

A photograph of a space station module with large solar panel arrays, orbiting Earth. The Earth's surface shows a mix of blue oceans, white clouds, and brown landmasses. The station's structure is white and metallic, with various instruments and antennas visible.

ANNUAL REPORT 2023

A world empowered by space

We work with



Innovate
UK

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Chairman's Statement

Sanjay Bhandari



The past year has been full of positives. There is so much good to draw from the Virgin Orbit launch from Spaceport Cornwall despite the final outcome. Our teams proved their technical leadership and ground segment capabilities, we showed we can build end-to-end UK supply chains with all the skills needed to take a mission from idea to orbit, and we generated more than 60 articles and broadcast appearances for the Catapult. So while the launch was not the triumph we had hoped, we have a lot to celebrate.

We have supported the UK space sector to leverage R&D investment that totals £34.3 million in 2022-23 alone, encompassing core grant investment, commercial investment, grant funding and partner funding. Looking back over the ten years the Satellite Applications Catapult has been driving the take-up of space technology and spearheading the satellite services revolution, we have supported more than 800 SMEs, forged more than 500 industry and nearly 250 academic collaborations, and taken part in more than 100 international projects. It's a record to be hugely proud of!

In the domains of connectivity, geospatial intelligence and access to space we have once again proved our capabilities as world leaders, whether it's the transformative capacity of space-based 5G telecoms, opening new commercial routes to market for Earth Observation or leading the way with our unique In-Orbit Service and Manufacturing facility. Our National Capabilities and Clusters team, meanwhile, is ensuring we promote the interests of the space sector across the whole of the UK, and acting as a magnet for inward Foreign Direct Investment.

We are at the forefront of promoting space-based solar power, launching a campaign with a 12-year programme to secure £220 million to advance the scale of UK operations in this field. It has, however, been disappointing to witness the lack of funding for the Net Zero Space Coalition to decarbonise the UK space sector, and lack of investment in our ForestMind initiative to stop deforestation. As a nation we must be bold in our space aspirations, especially where the solutions ultimately impact Net Zero.

As we move forward, we will be developing a mission-led approach to make us even more impactful in the sector. A new organisational design and new ways of working will go hand-in-hand with this approach to drive all our future work forward with increased focus.

We have so much to look forward to.

Sanjay Bhandari

Chief Executive's Statement

John Abbott

Our mission is to drive the commercial growth of the UK space sector, guided by a mission-led approach.

I write this with my feet barely under the desk in my new role as Chief Executive of the Satellite Applications Catapult, but I have already been hugely impressed by the energy, the passion and the sheer brilliance of the teams I am excited to be working with.

Our mission for the next five years is to drive the commercial growth of the UK space sector, and mission is the operative word. We have set out a new direction as a mission-led organisation and are creating four mission teams with dedicated mission leads. The teams will be multidisciplinary and include colleagues with expertise in technology, professional services, business development, user-centred design and project management. We are also reviewing our ways of working to ensure all of our systems and processes fit with the new mission structures, and adapting and improving those that need it.

What does this mean? It means we will continue to be the outstanding pioneers and high achievers we have always been, but with even greater impact. Our four missions express the key growth opportunities for the space sector, and where we can make the most difference. In broad brushstrokes, they cover connectivity, sustainability, space-enabled autonomy and the new era of infrastructure in space. They are about connecting people, communities and businesses in the UK and around the world, and about using space tech to improve human wellbeing.

A mission-oriented approach provides a framework for innovation with purpose – so that the sector grows in size and renown, and UK space businesses increase their revenues, job creation and visibility in the global market. We will need to drive large-scale capital investment into the sector and we know this will be a challenge, but we will be in prime position to do it as we prove our credentials for expertise, impact and creating value.

Writing this statement is a fantastic opportunity for me to pay tribute to Stuart Martin, who stepped down as CEO in October 2023. All the achievements recorded in this report, all the obstacles overcome and the pioneering paths embarked on, came under his stewardship. Stuart was our founding Chief Executive and served for ten years. The role he played in forging the UK's reputation as a world-leading space start-up ecosystem was fundamental, and he was an early and enthusiastic cheerleader for space as a force for good as the planet transitions to a more sustainable future.

I could not agree more with his parting analysis that the space sector is going from strength to strength, and I wholly endorse his view that the Catapult and our amazing staff have a tremendous future ahead. Thank you, Stuart for the exceptional leadership you provided and for the example you have set.

I have joined the Catapult from a role in Saudi Arabia, so it will come as no surprise that I have a wide world view. I have no doubt that from Harwell, from Westcott and from our interventions across the UK we can make a difference on a global scale. The government's ambition has been to establish the UK within the first rank of space nations as a world leader in science, research and development. It is an ambition that, working together, we at the Satellite Applications Catapult are turning into reality.

John Abbott

The Year in Numbers (2012 - 2023)

The Catapult represents exceptional value for money for our funders. Grants, commercial investment and partner funding result in hundreds of game-changing projects with businesses, industry and universities. They are all contributing to the UK's ambition to be among the first rank of space nations.



508

INDUSTRY
COLLABORATIONS



836

SMES
SUPPORTED



111

INTERNATIONAL
PROJECTS



over £15M

OF RESEARCH AND
DEVELOPMENT FACILITIES



242

ACADEMIC
COLLABORATIONS



210

EMPLOYEES IN 2023

Geospatial Intelligence

Our Earth Observation (EO) team continues to explore innovative uses for EO data, helping develop the market for EO products and services.

We partnered with the Department of International Trade to host a visit from 14 Mongolian mining company CEOs. We have forged new relationships with many government organisations after co-funding the report 'Investigating UK public sector demand for Earth Observation technology'. It identified how 125 UK public sector bodies can use EO data to create greater value in their work, with the Catapult ready to provide expert support.

