# SPACE HUB
## YORKSHIRE

# Unlocking the Space Sector

Foreword:
Sir Roger Marsh,
OBE DL

**FOREWORD FROM SIR ROGER MARSH OBE DL, CHAIR LEEDS CITY REGION LOCAL ENTERPRISE PARTNERSHIP AND NP11.**

## ACCELERATING ECONOMIC GROWTH THROUGH TECHNOLOGY AND INNOVATION

The Space sector is of course about rockets and astronauts but is also about the opportunity to develop new ideas and products to expand our capabilities in the air, map our geographies, support our health system and build the telecommunications technologies of tomorrow.

There is huge untapped potential in the region to capitalise on our strengths and assets in the Space sector.

By 2030 the UK Space industry is forecast to be worth over £40 billion – driving significant global investment opportunities and international trade. Harnessing the huge potential of the Space sector in the region will drive our attractiveness to future investors, creating jobs and opportunities for local people and help support our post covid recovery.

Our mapping work has identified a strong Space sector across Yorkshire which is high growth, high productivity and has the potential to act as a catalyst to create highly skilled jobs and support a strong and resilient economy.

Equally, if not more, important are the opportunities Space technology can bring in terms of digital transformation for businesses across a range of sectors.

The SHY Growth Strategy is the culmination of an intensive deep dive into the sector and extensive engagement with the sector and senior stakeholders across the region and beyond.

The ambitions of Space Hub Yorkshire (SHY) are rightly ambitious and will accelerate the development of a thriving, resilient and well-connected ecosystem, to ensure the region can capitalise on the opportunities Space brings.

SHY will create new opportunities by harnessing the world-class expertise and talent already in our region as well as inspiring the next generation of young people. With an ecosystem underpinned by world leading universities, with nationally recognised research strengths, we have the talent to fuel this sector.

**This is my call to action for the region, and for local and national stakeholders to get behind this opportunity to leverage our Space assets to launch us to the next level.**

Foreword:
Yorkshire
Universities

**FOREWORD FROM DR PETER O'BRIEN,
EXECUTIVE DIRECTOR,
YORKSHIRE UNIVERSITIES**

## WE CAN BUILD ON OUR RESEARCH AND INNOVATION ASSETS AND CAPABILITIES TO EXPAND THE SPACE SECTOR IN YORKSHIRE AND THE HUMBER

The Prime Minister has set out an ambition for the UK to become a science superpower, and to increase its market share of the global Space sector. Our higher education (HE) sector in this country is world-class, and it is a vital partner with government and business in the development and application of new products and processes in new and emergent industries.

Universities in Yorkshire and the Humber, working in partnership as Yorkshire Universities (YU), have distinct and particular research and innovation (R&I) capabilities and assets that, when harnessed, connected and aligned with industry, are positioning the region as a leading plat-
form to launch the accelerated  development of the UK Space sector.

Working with Space Hub Yorkshire (SHY), YU has mapped R&I activity within the region's universities, and this was instrumental in the development of SHY's local growth strategy. We are now building on this work to bring together academia, government & industry expertise to deliver a local Space cluster for the North of England.

The SHY vision builds on the global Space opportunity by "Unlocking Space for the people & businesses of Yorkshire. Connecting, promoting & guiding innovation. Raising skills, raising aspiration.  Delivering prosperity." A key premise of this strategy is to develop a Virtual Space Campus across Yorkshire's universities. This flagship activity will maximise the visibility of the significant contribution that the region's universities make to the UK Space industry in both knowledge through research, and in skills training through teaching, and inspiration through educational outreach.

In bringing together R&I and teaching and knowledge exchange activities that relate to the Space industry, we can ensure that the region is at the forefront of new technologies and the development of skills and talent to work in a sector that is expected to create significant new employment and business opportunities.

**Yorkshire is famed for its innovation and creativity. Where better to demonstrate  these enduring qualities than by helping to turn the SHY blueprint into reality. The region's universities  are ready to play their part.**

# A Case for Space in Yorkshire

# OUR VISION

## UNLOCKING SPACE
for the people and businesses of Yorkshire

Connecting, Promoting & Guiding **INNOVATION**

Raising **SKILLS**

Raising **ASPIRATION**

Championing **INCLUSION**

Delivering **PROSPERITY**

# GROWING THE ECONOMY

Space-enabled technology and services will underpin **£ 600BN** of growth in UK GDP by 2030, delivering jobs that are **2.6X** more productive than the UK average.

Yorkshire and the Humber can expect Space-enabled technology and services to underpin **£50BN** of regional GDP growth by 2030.

Support to build an active Space cluster could increase Yorkshire and the Humber's share of Space-related GDP by at least another **£500M.**

# GROWING INVESTMENT & EXPORTS

Since 2003 the UK has secured **£339M** of foreign direct investment in **61** Space sector inward investment projects supporting **2,000** high-value jobs.

We must create a destination for Space in our region. Each Space-related FDI project secured in Yorkshire and Humber could be expected to deliver up to **30** high-value jobs.

In 2019 the UK Space industry exported **MORE THAN A THIRD OF ITS OUTPUT** (£5.5bn) in Space sector goods and services, so increasing Space activity will increase exports.

# CREATING HIGH VALUE JOBS

In 2019 **80%** of reported UK Space sector revenue and employment were generated by companies headquartered in London and the South East.

**143** regional Space-relevant Yorkshire and Humber businesses have grown headcounts by **15%** in the last three years – supporting these innovative Space businesses, and helping others to recognise the opportunities of Space can make to their sector could be a major contribution to the levelling up effort.

# HOW TO UNLOCK SPACE?

Space Hub Yorkshire is a single coordinating and convening body for Yorkshire. We will build 3 core functions to structure regional activity, delivering practical and achievable actions based on regional strengths in Earth observation and advanced computer techniques, advanced manufacturing and secure communications. We will deliver three functions:

## AGENCY

**A VIBRANT MATRIX OF CONNECTIONS WORKING TOGETHER TO CREATE A DESTINATION FOR SPACE IN YORKSHIRE.**

## CAMPUS

**A VIRTUAL SPACE CAMPUS ACROSS OUR YORKSHIRE UNIVERSITIES, COLLEGES AND INSTITUTIONS.**

SPACE HUB
YORKSHIRE

## NETWORK

**A FRONT DOOR TO CREATE CONNECTIONS TO ACTORS OF INNOVATION AND FUNDING.**

# Introduction

In November 2020, the University of Leeds and Leeds City Region Local Enterprise Partnership (LCR LEP) secured funding from the UK Space Agency to accelerate the growth of a Space industry cluster in Yorkshire.

Our in-depth study into the space eco-system in the region tells us that:

— Yorkshire has powerful and unique contributions to make to the UK Space industry, particularly regarding commercial applications of satellite data and geospatial intelligence, ubiquitous connectivity and secure communications, and advanced manufacturing and precision engineering capabilities.

— Advances in Space technologies, satellite communications and Space data present major economic growth opportunities in high priority industries across Yorkshire including digital and IT, telecommunications, low carbon and environmental industries, health innovation, agriculture, finance and legal.

— The region's contribution to research and teaching on issues highly relevant to the future Space industry stands out compared to other UK regions, including climate and environmental science, advanced computer techniques, satellite technology, telecommunications and quantum technology.

— There is enormous appetite amongst regional businesses to contribute to the UK's Space industry growth ambitions, leveraging software development, IT and computer science, telecommunications, advanced and additive manufacturing and precision engineering capability and expertise.

— The potential economic opportunity of Space is pro-actively supported by the region's economic development actors.

To effectively leverage Space-enabled economic growth investment is now required to take action under three core functions:

— **CAMPUS:** to maximise the benefit to the UK Space industry of the region's academic institutions by developing a virtual Space campus that utilises the existing resources of the region's schools, colleges and universities. We will contribute world-class knowledge through research, world-class skills through teaching and professional development, and inspiration through world class educational outreach.

— **AGENCY:** Provide an effective and properly resourced coordinating body. Effectively engaging with, influencing, promoting and disseminating opportunities from agencies such as UKSA, ESA, UK Government departments and other UK and non-UK government bodies, including inward investment and export activity.

— **NETWORK:** Provide a platform for information exchange and networking. Enabling the region's business base to make connections, learn from and inspire best practice and build supply chains.

This document sets out our evidence-based ambition for the region – the vision, mission, values and practical actions that will maximise the region's contribution to the UK Space industry, and vice versa.

# Background & Scope

This document provides a comprehensive evidence base that articulates the case for investing in the Space industry in the region and informs the development of a Growth Strategy and Action Plan, including its strategic functions, priority actions, and associated resource requirements.

