK providing a range of ambitious space services such as orbital assembly, space-based power generation, small satellite manufacture, launch, in-orbit-operation and autonomous robotic retrieval of debris. All in support of next-generation connectivity, green energy and the creation of many high-value and highly sought-after jobs.


CATAPULT
Satellite Applications