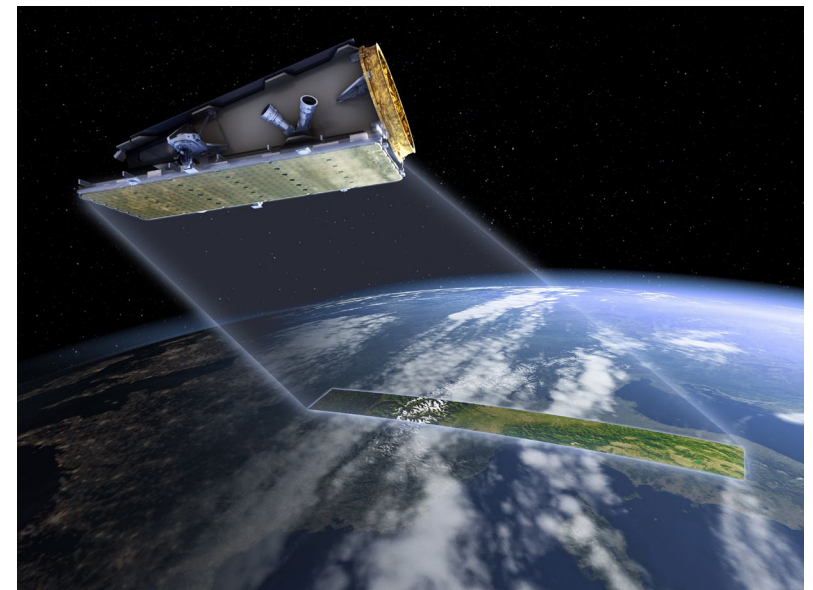
Image: Sossuvlei, Namibia, captured on January 7, 2012, © KARI and ESA.

Averting disaster

Our collaborative work played a part in helping the United Nations avert a disaster in the Red Sea, solving a problem it had been wrestling with since 2015. A decaying supertanker had threatened to spill a million barrels of crude oil off the coast of Yemen, destroying 200,000 livelihoods in fishing communities and costing £16 billion to clean up. After we helped model the risks in collaboration with the UK Foreign, Commonwealth and Development Office (FCDO) incident modellers Riskaware and humanitarian analysts ACAPS, the United Nations carried out a successful mission to drain the oil and ship it away to safety.

NovaSAR workshop

We have organised and hosted the first NovaSAR workshop to encourage the academic, commercial, civil and defence communities to exploit the data gathered by the NovaSAR-1 satellite. NovaSAR-1 is a small Synthetic Aperture Radar (SAR) mission designed for low-cost programmes and optimised for shared launches. Part-funded by UK government, NovaSAR-1 is the first SAR to be manufactured entirely in the UK. Its revolutionary ability to take pictures of the surface of the Earth in any weather has recently allowed data collection about the Russian invasion of Ukraine for NATO, flooding for Natural Resources Wales, rice-growing regions for the University of Surrey and ship detection in the fight against piracy. Our workshop, in collaboration with Airbus, the Defence Science and Technology Laboratory, the UK Hydrographic Office and Surrey Satellite Technology Ltd, saw external speakers give nine talks to 100 attendees.



Ubiquitous Connectivity

Advances in 5G connectivity are proving transformative in industry, the economy and daily life. From Surrey to South America, the Catapult is valued as an exceptional partner at the forefront of innovation.



Introducing TINA

Through TINA (5G Terrestrial Including Non-terrestrial Architectures), the Catapult is spearheading a consortium of sector-leading innovators in a project to validate 5G connectivity standards for space-based telecoms systems. Satellites play a vital part in solving 5G coverage problems that ground-based infrastructure cannot achieve alone, hence our prime role in this project funded by the European Space Agency (ESA).

We are heading up this collaboration with the University of Surrey. After defining a Minimum Viable Product, the project moved forward to create a testbed architecture capable of emulating innovative 5G Non-Terrestrial Networks scenarios that can maximise the value of 5G connectivity. More work on this theme will follow with our new ESA-backed project 5G-SPECTRA.

Digital Ambulance Initiative

We've made notable strides in the **Hybrid-ConneX Digital Ambulance** project, an ESA initiative for a constantly connected, cloud-based digital ambulance offering Hybrid Connectivity as a Service (HCaaS). To garner attention for upcoming trials at our Westcott testbed, and to promote the uniquely designed testbed

created to support end-to-end testing of the product developed in this project, our Ubiquitous Connectivity Team showcased the project at the annual British Association of Public Safety Communications Officials conference along with other partners.

Airspace of the Future

The Airspace of the Future project, designed to improve the safety of drone operations in the UK's uncontrolled low-level airspace, has come to a successful conclusion. It has highlighted the Catapult's pivotal role in supporting the UK drone industry in commercialising drone services as well as energising the urban mobility market. We created a tool for height-based radio coverage calculation and drone-connectivity analysis that was demonstrated to a large group of industry users at a showcase event organised by the Connected Places Catapult at Cranfield University's Digital Aviation Research and Technology Centre.

This provided a great opportunity to reinforce the importance of satellite technology in delivering BVLOS (Beyond Visual Line of Sight) flight to companies that will be instrumental in deploying the technology in industry. The Ubiquitous Connectivity Team is playing a part in creating a world-leading drone-services market that can operate drones at scale, integrated with other airspace

users in a transparent, safe and acceptable manner.

O-RANOS tests successful

We have contributed our satellite communications and Open Radio Access Network (ORAN) expertise to a multi-skilled consortium that aims to accelerate 5G and 6G deployment for rural areas and emergency networks. The solution was successfully tested at Westcott, where further use cases ranging from agricultural robotics to automated mobility are being developed.

India-UK Future Telecoms

A Catapult team has travelled to India to meet high-level officials in government, industry and academia to support the Department for International Trade's India-UK Future Telecom Programme. This initiative aims to explore areas for bilateral collaboration, and our interactions with key stakeholders in India are seen as a vital enabler to attract investment and partnership.



CASE STUDY:

Rural Connected Colombia

The Catapult’s expertise is pivotal to delivering 5G internet connectivity to remote, rural areas of Colombia where telecoms companies do not offer commercial services.

Background

Only 28.8% of rural households in Colombia benefit from internet connectivity. The predominately agricultural community has low levels of education and financial literacy, and very limited access to devices such as smartphones, tablets or computers. This also impacts the business community, which also finds the cost of connectivity is often unaffordable. The government is phasing out the 2G networks these regions rely on, but installing fibre or coaxial fixed-access technologies is hampered by landslides, poor roads and armed conflict. Extending connectivity to remote parts of Colombia is a political commitment, and satellites will play a key part in complementing the lack of terrestrial network infrastructure.

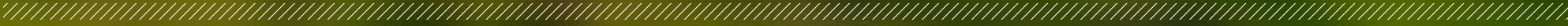
The Catapult led the first phase of this Rural Connectivity project (funded by UK government and a major Colombian bank) to develop a technical and business roadmap along with a focused plan for implementation in locations in the Urabá region. Later phases will be financed by tax breaks for public works along with CAPEX and OPEX funding until the network becomes self-sustaining.