The evidence-base has been constructed following an in-depth study into the Space eco-system in the region. This involved more than 120 representatives from at least 70 unique organisations spanning industry, academia and policy in Yorkshire and across the UK, including the UK Space Agency, the Satellite Applications, Compound Semiconductor, High Value Manufacturing and Connected Places Catapults, UK Research and Innovation (EPSRC, NERC, STFC), the Knowledge Transfer Network, Innovate UK, Local Authorities and Local Enterprise Partnerships.  This also included the evidence base aims to:

**01** ESTABLISH THE CASE FOR SPACE IN YORKSHIRE

**02** SET THE STRATEGIC DIRECTION FOR THE REGION'S SPACE INDUSTRY, BUILDING ON  EXISTING STRENGTHS

**03** CLEARLY DEFINE SPACE HUB YORKSHIRE'S ROLE AND IDENTIFY MECHANISMS FOR COLLABORATION
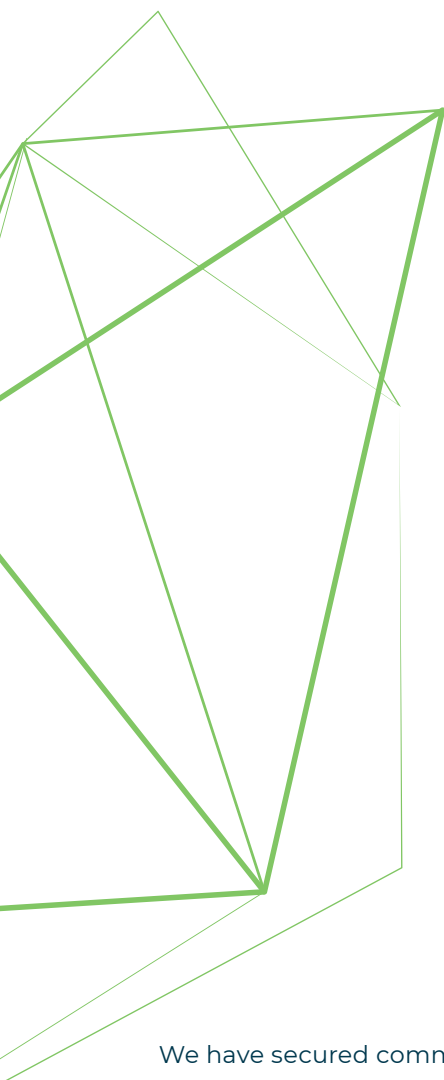
**04** ESTABLISH TANGIBLE ACTIONS THAT WILL ACCELERATE GROWTH OF THE REGION'S SPACE INDUSTRY

**05** IDENTIFY THE CHANNELS THROUGH WHICH SPACE HUB YORKSHIRE WILL CONNECT TO THE WIDER SPACE ECO-SYSTEM IN THE UK AND BEYOND

With funding and support from the UK Space Agency and the Satellite Applications Catapult our eco-system mapping exercise has helped to substantively advance the maturity level of our regional cluster by:

— ALIGNING OUR CAPABILITY, EXPERTISE AND FUTURE PLANS TO RECENT CENTRAL AND LOCAL GOVERNMENT POLICY AND EXISTING NETWORKS **(SECTION 4).**

— DENTIFYING MARKET OPPORTUNITIES **(SECTIONS 4 AND 5)**, AS WELL AS THE BARRIERS, SUPPORTS AND MECHANISMS THROUGH WHICH THESE OPPORTUNITIES CAN BE REALISED **(SECTION 6)**.

— GENERATING ROBUST EVIDENCE OF THE KNOWLEDGE AND INDUSTRIAL ASSETS IN THE REGION **(SECTION 5)**.

— DEVELOPING A CLEAR, DETAILED AND FULLY CONSIDERED FORWARD PLAN FOR ADVANCING SPACE IN THE REGION **(SECTION 6)**.

We have secured commitment and sustained involvement in the Space Hub Yorkshire proposition from all key regional actors including Yorkshire Universities, individual university representatives, industry representatives and regional Local Enterprise Partnerships.

## 3.1 Defining the Region

While the original application for funding was driven by the University of Leeds and Leeds City Region LEP, there are compelling reasons why this initiative should span Yorkshire as a whole. Space Hub Yorkshire will therefore be committed to engaging with businesses, Local Enterprise Partnerships, Local Authorities, and Universities across the region – ensuring that the benefits of growth in the UK Space industry can be felt by all, and that the region's capability and expertise contributes fully to delivering the UK's Space industry ambitions.

# What is the economic case for Space in Yorkshire?

The economics of Space have changed radically in the past 10 to 15 years with the sector evolving into a major commercial industry based on a mix of industrial and consumer markets. The global Space economy is now at a turning point with new 'disruptive' technologies emerging to challenge the existing order. Jobs in the UK Space industry are estimated to be around 2.6 times more productive than the UK average.

This section sets out an economic case for Space driven by national policy and regional industry intelligence and analysis of international inward investment and export markets.

## 4.1 UK Space industry ambition

**The UK Government has set ambitious goals for the UK Space sector and continues to pave the way for future growth via a series of major policy initiatives and funding commitments.**

By 2030 income from the UK Space industry has been forecasted to grow to c.£40bn, supporting wider UK industrial output worth up to £600bn in UK GDP – building on existing UK strengths including connectivity services (£40bn forecast market delivering broadband and 5G for all), Earth information services (£20bn forecast market delivering real-time global awareness, navigation, analytics and security for the advanced data economy), access to Space (£10bn forecast market driven by UK Spaceports and launch capabilities), and in-Space robotics (a nascent but potentially transformative market)[i, ii].

**BY 2030 INCOME FROM THE UK SPACE INDUSTRY HAS BEEN FORECASTED TO GROW TO C.£40BN**

## 4.2 Regional growth opportunities

**With support to leverage Space-enabled opportunities, our academic assets and industry base could be a driving force behind the levelling up agenda.**

The Government's vision of the role that the UK Space industry should play in regional growth is clearly conveyed in the recent Space Sector COVID Support Plan which states:

[THE SPACE SECTOR] IS A KEY ENABLER OF OUR WIDER ECONOMY, UNDERPINNING MANY OF THE SERVICES WE TAKE FOR GRANTED AND INCREASINGLY PIVOTAL TO DEVELOPING SOLUTIONS TO SOME OF THE GREATEST GLOBAL CHALLENGES INCLUDING CLIMATE CHANGE, FUTURE MOBILITY, AND TACKLING COVID-19. ALL PARTS OF THE SPACE ECONOMY OFFER OPPORTUNITIES TO LEVEL UP ACROSS THE WHOLE OF THE UK, STIMULATING NEW CENTRES OF EXCELLENCE AND CREATING HIGHLY SKILLED, HIGH VALUE JOBS.

*Space Sector COVID Support Plan (SSCSP)*

[i] London Economics, 2019 "Size and health of the UK Space Industry 2018". Retrievable from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/774450/LE-SHUKSI_2018-SUMMARY_REPORT-FINAL-Issue4-S2C250119.pdf. Note that a 2020 version of the report is currently being prepare by Know.Space but was not yet available at the time of writing.

[ii] https://www.spacepartnership.org.uk/

In February 2021 the Knowledge Transfer Network (KTN) published data on more than 900 Space sector organisations across the UK showing that Space sector businesses in Yorkshire and the Humber are already drivers of economic growth. Twenty-seven of the companies identified via the KTN mapping exercise are located in Yorkshire and the Humber, and in 2019 they employed almost 1,000 people (+15% since 2017) in high value adding sectors including media and telecommunications, electrical and electronic component manufacturing, precision engineering, software development and information technology, scientific and technical activities, and human health activities.

Yet the scale of the regional economic opportunity presented by Space is much greater – economic benefits are skewed to the south of England (Figure 4.1) and there are many more companies in the region with ambitions to lever Space technology and satellite data to drive economic growth, productivity and prosperity.

Currently, around half of UK Space sector organisations are located in London and the South East and in 2019 these two regions accounted for more than 80% of reported UK Space sector revenue and employment. Between 2017 and 2019 companies active in the Space sector in London and the South East grew revenues by c.£1.5bn and high value employment by more than 9,500.

The SSCSP highlights how local Space cluster development activity will build local capacity, expertise and networks required to scale up and take full advantage of Space as a growth opportunity.

Figure 4.1 KTN Space Sector Landscape Map
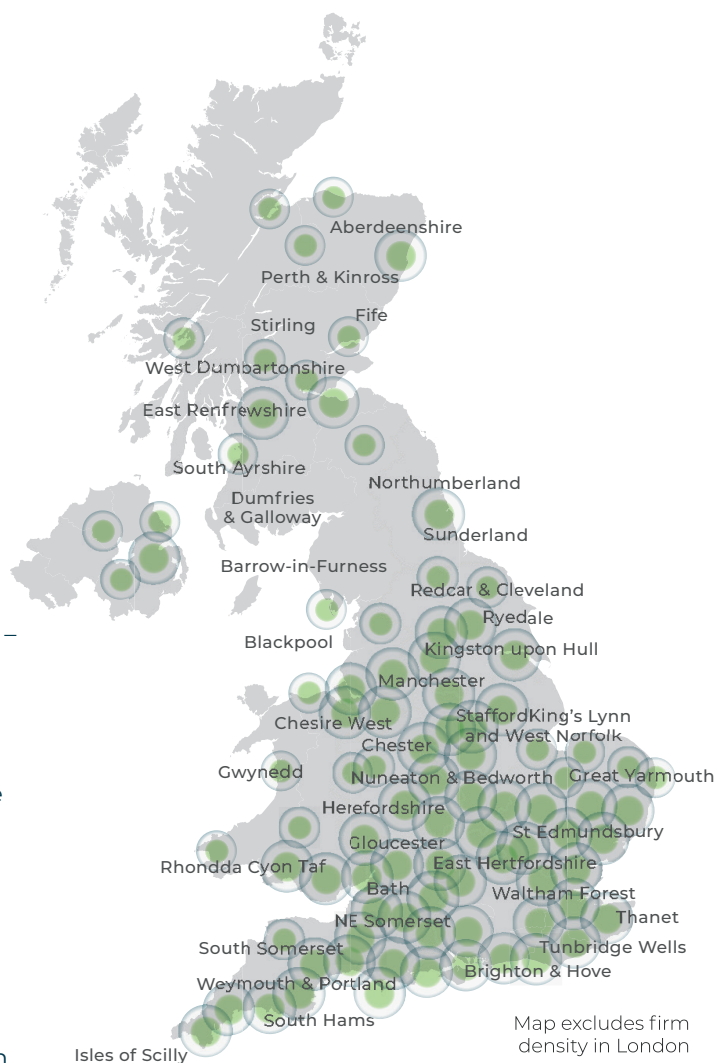


Our research has identified fifty regional academic assets than were identified in the KTN landscape mapping exercise and at least one hundred more Yorkshire companies that can contribute world-class knowledge, research, skills, economic growth and productivity to the UK's Space industry ambitions. **With support to leverage Space-enabled opportunities these academic assets and the region's industry base could be a driving force behind the levelling up agenda.**

## 4.3  Inward investment & exports

**Global opportunities presented by Space technology and satellite data are also rapidly rising. To capitalise on these opportunities the UK needs to secure more Foreign Direct Investment (FDI) and increase Space-related exports.**

Between 2003 and 2021 there have been a total of 61 Space-related inward investment projects in the UK, totalling c.£339m and supporting more than 2,000 jobs. The USA (33), France (11), Sweden (4), Italy (4) and Canada (3) are the top source countries for UK Space FDI projects.)