Catapult activities and outputs

Our unique ability to run this project comes from the technical, business and user-centred design experience we gained from our 5G Rural Dorset work. We travelled to Colombia to understand what the people of Urabá need, understand the inherent challenges, carried out market analysis and innovation research, and hosted a delegation of Colombian dignitaries. They visited Harwell then toured the award-winning sites in Dorset where Catapult projects now showcase how digital connectivity can revolutionise rural economies. On one visit, for example, the delegation learned how sensors and cameras connected by 5G help farmers to monitor the health of individual cows among a large herd.

The advent of rural connectivity in Urabá will open up potential for virtual education and telehealth services, beef traceability required by export customers, digital marketing to commercialise farm products, better rural security from remote cameras and reliable emergency calls, the use of Internet of Things sensors to detect changes in soil composition or likelihood of pest and disease, and the development of new e-commerce businesses.

We have seen a real appetite for this among both local farming families and big businesses. Training local people to maintain and repair the infrastructure will reduce operational costs and bring new, well-paid jobs to remote regions. This work has also demonstrated how the successes of our ground-breaking 5G Rural Dorset project can be replicated across the world.





CASE STUDY:

Catapult R&D creates a unique timing service for OneWeb

The Catapult's specialist team has led innovative work to create a unique timing service for OneWeb's satellite constellations – a first step towards UK sovereign capability in Position Navigation and Timing (PNT).

Background

Secure and resilient UK space-based PNT capability is crucial to unlocking future transformational technologies, such as driverless vehicles, robotic ships and autonomous drones, as well as connected cities that will bring huge social and economic benefits.

Current GNSS (Global Navigation Satellite System) satellites operating in Medium Earth Orbit are equipped with a series of highly precise atomic clocks that give time accurate to billionths of a second and position accurate to a few metres. Being able to verify continuously when events take place is fundamental in contexts such as financial trading, but the prospect of disruption brings the threat of significant economic damage that the London School of Economics has calculated at £1bn a day.

Catapult activities and outputs

OneWeb's Gen-1 satellites operate in Low Earth Orbit, providing much higher power signals than conventional navigation services. The technology developed by the Catapult will allow for both high accuracy and up to 1,000 times greater resilience to jamming and interference. The Catapult has carried out substantial R&D work involving innovative use of mixed LEO/GEO backhaul for 4G and 5G to create a timing solution for the OneWeb PNT system – generating knowledge and understanding that did not previously exist. Our work has advanced rapidly, taking the solution from TRL (Technology Readiness Level) 1 to TRL 3 in record time. The OneWeb system is now operating at TRL4 as work continues on ongoing improvements, with a target of full service in 2025.

The rapid advances made by the Catapult PNT Team are moving the UK forward towards establishing the national sovereign independent capability it needs. The country will be able to further develop its advanced manufacturing base, making the most of a highly skilled workforce as equipment and services are deployed to make the most of this unique capability.

The Catapult's work with OneWeb will also contribute to the government's ambition to establish the UK within the first rank of space nations as a world leader in science, research and development.

Access to Space

Positive outcomes from the Virgin Orbit launch in February make it a key turning point for UK spaceport development.



Our IOD-3 spacecraft was among nine lost when a fuel-line blockage stopped the 'Start Me Up' mission's second-stage engine igniting. Nevertheless, our teams proved their technical leadership and ground segment capabilities; our extensive engagement with the Civil Aviation Authority to obtain licences will prove valuable to any organisation seeking to license spacecraft to operate from the UK in the future; and the mission generated 60+ articles and broadcast appearances for the Catapult amid a great deal of positive sentiment. Looking ahead, the launch of our next In-Orbit Demonstration satellite, IOD-6, with Open Cosmos is expected in March 2024.

LEO Development Cluster

Some 18 UK industry and academic organisations have contributed to a proposal for a LEO Development Cluster. This will enable the UK to exploit large-scale industrial opportunities such as space-based solar power, microgravity manufacturing and very large earth observation capabilities that are underpinned by robotic assembly in space. Conversations are ongoing regarding government funding for a Phase A study that could catalyse the creation of new, large-scale UK businesses. Meanwhile we are working with the Welsh Government to develop a model for a National Microgravity Facility near Newport that could become a European reference site, grouping different microgravity testing services and allowing quicker access to space to academics, innovators and entrepreneurs.

In-Orbit Servicing and Manufacture

The In-Orbit Service and Manufacturing (IOSM) facility at Westcott is fully operational with state-of-the-art ability to verify, validate and demonstrate future in-orbit operations – the only UK facility offering this to spacecraft up to 120kg in a representative environment and one of only six of this type in the world. We have welcomed our first commercial clients, carrying out projects at pace through simultaneous engineering and testing including early demonstrations with Airbus with their VISPA robotic arm and others such as GMV and Lunasa conducting spacecraft manoeuvres. The IOSM robotics facility now features one of the world's largest testing and validation facilities for close-proximity operations. We are seeing strong commercial interest from SMEs and industry primes, as well as intense media interest with visits from the US and European space and wider tech sectors.

The BSGN Advanced Materials Accelerator led by the Catapult is stimulating demand for in-orbit R&D and testing platforms in the materials sector, while our Advanced Manufacturing Facility has been used by numerous organisations, most but not all in the space sector. Their interests range from the additive manufacturing of rocket engines, to supporting companies designing docking and capture plates for spacecraft. Our ground segment services continue to support space debris removal, while we have lent our expertise to Amazon Prime's 'Engineering the Future' series for the episode 'The Race to Space'.



Emerging Technology

The Catapult is at the heart of innovation to bolster the UK's critical infrastructure and seek alternative sources of energy.

Our pioneering work to create a timing service for OneWeb's Gen-1 satellite constellations is a first step towards giving the UK sovereign capability for Position Navigation and Timing (PNT).

After making rapid progress, we have secured further funding to continue development of a fully functional demonstrator before moving towards a commercial product. With backing from the ESA/UKSA Sunrise programme we are working on product/service and system performance enhancements, while under Innovate UK's eGrid project we are qualifying the service and demonstrating capability to support a national grid timing solution.