**Most of FDI projects in the Space sector land in the South East (London included). Within the South East, project density was highest in Oxfordshire (8), Greater London (6) and Hampshire (6). Oxford's Harwell Science and Innovation Campus has attracted most of the large industry players.**

**In Scotland, project density was highest in Fife (4) and Glasgow (3). In the South West, project density was highest in Gloucestershire (2) and  Bristol (2).**

*No projects recorded in Yorkshire.*

After the US, the UK is the second largest global destination market for Space projects. Until the onset of the pandemic Space related UK FDI projects showed a general upward trend since 2013, yet each year only a handful of Space FDI projects have been completed.

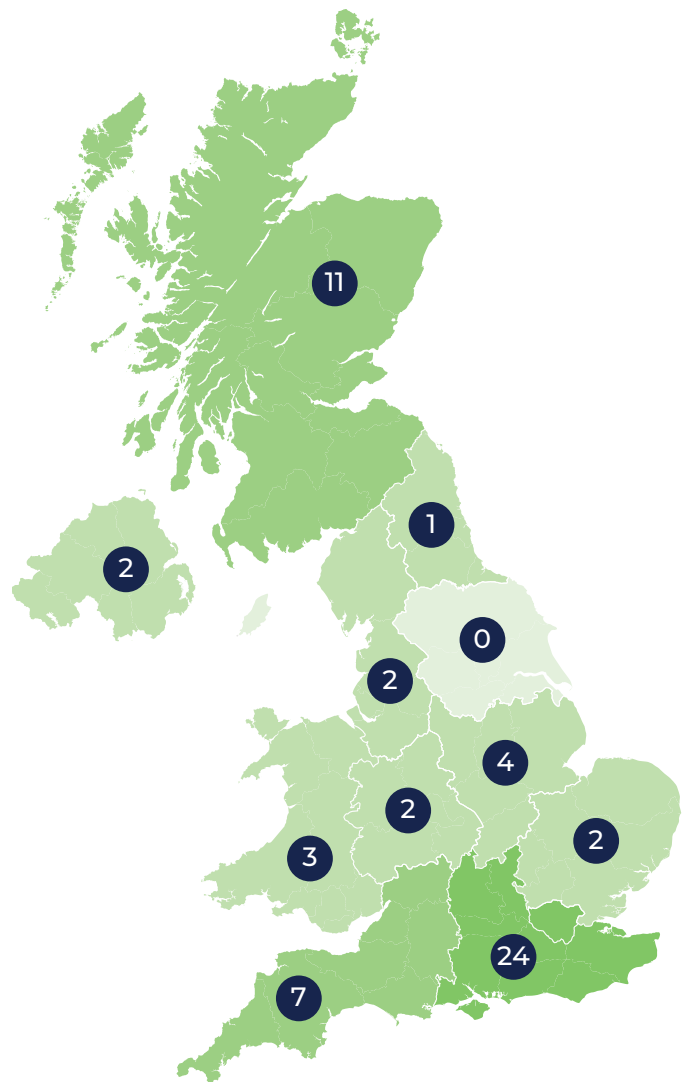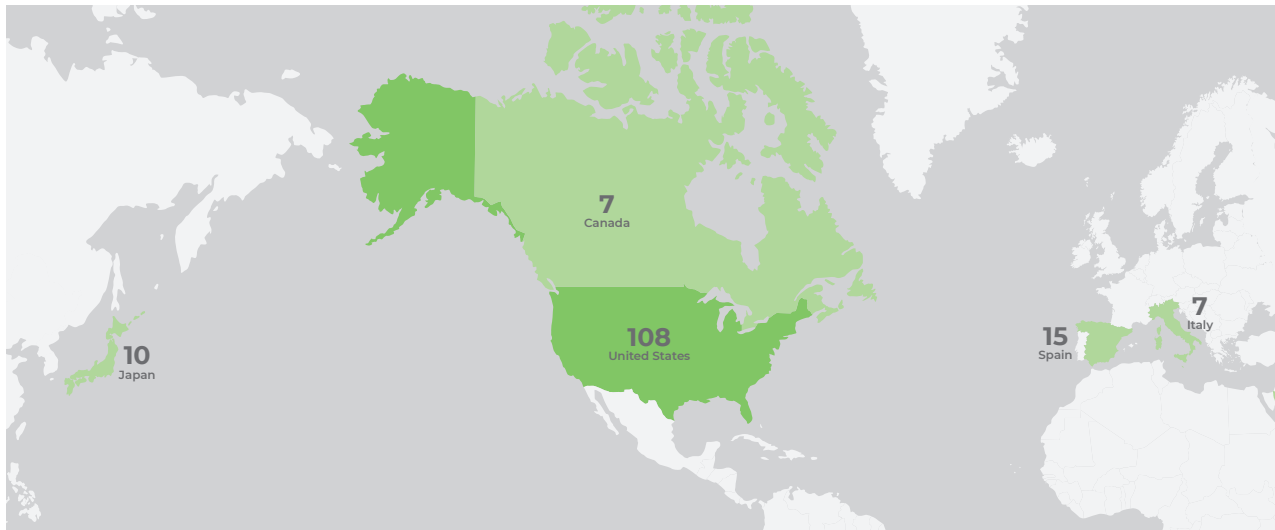Figure 4.2 Space-related Inward Investment by Region

Figure 4.3 Inward Investment Source Markets



*Source: Crunchbase*

Our mapping study identified a number of high priority source markets for active inward investment-targeting based on private and public funding for indigenous companies including the United States, Spain, Israel, Japan, Canada and Italy.

Other potential target FDI markets include Australia, France and Germany who together had 6 companies receiving funding in the same period.

Effectively targeting inward investment can act as a major catalyst for the Space industry in Yorkshire, particularly with respect to the region's advanced and additive manufacturing and precision engineering capability.

UK Space exports reached £5.5bn in 2019 – representing around one third of the Space industry's income. In 2019 France, India, Japan, Germany and Luxemburg were among the largest importers of Space sector products (UN Comtrade Database, April 2021). The region's existing capability and expertise, particularly within satellite data applications and component manufacture (upstream and downstream) therefore also offer sizeable export opportunities. In February 2021 Government announced economic measures that would support a new Virtual Space Sector Export Academy – offering training to UK SME Space businesses with a view to increasing international trade, investment skills and knowledge.

Given the UK's prominence in global Space industry segments such as satellite manufacture, and Government's heightened Space industry growth ambitions there should be significant scope to further internationalise UK Space capability and expertise via targeted inward investment and exports.

**Within this opportunity the scope for Yorkshire is more significant than any other UK region as it offers a wealth of industrial and academic expertise to any future Space-related inward investment projects.**

## 4.4 International investment trends

**The global markets to which Yorkshire companies can contribute are forecast to be worth an estimated $68bn within the next 5 – 6 years.**

Our Growth Strategy will be driven by evidence of the industrial and academic strengths across Yorkshire. Discussed in detail in Section 5, the economic opportunities that underpin our strategy are consistent with trends in international investment across the US and Europe over the past five years, including within geospatial intelligence, satellite data, navigation and positioning, quantum technology and quantum communications, and small satellites and satellite payloads.

### 4.4.1. Investment in geospatial intelligence, satellite data, navigation and positioning

Recent announcements by companies such as Amazon Web Services, Space-X and OneWeb reinforce the potential to deliver economic growth via a forecasted €23bn global Space data services market[iii]. Within the past five years, investors in Europe and the US have backed a wide range of companies involved in generating and using geospatial intelligence and satellite data, for example:

— 100m investment in US firm **Skylo:** to move machine data from sensors to its GEO satellite network (via hardware similar to a rugged mobile hotspot) and back to a data analytics interface. Skylo is now securely delivering to global enterprise and governments, with early deployments across fishing vessels, trains, trucks, tractors and more from the Himalayas to the Indian Ocean.

— €100m for French start-up **Kinesis** in 2020 to build and launch 25 IoT cubesats. Funding came from French maritime and environmental monitoring company CLS, the French Space Agency (CNES) and the French National Institute for Ocean Science (Ifremer). Kinesis now provides satellite enabled IoT solutions across sectors including environmental sciences, maritime, agriculture, infrastructure and transport and logistics.

— $30m in US firm **Satelles** – innovative provider of highly secure satellite-based alternative position navigation and timing services – in 2019 to broaden its partner network and accelerate product development to fulfil rapidly expanding industry and government requirements for secure PNT solutions.