Our expertise is advancing the technology readiness level of Low Earth Orbit PNT systems, services and industrial applications for critical infrastructure, telecoms, power utilities, the finance sector, data centres, broadcast and media. Our subsequent aim is to design and build a new hybrid comms/PNT terminal to work with OneWeb's Gen-2 constellation.

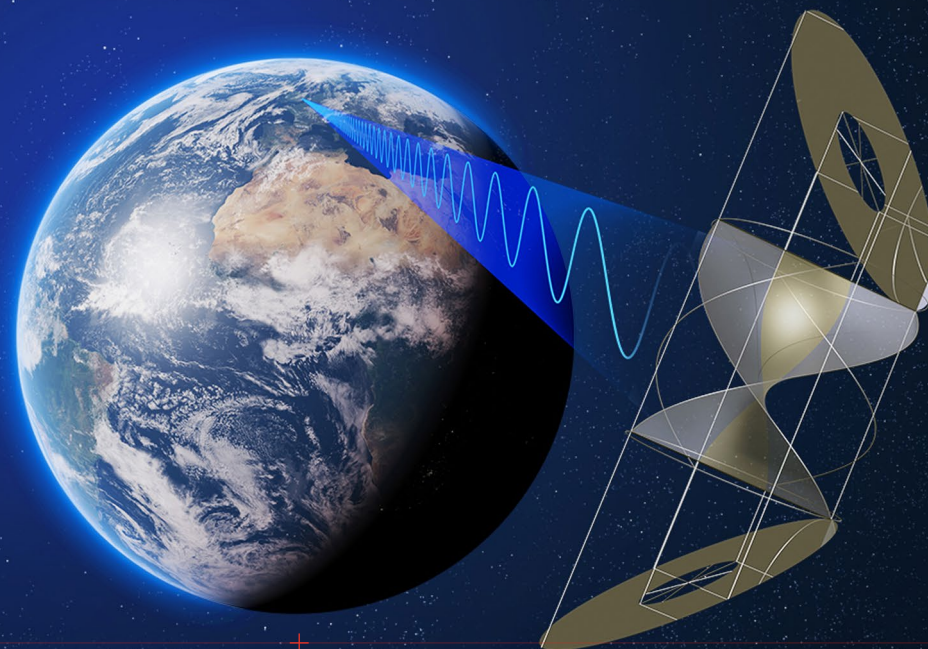
Space-based solar power

We have seen significant uptake from across industry, academia and government in space-based solar power (SBSP), demonstrating a major opportunity to engineer a solution to the carbon crisis and potentially provide UK domestic and global energy security. We have launched a campaign with a 12-year Development Programme to secure £220 million funding to advance the size and scale of on-orbit operations for the UK space sector. This is key activity if we are to realise viable space-based solar within a decade. Space Solar Limited is developing as a commercial business and we have completed an SBSP Enablers project with beneficial outcomes in regulation and robotics. NZIP Lot4 funding will help us advance the concept design of commercial, equitable and sustainable SBSP for baseload electricity, based on the CASSIOPeiA design (pictured above).

Image: CASSIOPeiA design, © Space Solar.

Space Energy Initiative

The Catapult continues to lead and develop the Space Energy Initiative, bringing new members into the group from space and non-space backgrounds. It has grown to more than 80 technical, financial, government and legal organisations and has been held up as an exemplar by NASA and ESA as something they should replicate.





Agri-tech

From space farming to deforestation, the Catapult's expertise is valued worldwide.

Image © Satellite Applications Catapult

Agri Living Lab

The launch of our Agri Living Lab at Westcott, subsequently transformed into our Environmental Space Living Lab in south-west England (see National Capabilities), sparked some deep thinking. We ran a diagnostic session with Agro-Polis, a controlled-environment manufacturer looking to specialise in heritage coffee, which has long-term ambitions of growing food in orbit (lunar or Mars). This raised important questions over the existing test facilities for 'off-world agriculture' and prompted us to reach out to the controlled-environment agriculture/vertical farming community to look into the research, funding and facilities available for those wishing to explore space farming. Constructive discussions have taken place with Space Scotland, Red Planet Farms and the James Hutton Institute for crop research, and funding research is underway.

International collaboration

We are working with colleagues from the Izmir Agricultural Technology Centre in Turkey who are developing an Agri Living Lab and want to draw on the Catapult's experience. They visited Westcott and met nine UK companies developing satellite-enabled agri-tech solutions during a showcase event funded by the FCDO Science and Innovation Network. We are scoping an exciting project called 'The Most Innovative Soy Crop in the World', conducting a methodical deep dive into the production of a crop of soy to assist the Brazilian Agricultural Research Corporation (Embrapa) with a low-carbon initiative. Embrapa has also launched AgNest, its first innovation hub designed on the concept of a living lab to help produce food for a growing population and mitigate climate change. With both countries we expect to create new knowledge, open new markets and investment opportunities, and potentially match UK companies with local partners.

ForestMind

ForestMind demonstrates how satellite imagery can map and thereby reduce and prevent deforestation within global supply chains. Our pilot studies on coffee in Guatemala supported by Union Coffee and, on soy production in Brazil with Sainsbury's allowed, us to test value propositions in the market with a view to commercialisation. We presented ForestMind at GEO Business 2022 to 120 global brands and cutting-edge start-ups. We have also worked with UK government to promote the need for legislation to remove deforestation from UK food supply chains - without it there is a major barrier to commercialising ForestMind. We continue to investigate future avenues for investment and application.

Health and Wellbeing

Healthcare applications of satellites are an important and growing focus area for the Catapult, attracting both space and non-space-based organisations to work with us.



Versatile expertise

The versatility of our expertise is shown by a snapshot of projects we have supported: working with the UK Health Security Agency on geospatial intelligence with its climate change teams; investigating further dimensions of the health sector such as blood, pathology, life sciences, and cell and gene therapy to open new markets and create demand; evaluating digital tools used by NHS Occupational Health teams for NHS Improvement; designing a project with the University of Nottingham on 'Delivering a Net Zero NHS', focusing on how connectivity can improve in-home patient diagnosis using wearables, mobile phone data and AI; contributing to a Virtual Wards NHS Summit with ideas about how space can help provide care in hard-to-reach areas.

At Westcott Expo we engaged with NHS organisations as well as 30 companies such as Skyports, the UK Atomic Energy Authority and University of Portsmouth, all of which have solutions and ideas that could be absorbed into our ecosystem.

House of Lords success

A highlight of our year was the event we ran at the House of Lords, hosted by Lord Willets and sponsored and supported by Baroness Blackwood. The theme was How Connectivity Addresses Health and Social Care's Biggest Challenges and it brought together influential figures within the health and social care sectors, industry leaders from the space sector, ministers, MPs and peers. More than 200 attendees learned how some of society's most pressing challenges can be addressed through space-enabled technology, driving forward innovation within the NHS. Event chair Lord Willets later visited the Healthy Living Lab at Westcott for a day showcasing the testing facilities and innovation services we offer SMEs. The intention is that he will help lobby funders and policymakers to take advantage of the Catapult's capabilities.

Looking ahead

Our strategy for FY24 is to focus on commercially driven partnerships to fund innovation, commercialisation and adoption. The lack of relevant and impactful public funding calls has led us to pivot to commercial innovation funding such as from the Small Business Research Initiative Healthcare. We have also begun discussions with the Wellcome Trust and are developing proposals for The Kings Fund and BT.

Extractive Industries

It was a proud moment when we attended the opening of the world's first independent tailings monitoring centre in Brazil, proof of our leadership status within this sector.



This landmark event was the culmination of a successful multi-year partnership between the Catapult, the state government of Minas Gerais, the FCDO and a global engineering company. Through our intervention, satellites and space now have a prominent role in the development of tailings monitoring in Brazil. Indeed, work created by the Catapult and UK industry during Phase 1a of the tailings dam project was swiftly accompanied by a legal order for the decommissioning of two Brazilian tailings facilities that are amongst the largest in the world.

This flagship programme has created interest worldwide and has expanded further. It again involves the Catapult leading UK expertise from industry and academia to increase the number of tailings dams under monitoring and the types of space-enabled analysis being conducted. We have begun work on Phase 2 to integrate satellite capability into the new tailings monitoring centre in tandem with the engineers. This will directly embed UK capability in tailings monitoring solutions on an international scale.

Investor summit

The Catapult was invited to an investor summit on mining hosted by the London Stock Exchange and convened by the Church of England Pensions Board and the Swedish Public Pension Fund (with £19 trillion in Assets Under Management). It was a timely event, taking place on the eve of the fourth anniversary of the Brumadinho disaster in Brazil that killed 270 people and immediately following the collapse of a similar tailings dam in Free State Province, South Africa. Our work has been instrumental in driving safety concerns across the mining industry and was showcased to representatives of the United Nations.

Coal Authority

Following Catapult-led work by the UK space industry to analyse stability and track changes around five disused coal tips in Wales using Synthetic Aperture Radar, we are now progressing into a second phase. This involves validating measurements through on-site geological assessments and proposing the integration of ground technology with remote sensing for comprehensive monitoring and risk reduction. Additionally, we are addressing climate change impacts and economic opportunities by converting coal tips into natural capital assets, utilising satellite data for assessment and monitoring.



Critical minerals

We were delighted to attend the Critical Minerals Association briefing at the Houses of Parliament and hear Baroness Northover's opening address recognise the Catapult's role in driving innovation to tackle the critical minerals global challenge. We are supporting the UK's Critical Minerals Strategy and in combination with industry we provided for the UK's Critical Minerals Intelligence Centre a briefing and in depth report on the opportunities for Satellite technologies to address challenges within the Lithium supply chain. We also welcomed HMRC to Harwell to explore how satellites can incentivise the UK critical minerals supply chain and level the playing field internationally.

Intelligent Transport



We have proved again this year that the Catapult delivers world class applications across the transport sector.

Our dedicated Drone Test and Development Centre (DTDC) has opened at Westcott, offering drone companies a purpose-built, secure environment away from the restrictions of working in a contended aviation area. Funded by the Buckinghamshire LEP, it includes facilities for companies to design, build, test and operate advanced remotely piloted and autonomous aircraft. These include: three large workshops for technical development, a 270-metre runway for horizontal take-off and four dedicated landing pads for vertical or vertical-to-horizontal take-off. There are also multiple flying areas offering real-world flying conditions.

This capability is fundamental to integrating drone aircraft safely into the UK's national airspace, and our launch event to drive potential customers attracted 100 attendees. Ajuno were our first customers, using the facility to work with their Sellafield client in testing the competence of prospective drone companies. Once again we have underlined Westcott's renown as a centre for excellence.

Drone projects

Airspace of the Future, highlighting the Catapult's central role in supporting the UK drone industry to commercialise drone services, is described on the Emerging Technology page. We are also part of the LAUNCHPAD consortium aiming to create a multipoint BVLOS testing and development facility at the DTDC, Oakley airfield and Cranfield airport; our work on MOD-funded drone projects has expanded from last-mile re-supply to human machine teaming, drone swarming and heavy lifting; and presenting at Drone X, Europe's largest drone conference, led to 50 meetings with companies keen to use the DTDC.

Brigital Phase 2

Our Brigital platform continues to interest UK and international customers, monitoring the displacement of bridge infrastructure in real time to pre-empt catastrophic failures and focus remedial action on urgent need. We have had high-level engagement with UK construction companies for commercial use of Brigital on the UK road network – such as monitoring the movement of the Avonmouth Bridge on the M5 – as well as wider plans for multimodal transport research in Wales. In Canada it is being deployed by the Vancouver rail, port and airport authorities as well as on the road network in Ottawa.

We are developing new use cases for Brigital in the energy and utility sectors for pipelines, transmission lines and nuclear plants (following a request from the UK Nuclear Decommissioning Authority). Potential commercial funders include Expleo, a global engineering provider keen to invest in developing this technology and taking it to market worldwide. We also impressed a 26-strong Department for Business Energy and Industrial Strategy policy team with a presentation on how the Catapult is able to support government.



CASE STUDY:

End-to-end mission capability

The Catapult is helping its SME business partners prove they have end-to-end mission capability for UK orbital launches.

Background

Our In-Orbit Demonstration (IOD) programme provides a practical path for entrepreneurs seeking to create commercially successful services using space technology. We have helped build end-to-end UK supply chains with the skills necessary to take a mission from idea to orbit, reducing barriers to entry.