### 4.4.2. Investment in quantum technology and quantum communications

The quantum technology market, including quantum computing, quantum sensing and imaging and quantum communications, is expected to reach $21.6bn by 2025 led by Japan in the Asia Pacific market where compound annual growth rates are predicted to be c.30%[iv]. In the past five years, companies involved in the quantum technology and satellite communications markets across the US, UK and Europe have secured c.$1bn in external fundraising, including companies such as Finnish firm **IQM** (quantum computer hardware, $76m), and US firms **ColdQuanta** (cold atom quantum technology company, $49m), and **Quantum Xchange** (ultra-secure quantum-safe key distribution, $24m).

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[iii] *According to an industry report by Markets and Markets, the global Space data services market is projected to grow by c.$16bn between now and 2025 at an annual growth rate of c.21%.*

[iv] *Globe Newswire*

### 4.4.3. Investment in small satellites & satellite payload markets

Opportunities presented by the global small satellite and satellite payload markets were estimated to be worth c.$17bn in 2019 and expected to grow to c.$24bn by 2027[v]. In the past five years, companies involved in manufacture of Spacecraft systems and instrumentation across the US, UK and Europe have secured c.$1.3bn in external fundraising, including companies such as:

— **Astra** (San Francisco): rocket launch start-up that provides satellite delivery and launch services, including dedicated launch services of 50kg-150kg payloads to 500km SSO reference orbit in 2020 and 2021.

— **Reaction Engines** (Oxford): advanced combined cycle air-breathing rocket engine designed to enable aircraft to operate from standstill on the runway to hypersonic speeds.

— **Isar Aerospace** (Munich): rocket engineering research company developing launch vehicles dedicated to deploying and resupplying satellite constellations and ensuring low-cost Space access for small satellites.

— **Astrocast** (Ecublens): in partnership with the European Space Agency, Airbus, and Thuraya, Astrocast is developing an advanced Nanosatellite network for the Internet of things (IoT). A network of 64 CubeSat satellites in Low Earth Orbit (LEO), Astrocast is the first nanosatellite IoT network addressing market need in remote areas and for urban LPWAN applications needing satellite backup.

OUR GROWTH STRATEGY WILL SEEK TO PROVIDE THE KNOWLEDGE, NETWORKS AND SKILLS THAT ENABLE REGIONAL COMPANIES ACROSS SECTORS TO FULLY UNDERSTAND MARKET OPPORTUNITIES, SHOWCASE EXISTING CAPABILITY AND POSITION THEMSELVES TO LEAD FUTURE INNOVATION AND ECONOMIC GROWTH IN GEOSPATIAL INTELLIGENCE AND SATELLITE DATA, QUANTUM TECHNOLOGY AND FUTURE COMMUNICATIONS INFRASTRUCTURE, AND SATELLITE SYSTEMS AND PAYLOADS.

# $1.3BN

In the past five years, companies involved in manufacture of spacecraft systems and instrumentation across the US, UK and Europe have secured c.$1.3bn in external fundraising

[v] *Markets and Markets Small Satellite and Satellite Payload market forecasts.*

# What is our contribution to the UK Space industry?

There are at least fifty regional academic assets and more than 140 regional companies that can contribute world-class knowledge, research, skills, growth and productivity to the UK's Space industry ambitions.

Our regional capability and expertise is aligned to UK Space industry growth priorities, and we have important and unique contributions to make to both the upstream downstream skill segments of the Space value chain – including within Earth observation and geospatial intelligence, ubiquitous connectivity and future communications, and development of Space systems and payload instrumentation to leverage commercial NewSpace opportunities.

The region has a growing Space cluster, with evident strengths, assets, capabilities and the organising capacity (industrial, academic and public sector leadership) required to make a significant contribution to the growth of the UK Space industry.

Through our eco-system mapping study we have evidenced that, with effective support, Space Hub Yorkshire can deliver all of the components necessary to drive Space cluster development, as summarised in Figure 5.1 below.

Figure 5.1 Space Hub Yorkshire Cluster Development Potential

| Cluster Development Requirement | | Status | Evidence |
|---|---|---|---|
| Spatial Economic Conditions | Demand Conditions | 🟢 | • Extensive engagement in eco-system mapping by academics, policy-makers and businesses. |
| | Cultural Conditions | 🟢 | • Nationally significant further and higher education sector.<br>• Vibrant spin-out and start-up landscape.<br>• Commercial and entrepreneurial business population. |
| Organising Capacity | Vision & Strategy | 🟢 | • Clear vision and detailed strategy developed using UKSA funding |
| | Public Private Networks | 🟠 | • Regional Public Private engagement around Space initiated.<br>• Deeper engagement facilitated via Growth Strategy & Action Plan. |
| | Political Support | 🟠 | • Commitment secured and sustained engagement with regional policy makers. |
| Cluster-Specific Conditions | Scale | 🟠 | • c.100 additional companies identified with known involvement or interest in Space.<br>• c.50 research assets identified as relevant for UK Space. |
| | Presence of Cluster Engines | 🟢 | • Cluster engines identified across industry and academia including within geospatial intelligence, advanced manufacturing and future communications. |
| | Strategic Interaction | 🟠 | • Strategic interaction substantively advanced via eco-system mapping process.<br>• Deeper engagement with national Space leadership facilitated via Growth Strategy & Action Plan. |

🟢 *Meeting Condition*

🟠 *Progress Towards Condition*

## 4.4 Delivering against UK Space sector growth ambitions

We have mapped our industrial and academic capabilities to the strengths and opportunities outlined in numerous recent UK Space sector strategies and policies, and so we know that we can make major contributions to the UK Space industry in four key growth areas, namely:

— **Geospatial intelligence and Earth information** via world leading companies such as SatSense and JBA Risk Management, and expertise in Earth observation, machine vision, urban analytics, and climate science at the University of Leeds.

— **Ubiquitous connectivity and communications** via major UK connectivity providers such as AQL, CityFibre and Commscope, specialist electronics designers and manufacturers such as Saras Technology, Filtronic and Teledyne Defence and Space, and expertise in electronics and communications at the Universities of Bradford, Leeds and York.

— **Data infrastructure, data security and Space surveillance** via companies of strategic significance to some of the UK's most sensitive data infrastructure such as BJSS, Infinity Works and Bailie Group, and expertise in computer science and cyber security across the region's three Russell Group universities and beyond, including at Sheffield Hallam, Leeds Beckett University and the University of Hull.

— **Low cost access to Space** via unique companies such as Arkeik (micro-satellite Space launch platform design) and the region's globally renowned advanced and additive manufacturing and precision engineering industry and expertise in Precision Engineering and Ultra-Precision Technologies at the University of Huddersfield and the University of Sheffield's Advanced Manufacturing Research Centre (AMRC).

## 5.2 Providing capability across the entire Space value chain

The functioning of the developed world has become dependent on Space to provide economic, social and environmental infrastructure. Space industry activity is typically categorised across the overall value chain into upstream (hardware development and launch infrastructure), mid-stream (satellite launch/deployment, operation, and data downlink) and downstream activity (data processing and applications). The Yorkshire region has significant industrial capabilities that are highly relevant to both the upstream and downstream Space segments.

According to recently published KTN data c.70% of Space sector companies in the Yorkshire and Humber region are involved in downstream activity, specifically software development, information technology, telecommunications / wireless telecommunications and broadcasting. Building on the KTN data, our ecosystem mapping study confirmed that we have a major contribution to make within the downstream Space segment. However, our ecosystem mapping research also highlighted strong capability, expertise and appetite among the region's acclaimed advanced manufacturing and precision engineering industry[vi] to better understand and leverage future upstream commercial Space opportunities.

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[vi]  *c.40% of firms with known involvement or interest in space within study data compared to 30% within KTN mapping data.*

## 5.3 Pursuing a clear strategy to drive regional economic growth

Our strategy needs to ensure that we leverage the breadth of capability and expertise that the Yorkshire region has to offer, across both the downstream and upstream Space segments. We will maximise the economic potential of our industrial and academic capabilities by focusing on three high-level economic opportunities, illustrated in Figure 5.2 below and explained in the sub-sections that follow.

THE FUNCTIONING OF THE DEVELOPED WORLD HAS BECOME DEPENDENT ON SPACE TO PROVIDE ECONOMIC, SOCIAL AND ENVIRONMENTAL INFRASTRUCTURE.