Our IOD-3 programme has supported Horizon Technologies (HTC)'s ambition to create a business based on Signals Intelligence to geolocate ships around the world. HTC's data from orbital sensors could prevent illegal fishing, smuggling, trafficking, piracy and terrorism. The first mission for any organisation carries substantial risks and unknowns, however, and for an SME these can be prohibitive. As a newcomer to the space sector, HTC turned to the Catapult to get its AMBER payload into space.

Catapult activities and outputs

We worked with a wide range of UK organisations to build and manage a complete supply chain for the mission including ground systems, operator licensing and a place on Virgin Orbit's 'Start Me Up' launch, all delivered on time against a challenging schedule.

Although the launch from Cornwall Spaceport failed to achieve orbit, outcomes from the mission can still be used to build investor confidence for HTC. The company has gained experience, reduced risks associated with its technology development, grown its commercial supplier network and clearly demonstrated an ability to prepare a spacecraft for launch. Potential investors can see that HTC has a real product and the ability to bring it to the launchpad. While the first Amber spacecraft took several years to prepare, HTC can prepare future spacecraft in substantially less time. This is the result of increased technology maturity, stronger commercial networks, greater understanding and re-use of materials from IOD-3.

Defence and Security

This year, the new Defence and Security (D&S) team at the Catapult has established itself as a neutral, unbiased, technical entity able to give even-handed assessment of industrial and academic capabilities. The Catapult helps the HMG D&S community to increase its reach and in particular to identify SME activity which can sometimes be harder to detect. The Catapult's thought leadership also contributes to development of new technical propositions to meet D&S needs.

The D&S team at the Catapult supported important work on HMG Highly Assured Capabilities to understanding and reporting on the capacity of the UK industrial base to serve the government's space-related needs. This work, key for the delivery of the Defence Space Strategy and informing policy development, led us to engage with approximately 200 organisations, 60 of them in significant detail. Feedback has been excellent, and this work has led directly to multiple further opportunities to assist HMG.

Galvanising impact

The Catapult is valued because as a part-government funded, not-for-profit, it provides a neutral, trusted, technical customer-friendly role. We have had a galvanising impact, stimulating interest and revitalising contacts between the MOD and multiple companies and academics. Our effectiveness as an enthusiastic interlocutor has also won us a convenor role with a different part of HMG to liaise with industry and locate the pockets of specialist deep tech that needed to support operations.

Deepening contacts

We have deepened contacts with companies new to the defence space area at military-specific conferences (MISO Defence Connect – AI), general defence events (Make UK: Defence) and at local level (a Portsmouth space engagement event). The Catapult's Director of Defence and Security has chaired multiple panels and served as a panellist on upwards of 10 events ranging from Space Comm to RUSI Space Power, Defence in Space and most recently chaired a security-focussed panel at the UK Space Conference in Belfast.

Image: The radar domes of RAF Menwith Hill in north Yorkshire © Satellite Applications Catapult.



Climate, Environmental and Sustainability

A positive year with the Catapult again taking a leading role in work to transition to Net Zero.

The work we have carried out with UKSA's Space4Climate will identify, prioritise and drive the most impactful EO capabilities that can accelerate transition to Net Zero. The project is important in raising the profile of the UK's world-leading climate science and services community. We have explored ways to improve carbon reporting with Tata Consulting and Ordnance Survey through use of blockchain and digital receipts to accurately map global supply chains, which satellites would then review and validate. We have also finalised Pipeline Stimulation Activities in South Africa with a focus on climate resilience and sustainability.

Image: St Helen © Copernicus Sentinel data/esa.

We won three cross-Catapult Net Zero projects – Hii, Energy Efficient Networks and Carbon Accounting – which all contribute to key policy areas for the Government. The Innovate UK-funded Energy Efficient Networks project aims to accelerate Net Zero goals through advanced digital telecommunication infrastructure. The Catapult led the architecture workstream and investigated the demands that next-generation connectivity for emergency services will place on wireless networks and therefore on energy consumption, with a consequent impact on Net Zero targets.

Taking a lead

Our reputation in sustainability led to an invitation to present to the Global Digital Development Forum on the use of EO and geospatial data/analysis in a session entitled 'How technology can mitigate the effects of conflict and climate change' and presented on 'The role of satellite technology to drive climate action and solutions' at the Farnborough Airshow. We presented a thought leadership paper on the economic development of space for the sustainable development of Earth to a high-level team from BEIS, UKSA and the Cabinet Office, and spoke about climate justice to 73 member states at the UN in New York. Showcasing our capabilities at the World Future Energy Summit during Abu Dhabi Sustainability Week proved an ideal platform to engage with stakeholders from renewable energy company Masdar, Abu Dhabi National Oil Company and the UAE Space Agency.



International Development

The war in Ukraine is just one of many international crises where the Catapult can make a difference thanks to our expertise in EO and geospatial data.

This year has seen a significant increase in the Catapult's visibility in the International Development and Humanitarian sector. A key role for the Catapult is to act as a neutral, trusted entity in all our engagements within FCDO to help it develop stronger internal geospatial knowledge and capabilities. Our work on the IMEDA (Independent Monitoring, Evaluation and Data Analysis) programme to improve the effectiveness and targeting of humanitarian aid was graded A+ in an FCDO Annual Review. This experience has led to requests for us to support many organisations providing satellite-enabled geospatial data and services when they bid for FCDO contracts. The outcome should be greater humanitarian impact ahead.

UK suppliers

We have used the Catapult's Geospatial Capabilities Framework to provide an effective and rapid procurement route, ensuring that industry can respond to urgent FCDO requirements. Examples include: DSM (for agriculture and crop land assessment in southern Libya), RMSI (for solar panels in Yemen) and Helyx (for urban land use in Niger). Catapult attended the Humanitarian Networks & Partnership Week in Geneva and met with many organisations, raising the awareness of satellite data for humanitarian applications, engaging with several organisations including UNHCR, the World Health Organisation, IMMAP and crisis-response analysts ACAPS.

Ukraine

The Russian invasion of Ukraine has caused widespread devastation and satellite imagery has an important role to play in assessing the impact. We supported the Royal Agricultural University, Sumy National Agrarian University, hyperspectral satellite operator Pixxel, international consultants ARUP and CEOBS on the use of satellite EO and geospatial data to support the assessment and future cleanup of contaminated agricultural land across Ukraine.

Work is ongoing supporting the FCDO-funded Humanitarian Innovation Hub, where the Catapult has been developing training materials and guidelines on the use of satellite EO and geospatial data, analysis and visualisation for humanitarian professionals.

IOM Armenia

We are working with the UN International Organization for Migration in Armenia to understand the impact climate change will have on migration, and the impacts on other key sectors in country including agriculture and land use.

XCEPT

We offered continued support for the FCDO funded Cross-Border Conflict Evidence, Policy and Trends (XCEPT) research programme. This brings together world-leading experts and local researchers to examine conflict-affected borderlands, how conflicts connect across borders, and the drivers of violent and peaceful behaviour. XCEPT offers actionable research to inform policies and programmes that support peace and the Catapult has been working with researchers such as Chatham House with remote research methods. Analysis has included changes to artisanal gold mining across parts of the Sahel and the changing landscape for pastoralists.

Strategic Facilities

It has been a dynamic year as we have opened new facilities to unleash innovation in the UK space sector.



Westcott Space Business Innovation Park has been operating at almost maximum capacity, delivering on our ambition to become the UK centre for the next generation of propulsion systems, small satellite manufacture, in-orbit servicing and service applications. Our first Westcott Expo attracted 300 guests and a dynamic year has seen the Catapult's pioneering Drone Test and Development Centre, Living Labs and IOSM (In-Orbit Space Manufacturing) facility all become fully operational. They are described in detail elsewhere in this report.



Advanced Manufacturing Facility

Our Advanced Manufacturing Facility located at Westcott is also fully operational and has been actively supporting the development of new projects. With large-scale metal, plastic and composite manufacturing capabilities, this facility gives companies the ability to rapidly validate production approaches for use on Earth and in space. Users have come from the space and non-space sectors, many as a result of Innovate Edge awards: companies including OxLabs, Total Carbide, Nammo and European Astrotech have become key customers. We continue to build a strong relationship with the Digital Manufacturing Centre at Silverstone, increasing technical capabilities in both the space and automotive industries.

The **Westcott Incubator and Accelerator** programme is an exciting new funding opportunity for businesses of various sizes and maturity to use our facilities and expert teams to explore, build and test their innovations.



Comms on the move

Our **Comms-on-the-move, Electronically Steerable Antenna Test (CESAT)** facility is now in development and will provide a unique global resource based at Westcott. It will place the next generation of satcom terminals under full environmental test, simulating movement and vibration for airborne, land vehicular and maritime applications, combined with novel electromagnetic testing to stimulate multiple LEO satellites in a constellation. Using a laboratory environment ensures results can be verified without the expense and complexity of using in-orbit satellites.

We have also installed a **Thermal Vacuum Chamber** in our Zephyr building at Harwell to carry out pre-launch testing on complete satellites under the conditions they will experience in orbit. It can also be used as an Electron Propulsion Chamber to test and qualify in-orbit propulsion systems. Future activities will focus on business development of this facility with propulsion companies.

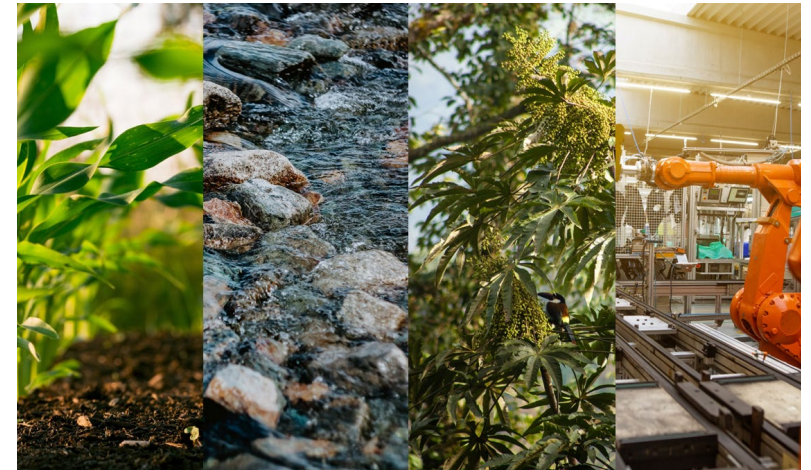
National Capabilities and Clusters

National Capabilities and Clusters is the new name for our Regional Growth Team, reflecting how now is the ideal time to talk about our national capability as a self-sustaining space sector across the whole of the UK, whilst recognising the expertise and facilities at each individual space hub and cluster.

Our Regional Clusters Advisory Board brings together all four nations with those in government who benefit from a growing UK space ecosystem such as UKSA, DSIT and UK Research and Innovation, plus academia and industry. Its purpose is to advise the Catapult and our partners as we work to support localities to realise the potential of UK space sector growth and develop our world class space clusters. The National Capabilities and Clusters team continues to work in close collaboration with UKSA to develop a whole UK Space Ecosystem through the Local Growth Collaboration Programme. One focus was the development of six UK-wide Capabilities propositions to attract inward Foreign Direct Investment: space manufacturing, Earth observation and climate intelligence, connectivity and PNT, space sustainability, spaceflight and habitation, and space science. We were also delighted to see Space East– the space cluster for Norfolk and Suffolk – launch with Catapult support.

Environmental Space Living Lab


The Catapult's Environmental Space Living Lab will offer real-world testing to demonstrate to farmers the benefits of satellite-enabled technologies for sustainable agriculture, animal husbandry and environmental management. Based across three colleges in Devon and Somerset, it will provide mobile 5G technology demonstrators, hubs for co-creating and collaborating, technology to test equipment, visualisation capabilities and remote sensing. It will also build a market for the innovation developed within the Lab. Established with the help of £2 million funding from Heart of the South West LEP, it is expected to generate more than 400 jobs across the region over ten years. Its work will complement the Agri Living Lab at Westcott.



Commercialisation and enterprise

Set up to help businesses commercialise their innovations, the **Space Commercialisation Engine** at Space Park Leicester is thriving. One focus is business development targeting the environmental risk market, including environmental consultancy, insurance, asset management and finance.

The **Space Enterprise Community** is an online platform designed to connect the space sector around the UK. It also highlights space sector opportunities for funding and business support to high-impact, locally led clusters and projects across the UK. By March 2023 it had nearly 1,300 users from 200+ validated, unique organisations with 32 current project/funding opportunities and 29 space sector events listed.



CASE STUDY:

Space Enterprise Labs drive growth in the UK space sector

The Catapult has provided initial funding for 12 Space Enterprise Labs (SELs), creating invaluable physical locations where industry, academia and government can connect, interact and innovate.