Figure 5.2 Space Hub Yorkshire Strategic Economic Focus

UPSTREAM

Development of Spacecraft systems,
payload instrumentation and

Capture, interpretation and value-adding use of Space date

Connectivity, quantum technologies,
optical and electronic engi-

DOWNSTREAM
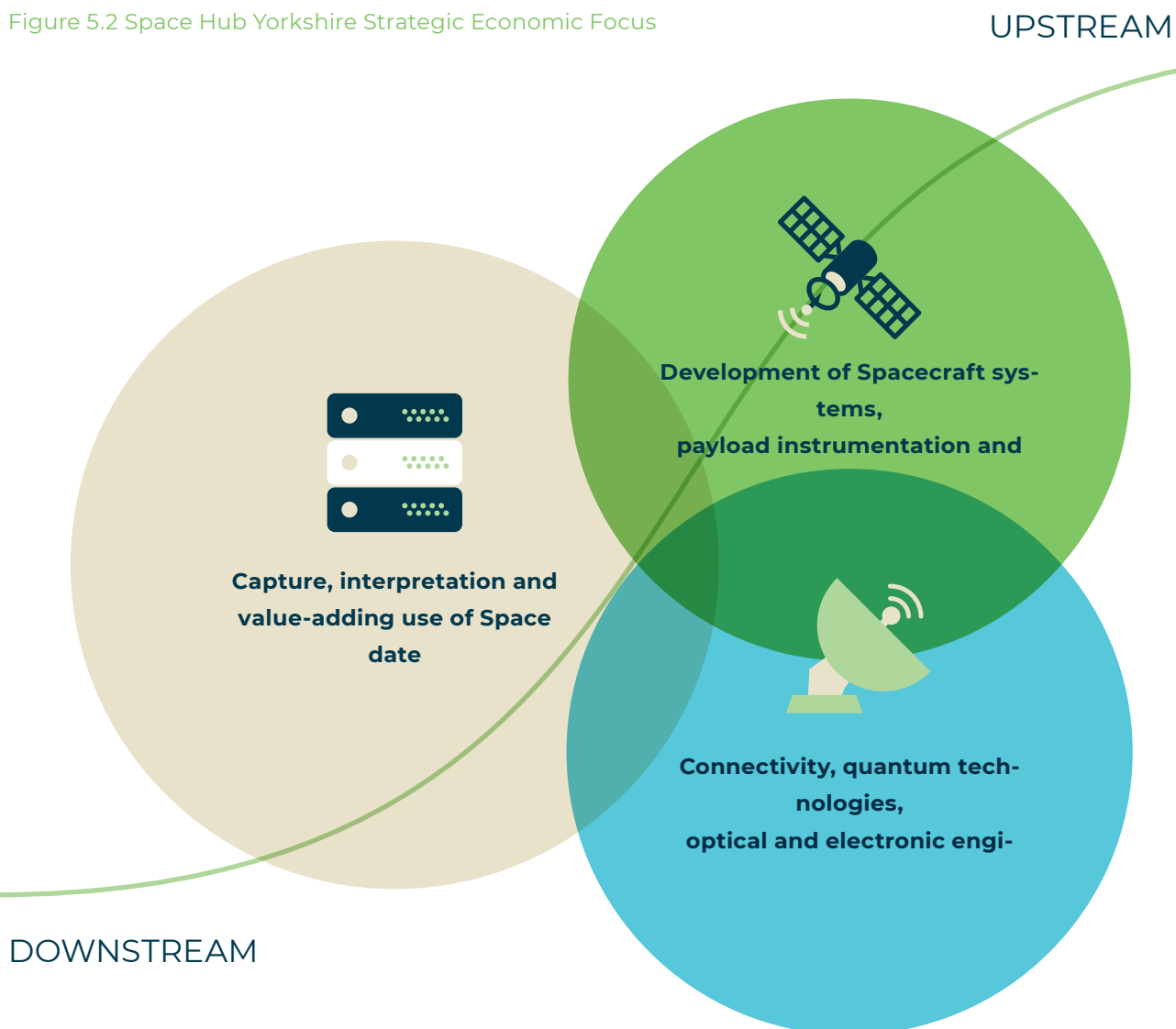
*Source: Space Hub Yorkshire Mapping Study*

### 5.3.1. A catalyst for value adding applications of geospatial intelligence & satellite data

**Yorkshire is home to some of the most innovative companies in the UK and globally when it comes to using machine vision and advanced computer techniques for the commercial exploitation of geospatial intelligence and Space data.**

Our ecosystem mapping study identified at least 45 companies with satellite data and geospatial intelligence capability and expertise. Commercial applications of geospatial intelligence and satellite data across the region are extensive and varied across sectors – from major utility providers to academic digital twin start-ups and everything in between.

| INDUSTRIAL CAPABILITY: extensive and varied applications of satellite data by some of the UK's most innovative companies. | |
|---|---|
| JBA THE FLOOD PEOPLE. | Global leaders in flood risk management, JBA Risk Management provides flood maps, catastrophe models, analytics and consultancy services to organisations (including finance and insurance companies) around the world. JBA was recognised as one of the UK's top 200 mid-market private companies with the fastest-growing international sales as part of the Sunday Times HSBC International Track 200. The companies new Climate Change Analytics are the largest and most comprehensive range of data available for understanding flood risk under a changing climate. |
| satsense High Resolution Ground Stability Data | SatSense provides precise up-to-date deformation monitoring services using data from satellite radar. Founded by leading academics, Professors Andy Hooper and Tim Wright at the University of Leeds, SatSense offers deformation data at a far greater level of accuracy and granularity compared with other data suppliers. Since 2018 the company has secured c.£1.4m in external investment. |

| | |
|---|---|
| **SLINGSHOT** SIMULATIONS | A spin out from the University of Leeds, Slingshot Simulations is pioneering simulation as a service globally. Committed to democratising simulation and digital twin technology to a wide commercial audience, Slingshot Simulations facilitates easier, faster and cheaper simulation solutions driven by automated configuration, deployment, management, and analysis of simulations. The company has recently delivered several projects that visualise satellite data to create large scale digital twins for urban and infrastructure planning. |
| YorkshireWater | Yorkshire Water collects, treats and supplies 1.3bn litres of water on behalf of 5 million customers every day. As a major utility provider the company manages 28,000 hectares of land and invests more than £1m per day to maintain and enhance Yorkshire's network of water pipes, pumps and treatment works[vii]. Using technology developed to look for water on Mars, Yorkshire Water's satellite leak detection pilot delivered a 500,000 litre reduction in Yorkshire Water's daily leakage figure. In recent years the company has invested more than £50m in leakage reduction strategies including satellite data to find and fix around 6,000 leaks per year on its network. |

Within the health sector companies such as Pharmacy 2U, EMIS, TPP, Tunstall and Intechnology see opportunities to use Earth observation, atmospheric and GNSS (Global Navigation Satellite System) data to better understand and address public health challenges, healthcare demand management, health risk and health outcomes capture.

Within the financial sector astronomical data analytics techniques (specifically the ability to derive insights from very limited data which is a focus of a recently appointed Professor in astrophysics at the University of Leeds) and artificial intelligence assisted satellite imagery are being used to provide competitive advantages in commodity trading, for example:

— **URSA Space** – a US-based satellite intelligence company – is using artificial intelligence to scan millions of satellite images and translate them into usable data on commodity supplies.

— **Orbital Insights Inc** – provides access to the world's most accurate global oil inventories data, covering 6 billion barrels of storage, by tracking daily crude oil inventory volumes stored in floating roof oil tanks.

— **McKenzie Intelligence Services** – agreed a renewal of its contract with Lloyd's of London to provide geospatial data intelligence and imagery, demonstrating commitment by one of the world's leading insurance and reinsurance marketplaces to using Space data and geospatial intelligence to improve insurance services and drive innovation.

[vii] *Yorkshire Water Business Plan 2020 – 2025.*

We will use this commercial expertise – showcased and connected via the SHY Space AGENCY and NETWORK – to advance UK capability and drive economic growth around the capture, interpretation and value adding use of Space data. Our commercial expertise will be furthered via collaborative research and knowledge transfer between industry and our leading universities through the SHY Space CAMPUS.

The region's higher education institutions provide deep technical academic capability in machine vision, advanced computer techniques, urban analytics and computer science, and we will apply sector lenses using world-leading knowledge of environmental science, climate finance, renewable energy, health and transportation so that our capability adds value across sectors that are significant both to the region and to the UK.

**ACADEMIC EXPERTISE: Combining deep technical capability and world-leading knowledge to deliver future commercial applications of geospatial intelligence and Space data.**

The region is home to deep technical capability in machine vision and advanced computer techniques at the Universities of Bradford and Leeds, which we will combine with world-leading knowledge to deliver new commercial applications of geospatial intelligence and Space data for economic, societal and environmental benefit.

UNIVERSITY OF BRADFORD
MAKING KNOWLEDGE WORK

The University of Bradford's AI and Visual Computing Research Unit, including the University's Centre for Visual Computing, focusses on the development of novel AI and visual computing solutions for real-world problems. Academics at Bradford have worked with major UK companies and international partners including Croda, QinetiQ, the NHS and NASA. The Centre for Visual Computing is delivering research across sectors including healthcare, security and Space weather applications. A recent £2m philanthropic donation will establish the Bradford-Renduchintala Centre for Space AI to support the commercial exploitation of Space data for regional and national economic growth.

The University of Bradford also leads Bradford's Digital Health Enterprise Zone (DHEZ) – part of a £13m investment in a regional hub for digital health knowledge and innovation, leveraging strong relationships with NHS Clinical Commissioning Groups and Trusts and a growing number of partnerships with the Bradford Institute of Health Research, including the establishment of the Wolfson Centre for Applied Healthcare Research.

| UNIVERSITY of York | The Energy and Environment Institute at the University of Hull brings together leading interdisciplinary academics to tackle global issues surrounding the environmental and societal impacts of climate change. Within the Institute, the Centre for Sustainable Energy Technologies leads nationally significant research into energy efficiency, renewable energy, sustainable heating, energy management and green buildings. <br><br> In March 2021 academic experts that the university began a research project which hopes to develop cutting edge technologies to capture the enormous renewable energy power of the oceans. Funded by the Engineering and Physical Sciences Research Council (EPSRC) the Novel High-Performance Wave Energy Converters (NHP-WEC) project will develop critical control and monitoring systems that make wave energy machines more controllable and reliable. <br><br> The University of Hull is also renowned for expertise in logistics and supply chain management. Established in 2008, the Logistics Institute conducts research into end-to-end global supply chain optimisation, decarbonisation of freight movement and digital supply chains. The Institute created and maintains the Logistics Institute Data Observatory (LIDO) and is developing a user-centred multimodal transport application and services to improve movement of freight across land and sea. |
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| UNIVERSITY OF LEEDS | The University of Leeds is one of thirteen UK universities providing research expertise as part of the Alan Turing Institute – the UK's national institute for data science and artificial intelligence. Within the Institute the University of Leeds is a go to location for urban analytics – developing data science and AI focussed on the process, structure, interactions and evolution of agents, technology and infrastructure within and between cities. Leeds is also home to a nationally leading computer vision and artificial intelligence research group, applying computer vision analytic techniques across multiple sectors including medicine, security, urban data, transport, climate and the environment, and to the Leeds Institute for Data Analytics (LIDA), which brings together applied research groups and data scientists to open up new opportunities for understanding health and human behaviour. University of Leeds expertise in Earth observation and advanced computer techniques is a key strength underpinning our leading role in the Met Office Academic Partnership (MOAP), and the decision to locate the headquarters of UK centres of excellence, such as the National Centre for Atmospheric Science (NCAS) and the Centre for the Observation and Modelling of Earthquakes, Volcanoes and Tectonics (COMET), at Leeds. |

Within the University of Leeds there are also already cross-disciplinary examples of combining advanced computer techniques to climate, environmental science and Earth observation, drawing on world-leading knowledge and skills within:

– **Earth Observation via SENSE** – funded by the Natural Environment Research Council (NERC), UKSA and the Universities of Leeds and Edinburgh the Satellite Data in Environmental Science Centre for Doctoral Training (SENSE) is training 50 PhD students to tackle cross-disciplinary environmental problems by applying state-of-the-art data science methods to complex, multi-format satellite data. Projects are supervised by a consortium of world-leading UK scientists, with topics co-developed with the UK's most innovative spatial data companies;

– **Climate science via the Priestly International Centre for Climate** – one of the University's flagship strategic investments in response to the global climate challenge, the Priestley Centre has more than 170 experts leading climate related research projects across all 7 university faculties;

– **Environmental science via the Yorkshire Integrated Catchment Solutions Programme (iCASP) and the Met Office Academic Partnership** – iCASP is an ambitious and exciting programme that seeks to deliver environmental and economic benefits to Yorkshire and the Humber by applying environmental science to catchment challenges. The University of Leeds is one of just six UK universities involved in the Met Office Academic Partnership which draws together world-class expertise to tackle key challenges in weather and climate science and prediction;

– **Climate Finance** – in February 2021 the Department for Business Energy and Industrial Strategy announced a £10m investment via UK Research and Innovation (UKRI) for new world-class green finance research hubs based in Leeds and London. The new UK Centre for Greening Finance and Investment will provide world-class data and analytics to financial institutions and services such as banks, lenders, investors and insurers around the world to better support environmental and climate conscious decision-making.

By providing access to market intelligence, knowledge transfer, technology briefings and networking opportunities, the Space Hub Yorkshire Space NETWORK will better position the region's innovative geospatial intelligence and satellite data analytics companies to **leverage growth in the forecasted €23bn global Space data services market[viii].**

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[viii] *According to an industry report by Markets and Markets, the global Space data services market is projected to grow by c.$16bn between now and 2025 at an annual growth rate of c.21%.*

### 5.3.2. A test-bed for ubiquitous connectivity & future communications solutions

With new generations of satellites built from 5G architecture, satellite technology will integrate with terrestrial mobile networks to manage connectivity to cars, vessels, airplanes and other IoT devices in remote and rural areas. Our ecosystem mapping study identified at least 20 companies involved in providing connectivity and communications infrastructure products and services.

**The region's connectivity providers and communication electronics manufacturers can play a critical role in the design and delivery of the ground infrastructure required to deliver integrated satellite and terrestrial communications** – offering solutions to existing ubiquitous connectivity challenges and addressing future challenges associated with integrating 5G and satellite communications, and future 6G infrastructure.

Yorkshire is already established as a region at the forefront of connectivity and future communications infrastructure. Leeds City Region has the highest concentration of internet service and telecommunications providers in the UK and has pioneered a vision for low-cost, high speed and ubiquitous connectivity. York was the UK's first gigabit city, it has the fastest download times in the UK, and IXL Leeds was the UK's first mutual internet exchange. The City Region's mixed urban and rural geography makes it an ideal location to test and develop future ubiquitous connectivity solutions.

**INDUSTRIAL CAPABILITY: Bringing together forward thinking connectivity providers and communications engineers to deliver future integrated communications infrastructure.**

AQL is one of the UK's most innovative telecoms operators and a 'hidden enabler' of smart cities. From its headquarters in Salem Chapel in the centre of Leeds, AQL operates a heavily interconnected national communications network spanning multiple UK sites and data centres. AQL is one of the largest inbound DDI providers in the UK and has invested significantly in secure infrastructure to provide reliable delivery of voice solutions. AQL also owns Spaceman – a satellite teleport on the East Coast of the Isle of Man and is an Inmarsat partner.

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| arqiva | Arqiva is a multi-award winning independent teleport operator providing a satellite and fibre network with global coverage, offering real-time business critical communications for voice, video and data, and managed satellite communications for enterprise, including in remote and hostile locations. |
| COMMSCOPE® now meets next | In 2019, CommScope acquired ARRIS (formerly Pace PLC based in Saltaire) creating a communications company equipped to design and deliver networks of the future, from material design to architecture and bandwidth. The company is pushing the boundaries of communications technology to create the world's most advanced networks, offering expertise in copper, fibre, wired and wireless infrastructure. |
| Filtronic | Filtronic develops RF solutions for mission-critical environments and provides design, manufacture and test of high-performance RF devices & sub-systems. Filtronic is supplying products and technologies to leading businesses in mobile telecommunications infrastructure and critical communications markets that will see major deployments in the coming years. Their 'Critical Communications' division includes public safety, defence and aerospace customers and includes emerging applications such as 5G XHaul and high-altitude pseudo satellites. |
| radio design SMARTER WIRELESS | Radio Design brings a collective 500 years of leading-edge RF design, development and volume-manufacturing experience for OEMs, operators and infrastructure companies. The company is a multi-award winning technology leader in infrastructure-sharing RF solutions, with an international footprint in Finland and India, enabling many of the world's largest network operators to achieve maximum data throughput and capacity for their cell sites. |

With ever increasing threats to cyber security, ensuring that future communications networks and infrastructure are secure will be critical within both the civilian and defence Space segments. A March 2021 report by the UK's Quantum Communications Hub and the National Cyber Security Centre (NCSC) recognised a need to consider the role for quantum technologies within 6G, 7G and conventional satellite communications.

**INDUSTRIAL CAPABILITY: While quantum technologies for secure communication remains a niche area, quantum technology expertise in Yorkshire, together with existing connectivity and telecommunications capability positions the region as a location for end-to-end testing and demonstration of quantum technologies for secure satellite communications.**

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| **ADVA** Optical Networking | ADVA Optical Networking is a world leader in the design and manufacture of telecommunications equipment. In 2018 the company achieved a world first by transporting 100Gb of quantum-safe data over a distance of 2,800km demonstrating that ultra-secure encryption is possible over existing operational infrastructure. ADVA is now part of the OpenQKD (Open Quantum Key Distribution) project to help accelerate the adoption of QKD technology globally. |
| AegiQ | AegiQ is securing global communications with quantum light via the design and manufacture of high-performance quantum photonics hardware for communications, imaging and compu ting applications. The University of Sheffield spin-out secured £1.4m in late 2020 to develop secure quantum communications for fibre optic and satellite based applications. AegiQ will join a global pilot project to provide scalable, high-performing semiconductor technology for next generation telecoms. |

With support from the Space Hub Yorkshire Space AGENCY and Space CAMPUS to build knowledge, test and demonstrate quantum technology applications, these companies can heighten the UK's world leading position in quantum technology and can add significant value to the UK Space industry via expertise in quantum-enabled secure satellite communications.

To help leverage the economic opportunities presented by ubiquitous connectivity and future communications infrastructure, the region's academic base will provide skills and research expertise in electronic engineering, communications and quantum technology.

**ACADEMIC EXPERTISE: Offering leading-edge connectivity and communications capability to deliver ubiquitous connectivity and future communications solutions.**

The region is home to a wealth of academic expertise in electronic engineering and communications research via the Universities of Bradford, Leeds and York.

The University of Bradford has considerable expertise in Satellite Communications via its Communications and Networks Research Unit which comprises four research groups with a focus across multiple research themes including: antenna, electromagnetics and radio frequency engineering; mobile, wireless and satellite communications networks and applications; and networking and performance engineering. The Future Ubiquitous Networks research group has particular expertise in aeronautical communications and mobile, wireless and satellite communications networking, with collaborations involving the Fraunhofer Institute for Telecommunications, Inmarsat, Thales Alenia Space and numerous universities across Europe and beyond. The RF and Computational Electromagnetics research group offers measurement and modelling facilities and services, including microwave anechoic chambers, near and far field antenna range testing and a wide range of RF and microwave equipment.