Background

The SELs are local places for space innovation fulfilling an objective set out in the National Space Strategy to connect the whole UK Space Ecosystem. They are situated at Harwell and at Westcott, as well as in Daresbury (Liverpool City Region), Edinburgh, Exeter, Glasgow, Leeds, Leicester, NETPark (County Durham), Newport, Newquay (Cornwall) and Portsmouth. They also offer digital resources that facilitate hybrid collaboration such as video conferencing, event streaming and virtual reality demos. With their user-friendly technologies and decentralised locations, it is easy for organisations and individuals working in the space sector to come together to share ideas and work on projects across the UK.

Catapult capabilities and outcomes

The Catapult's contribution was an investment of c. £30,000 per location, which represents the costs to set up and run an SEL for the first year. They fill a void in the space innovation ecosystem – providing a free-to-use physical space to facilitate collaboration and networking. In nine months during 2022-23 the SELs worked with 65 unique organisations (from universities and local authorities to businesses, government departments, banks and research centres) and hosted and/or streamed more than 335 events including writing days, strategy sessions, demonstrations and business engagements.

Achievements include improving the flow of information in the sector, fostering greater collaboration and increasing team productivity. One company only learned of the existence of the Space Commercialisation Engine (see National Capabilities) through an SEL event, while a business whose wider team spread between Colombia, Edinburgh, Stirling, Geneva, York, Glasgow and collaborators in USA was able to use the SEL Edinburgh to facilitate co-working days and strategic planning workshops. Team members scattered across the globe could work together and solve problems.

Plans are underway to work with partners to invest in more SELs in areas where there are gaps in coverage across the UK Space Ecosystem.

International

The Catapult is creating meaningful impact in multiple projects with international organisations.

International Discovery Programme

Our International Discovery Program aims to pinpoint potential collaborative opportunities and assess where UK capabilities can make the most significant impact globally. Through this initiative, we have identified several promising projects across several markets. In South Africa, the Catapult has successfully secured multiyear funding to identify and execute projects and programs fostering collaborations between nations. In Singapore, we have collaborated with the UK Space Agency (UKSA) and the Space South Central cluster to identify areas for mutual Foreign Direct Investment (FDI) and Export.

The outcomes of our efforts in South Africa (Phase 1), India (Phase 2), Singapore, and Australia over the past two years have sparked discussions with the FCDO: Science & Innovation Network regarding trilateral activities with the possibility of Commonwealth expansion. Additionally, we have been exploring potential activities in Australia, New Zealand, North America, Japan, Singapore, Kenya, as well as a number of territories in the Middle East.

Space Capabilities Catalogue

The Space Capabilities Catalogue, acknowledged as a valuable tool across government for providing a realistic, single version, evidence-based representation of the UK space sector, continues to be significantly developed. Firstly, we've introduced an International Dashboard with Australia as our first international ecosystem onboarded by tagging their supply chain. Over 100 attendees joined us at Avalon for a launch event, while a promotional campaign brought an additional 500 users to the platform within a month. Secondly, we're actively mapping two other international space ecosystems. Thirdly, an academic dimension has been added to the catalogue, with data contributions from twenty-two universities. This enhancement facilitates the identification of university partners with specific expertise.

These international views are pivotal in allowing us to identify areas for collaboration, trade, and investment between nations.

Overseas Network

Having hosted 13 delegations at the Catapult, and engaged with UK and Overseas Government on every continent, the International Team has sought to bring further insights to our work to identify strategic markets of interest and to grow relationships with overseas partners from Australia to Colombia, the USA to Oman, Bahrain to France, and many more.

Business Support

The Catapult is fulfilling its mission to help UK businesses innovate for a better world, empowered by space.

The breadth of our impact in supporting UK space sector businesses can be gleaned from a few highlights of our year. One example is how the Catapult undertook market and technical due diligence of a geospatial SME that led to a multi-million pound investment from a large international corporate. This will enable the company to exploit an ESA EO programme to develop a technical solution leading to a commercial product with strong market demand. At a different scale, the Seraphim Space Camp Mission 9 took on a new cohort of seven start-ups, four of which are based in the UK with the remaining three showing some potential for future participation in the UK economy. Our contribution was coaching and critiquing the start-ups, helping them to create an effective and coherent pitch.

New directions

Our expertise can be transformative for businesses, guiding them in new directions for growth. We have supported space logistics company D-Orbit to expand its offering to include satellite in-orbit services and develop a commercialisation strategy; we advised microgravity firm Space Forge to diversify by seeking non-space customers (such as in pharmaceuticals) who can benefit from microgravity to develop, test and ultimately manufacture materials and products in space; we have introduced Agtelligence, a farmer-friendly platform translating EO data and agricultural science into action plans, to specialists in soil science; and we have helped Weardale Lithium source funding to extract lithium and geothermal energy from underground brines in County Durham.



Fawley Digital Twin

We worked with Fawley Waterside to develop a digital twin of its proposed new International Maritime Innovation Centre. The prototype digital mock-up of the architectural plans, together with marketing videos, will help investors visualise the development, inform the business case and secure funding to deliver the centre. This project in partnership with Jacobs is the result of a £750,000 grant from Innovate UK.

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 £20.3m of collaborative and commercial income in the year (2022: £15.5m).

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

| | 2023 | 2022 | 2021 | 2020 |
|-------------------------------------|----------------|----------------|----------------|-----------------|
| | £'000 | £'000 | £'000 | £'000 |
| Innovate UK core grant income | £20,298 | £15,204 | £11,901 | £12,000 |
| Collaborative and commercial income | £10,771 | £15,488 | £11,539 | £11,740 |
| Total income | £31,069 | £30,692 | £23,440 | £23,740 |
| Operating profit / (loss) | £798 | £4,348 | £1,422 | (£1,284) |

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 £217k (2022: £700k). 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:

| | 2023 | 2022 | 2021 | 2020 |
|-----------------------------------|----------------|----------------|----------------|----------------|
| | £'000 | £'000 | £'000 | £'000 |
| Fixed Assets | £15,804 | £14,972 | £10,924 | £10,824 |
| Net current assets | £4,161 | £4,321 | £4,075 | £2,451 |
| Net Assets | £18,647 | £17,581 | £13,380 | £13,274 |
| Total capital and reserves | £18,647 | £17,581 | £13,380 | £13,274 |