The Institute for Communication and Power Networks at the University of Leeds has a longstanding international reputation for communications, signal processing, control systems and instrumentation research and training. Within the past decade the Institute has seen significant expansion into optical communications and networking and is currently delivering a £6m EPSRC programme grant for energy efficient communication systems and networks. The University leads the Wired Core & Access Networks (WCAN) working group on behalf of the GreenTouch consortium – an international consortium of 55 leading information and communication technology research experts. Via its wireless communications group, the Institute is also conducting research on a range of key technologies for future wireless communication systems including massive MIMO, mmWave communications, Heterogeneous networks, device to device (D2D) communications, and spatial modulation. Industrial collaboration includes BT, Ericsson, Telecom New Zealand, Cisco, Solarflare and Broadcom.

|  | The University of Leeds also has extensive quantum technology expertise through the Theoretical Physics Group. The group's eight leading academics cover topics that range from quantum information processing, quantum optics and quantum field theory, to condensed and soft matter physics and computational biophysics. Members of the theoretical physics group in Leeds also contribute to the efforts of the Oxford Quantum Technology Hub NQIT on Networked Quantum Information Technology and the York Quantum Technology Hub for Quantum Communications Technologies. |
|---|---|
| UNIVERSITY of York | The University of York is home to several highly specialist research groups with deep expertise in Communication Technologies, Quantum Communication, Cognitive Radio and Green Communications. The Communication Technologies Research Group within the University's Department of Electronic Engineering addresses the complementary areas of communication systems, wireless transmission, acoustic and audio signal processing and applied electromagnetics and devices. The Group's work is underpinned by world-class facilities including comprehensively equipped radio communications and electromagnetics labs, a standards-compliant listening Space and three professional recording studios.<br><br>The university hosts the UK Quantum Communications Hub and is closely involved with the Department for Business Energy and Industrial Strategy and the NCSC in delivering future-proof, practical secure communications using quantum secure technologies.<br><br>The York-Zhejiang (YZ) Lab for Cognitive Radio and Green Communications is a joint venture between the University of York and China's Zhejiang University. Capitalising on the research and development work at the two universities, the YZ lab's cognitive radio work deals with delivery of innovative ways to share radio spectrum, particularly through the application of distributed artificial intelligence, enabling radios to learn about their environment. The Lab's work on Green Communications seeks to reduce the amount of energy consumed by wireless devices in both production and day-to-day operation. Most recently academics at the Lab have begun to bring the two fields of research together, investigating whether the concept of Green Cognitive radio can exploit AI to reduce energy consumption. |

### 5.3.3. A vanguard for Space data infrastructure, data security & surveillance

Ever increasing applications of satellite communications and satellite data requires end-to-end IT infrastructure, including data warehousing, processing, IT asset management

and security. **Yorkshire is home to some of the UK's foremost information technology, IT asset management, data analytics and software development firms** – a small sample of which are illustrated below.

| INDUSTRIAL CAPABILITY: Providing data infrastructure and security to the UK's satellite data and Space operations networks. | |
| --- | --- |
| **ARROW ELECTRONICS** | Headquartered in the US with significant UK presence in Harrogate, Arrow Electronics is a Fortune 500 company specialising in distribution and value added services relating to electronic and computer products. The firm provides complete IT solutions from cloud and data intelligence to security and IoT. |
| **Bailie Group** | IT and software engineering firm with extensive experience in public sector IT and digital infrastructure asset mapping, asset protection and data security, including information security and resilience for MoD, secure collaboration zones, monitoring and analysis of satellite feeds and information security user experience. |
| **bjss** | Leeds-based BJSS is a leading technology and engineering consultancy delivering complex, innovative technology and software engineering solutions including building secure IT platforms for Reuters and the NHS. A Microsoft Azure Computer Vision Partner of Recommendation, BJSS has growing capability in image analysis, static and video imagery. |
| **INFINITYWORKS** Part of **Accenture** | Infinity Works is one of the UK's leading digital transformation and software engineering consultancies offering technical IT and software engineering expertise including full stack engineering, cloud architecture and data science, across sectors and in some of the largest technology led projects in government. |

The region's data infrastructure and analytics capability and expertise is also relevant for the UK's Space domain awareness capability – primarily a data issue – particularly when combined with unique Space surveillance assets and expertise such as[ix]:

— RAF Fylingdales in North Yorkshire provides a continuous ballistic missile early warning service to the UK and US governments. It is a key part of the Allied Space Surveillance Network – monitoring objects in Space that can easily resemble incoming missiles when re-entering the atmosphere. Fylingdales also supports the United States' evolving missile defence system. The Unit employs c.350 people, including those in scientific and technical surveillance roles, and offers a source of significant local expertise in Space surveillance.

— RAF Menwith Hill located near Harrogate provides communication and intelligence support services to the United Kingdom and the United States. The site, owned by the MoD but made available to the US National Security Agency, contains an extensive satellite ground station and is a communications intercept and missile warning site. It is an important US overseas base and employs hundreds of highly-skilled staff from the Government Communications Headquarters (GCHQ) in support of satellite communication, surveillance and intelligence capabilities.

Via the SHY Space AGENCY we will bring this unique expertise to bear – providing a user-focused bridge between national defence and commercial Space surveillance and tracking opportunities.

[ix] Note: while Space surveillance may be considered within the upstream segment, it has been included here due to the alignment with regional analytics capabilities.

THE REGION'S FURTHER AND HIGHER EDUCATION INSTITUTIONS WILL PROVIDE THE KNOWLEDGE, SKILLS AND EXPERTISE NECESSARY TO DELIVER FUTURE IT INFRASTRUCTURE AND CYBER SECURITY PRODUCTS AND SERVICES TO THE UK'S SPACE OPERATIONS AND SATELLITE DATA INFRASTRUCTURE.

**ACADEMIC EXPERTISE: Providing the knowledge and talent necessary to protect the UK's Space operations and satellite data infrastructure.**

Recent studies by DCMS suggest that there are around 2,400 talented people working within the cyber security sector in the region, and an estimated 6,500 people working in wider cyber related roles. The region is home to a wealth of academic expertise in electronic engineering and communications research. In 2019/20 the region's Universities enrolled approximately 4,500 students in computer science subjects, and many also have highly relevant research capability.

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| *University of* **HUDDERSFIELD** Inspiring global professionals | The Centre for Cyber Security at the University of Huddersfield conducts research driven by end-user needs, with a common theme of artificial intelligence and machine learning to provide technologies that can deliver security and efficiency improvements to end-users via, for example, development of novel methods to autonomously detect security vulnerabilities using unsupervised machine learning, new mechanisms for anomaly detection based on statistical analysis techniques, mechanisms to extract, store and analyse key security action knowledge, or research regarding digital forensic investigations in complex computing environments. |
| LBU | The Cybercrime and Security Innovation Centre at Leeds Beckett University provides a collaborative hub for research and development related to cybercrime, digital security, forensics and safety. The centre has a close working relationships with West Yorkshire's Digital Forensics Unit and Cyber Crime Team, including in respect of large scale collaborations designed to develop an evidence-based approach to digital forensic investigations.<br><br>The Centre also has a focus on providing innovative, state-of-the-art teaching facilities and methods, including its 'Hacktivity' cyber security labs, which offer technical solutions for running hacking challenges and delivering realistic security assessment exercises. |

**Sheffield Hallam University**

The Centre of Excellence in Terrorism, Resilience, Intelligence and Organised Crime Research (CENTRIC) at Sheffield Hallam University is a multi-disciplinary end-user focussed centre of excellence offering expertise across a range of disciplines including situational awareness and open source intelligence, cybercrime and cyberterrorism. CENTRIC is vastly extending its capabilities in gathering and processing open source data for both situational awareness and open source intelligence through the teams' research and technology delivered within and around two EU FP7 projects – delivering data federation, aggregation and analysis capabilities through extensive models of crime and crises all the way to bespoke visualisation techniques. Through two further EU funded programmes, CENTRIC is engaging with stakeholders, including law enforcement, government officials, cyber-security experts and others, to define the future cyber security challenges and issues that should be addressed as a priority by future EU research initiatives.

In 2018 degree apprentices at Sheffield Hallam, in partnership with cyber security experts Satisnet, opened a new Security Operations Centre focussed on helping businesses to defend themselves against cybercrime. As part of the Centre, CyberKombat – a multi-user, multi-machine, multi-lab, cloud-based training environment – provides training regarding real world security techniques. The platform runs tools from leading security companies such as IBM as well as new, innovative detection and protection technologies and the added value of real world labs generating real-life attack and defence scenarios.

**UNIVERSITY of York**

The York Interdisciplinary Centre for Cyber Security brings together expertise across the University of York and internationally to address current and potential cyber security challenges. The Centre has a particular focus on the Internet of Things, blockchain, cryptographic protocols, quantum and post-quantum cryptography, homomorphic machine learning, cyber security mathematics and data analysis for encrypted medical data. Current research projects span responsible data science by design, quantum key distribution, assured and autonomous systems and the safety of deep learning AI techniques (among various others). The Centre delivers two NCSC certified programmes within the Department of Computer Science, including an MSc in Cyber Security and an MEng in Computer Science with Cyber Security.

### 5.3.4. A facilitator of industry-academia collaboration on Space systems & payload instrumentation

Since 2010 the Space industry globally has shifted towards "NewSpace" technology, which focuses on smaller, cheaper hardware and increased accessibility to data for commercial markets. High quality additive manufacturing and precision engineering capability will be central to effectively leveraging these NewSpace opportunities.

Within the upstream Space segment Yorkshire is home to industrial capability and expertise across the NewSpace supply chain including but not limited to; speciality materials, materials testing firms, advanced and additive manufacturing and precision engineering companies, and in-Space electronic component manufacturers.

| INDUSTRIAL CAPABILITY: Supplying the materials, components and commercial manufacturing and precision engineering capability required to leverage future NewSpace opportunities. | |
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| **Speciality Materials**<br>✳ATI | ATI Speciality Materials (Sheffield) is a global specialist in technically advanced speciality materials. The company's nickel and cobalt-based superalloys, titanium-based alloys, and specialty steels have been meeting extreme specifications for Space customers since the dawn of Space travel. |
| **Material Testing**<br>⊙ element | Element's Space simulation testing laboratories (Sheffield) provide materials testing services for the missile, satellite, and Space industries. From electronic components to complete assemblies, Element provides test programs for the United States Department of Defence and NASA. |
| **Additive Manufacturing**<br>WAYLAND ADDITIVE | Wayland Additive (Huddersfield) develops 3D printing machines for use in the aerospace and medical industries. Pursuing commercial metal additive manufacturing opportunities with ESA including 3D printed flexures for mounting micro RF electric thrusters and jointless CubeSat chassis. |
| **Precision Engineering**<br>Reliance Precision Limited | Reliance Precision (Huddersfield) has been active in the Space sector since 2011. Part of the supply chain for the successful 2014 Rosetta science mission, the company now provides a range of gearing products designed specifically for Space. |
| **Electronics**<br>TELEDYNE TECHNOLOGIES Everywhereyoulook | Teledyne Defence & Space (TDS, Shipley) is a global provider of advanced RF and microwave solutions to the defence, Space and commercial sectors worldwide. In June 2016 TDS was awarded a multi-year OneWeb contract to develop and manufacture channelised converters for the satellite constellation. |

Our ecosystem mapping study identified many more examples of unique industrial capability and expertise in speciality materials, materials testing and component manufacture, within companies such as:

— **Amg Alpoco:** Rotherham based AMG Alpoco is a world leader and major producer of air and gas atomized aluminium powders, aluminium alloy powders and aluminium granules. The company holds a unique position within the aerospace and defence industry as a market leader supporting major aerospace and defence programmes globally with gas atomised aluminium powders used in rocket fuel;

— **Schunk Carbon Technology:** based between Bradford and Leeds Schunk is a regular participant in international Space projects and supplied the coatings used on c.15 of the telescopes used on ESA's Gaia Space probe charting a three dimensional map of the Galaxy. Schunk also owns Weiss Technik – a market leader and one of the most innovative manufacturers of environmental simulation systems, including vacuum chambers used to test components for satellites;

— **Teconnex:** Keighley based Teconnex is a world leader in jointing technologies and has a long-standing history of Space industry involvement, responsible for design and manufacture of thruster clamps used on Surrey Satellite Group's NigeriaSat. Teconnex also currently has clamps on the test rig in Berlin for the supersonic combustion program.

— **Arnold Magnetic Technologies:** Headquartered in Sheffield, Arnold Magnetic Technologies is a leading global manufacturer of high performance magnets, magnetic assemblies and precision thin materials, supplying military, aerospace and telecommunications clients with a comprehensive range of high-performance complex magnetic solutions.

— **Schaeffler:** Sheffield based Schaeffler designs and manufactures high-precision special bearing systems and precision components such as super precision spindle bearings for aircraft engines, helicopters and Space applications.

In total **our mapping study identified c.40 businesses in the region with known involvement or interest in the upstream Space segment.** With support from the SHY Space NETWORK and AGENCY to understand supply chain opportunities, technology requirements, and to engage with the wider UK Space industry these companies can leverage opportunities presented by the global small satellite and satellite payload markets – estimated to be worth c.$17bn in 2019 and expected to grow to c.$24bn by 2027[x].

The region's deep manufacturing heritage has given rise to some of the UK's most advanced materials, manufacturing and precision engineering research facilities. Materials innovation has become a regional focus for Yorkshire, driven by the White Rose University Consortium and the N8 Group of world-class universities – including York, Sheffield and Leeds.

Facilities such as the Advanced Manufacturing Research Centre at the University of Sheffield and the Centre for Precision Technologies at the University of Huddersfield have become go- to location for complex solutions to industrial manufacturing and engineering challenges across sectors including rail, aerospace and automotive.

**ACADEMIC EXPERTISE: Providing the knowledge, expertise and facilities required to effectively bring together world-leading manufacturing research and industrial know-how to improve Space systems and payload instrumentation.**

The University of Sheffield's Advanced Manufacturing Research Centre employs approximately 500 highly qualified researchers and engineers to deliver Advanced Manufacturing and Autonomous Systems research for more than 125 industrial partners. Last year composite engineers at the university were praised by Airbus Defence and Space for their work on critical satellite components which 'helped keep the industry moving' during lockdown.

As part of the High Value Manufacturing Catapult, the AMRC has a global reputation for helping companies overcome manufacturing problems and has become a model for collaborative research involving universities, academics and industry. The Centre's manufacturing expertise spans machining, hi-tech assembly and automation, robotics, casting, welding, additive manufacturing, composites manufacturing and structural testing across multiple high value manufacturing sectors including aerospace and Space.

The Centre hosts a dozen nationally significant collaborative research facilities spanning advanced structural testing, castings, composites, design and prototyping, factories of the future, and metal technologies.

The University of Bradford's Polymer Interdisciplinary Research Centre (IRC) is a focal point for UK polymer science & engineering. Supported by EPSRC over its first 11 years, the IRC focuses on advanced materials including soft matter, nanocomposites, biomaterials, with strong UK and International links, and has unique capabilities in the fields of micro and nano featured mouldings which enable the manufacture of new materials and compounds at scales to suit industry. The IRC has an extensive range of polymer processing hardware specifically designed for micro and nano-moulding activities.
The combination of equipment gives the University the flexibility it needs to make a variety of sizes from a range of materials, including engineering thermoplastics, nano-composites, and metal and ceramic powders.

In conjunction with its new Bradford-Renduchintala Centre for Space AI the University will launch an MSc in Space Systems Engineering in September 2022. A dedicated lab Space will be launched to provide students with hands-on experience in Space technologies including UAV and Cubesat technologies.

*University of*
**HUDDERSFIELD**
Inspiring global professionals

The University of Huddersfield has extensive expertise in Materials Science, Precision Engineering and Ultra-Precision Technologies spanning seven schools and more than twelve institutes or groups.

Material research and engineering activity at the University of Huddersfield is spread over seven schools and more than 12 research institutes and groups. The University has invested more than £5m in the development of materials related research and will continue with at least this level of investment over the next five years. More than 150 university members are involved in materials research activity spanning new material synthesis, material modification, process modelling and understanding fundamental processes, materials characterisation and development of material applications across sectors.

In September 2018 the Centre for Electron Microscopy and Materials Analysis (EMMA) and the International Institute for Accelerator Applications (IIAA) combined their expertise to form Huddersfield's Ion Beam Centre. Part of the UK National Ion Beam Centre, the new Huddersfield Centre brings together the fields of innovative particle accelerator development and the use of particle accelerators for probing the properties of materials using world-leading MIAMI and MEIS facilities at the University of Huddersfield.

The Centre for Precision Technologies (CPT) at the University is a centre of excellence for collaborative metrology research, solving real-world manufacturing problems through cutting edge metrology research in precision engineering. The Engineering and Physical Sciences Research Council (EPSRC) has designated the CPT as a National Centre of Excellence in Advanced Metrology, and a £10m grant in 2017 supported creation of Future Manufacturing Research Hub – designed to transform the UK's manufacturing performance by delivering significant improvements in the speed, accuracy and cost of measurement.

In late 2019 CPT researchers formed a new lab at Sci-Tech Daresbury which will focus on the ultra-precision surfaces – particularly optics, including lenses and mirrors – needed for the Science and Technology Facilities Council to deliver its science programme in ground and Space-based astronomy, high power lasers and synchrotrons.

UNIVERSITY of York

The University of York's Centre for High Altitude Platform Applications develops novel uses for high altitude platform infrastructures and is led by a multi-disciplinary team from across the Electronic Engineering, Chemistry and Environment and Geography departments. Specialisms within the centre include wireless communication, atmospheric science research, environmental monitoring and control of smart cities.

The York Plasma Institute brings together plasma scientists across a broad range of areas, with applications to magnetic and inertial confinement fusion, industry and medicine. The Institute is currently researching plasma propulsion in collaboration with the Space Plasma, Power and Propulsion Laboratory (SP3), Australian National University and the Computational Plasma Science and Engineering Group (CPSEG), University of Michigan, and also offer opportunities to work with industry.

The York Robotics Lab is a purpose-built research facility equipped with multiple tracking systems and controllable lighting systems, allowing for the repeatability and accurate analysis of experiment results. Work is ongoing at the centre in varied areas, which include and are not limited to the development of rover technology, knowledge-based self-configuration modular Space robots, and self-repairing robots. Researchers within the lab were also involved in the MOSAR project, which aims to create a new paradigm technology to support sustainable and cost-effective access to Space.

## 5.4 Servicing the UK Space industry's future skills needs

**Yorkshire's 12 universities and 34 regional colleges will be critical in servicing the UK's future Space industry skills requirements and addressing gaps in existing provision.** The region is home to three of the eight Russell Group universities in the North of England and has one of the longest standing histories of structured collaboration via Yorkshire Universities – a unique partnership based on a shared commitment to strengthen the contribution that universities and HEIs make to the region. This structured collaboration has been pivotal in garnering input into our Space ecosystem mapping study and will continue to be a lynchpin for effective regional university engagement.

The UK Space industry expects that an additional 30,000 highly skilled people will need to be trained to support UK Space industry growth ambitions by 2030. Significantly more skilled people will be needed to support growth in parallel 'Space-enabled' markets such as satellite data and geospatial intelligence and ubiquitous connectivity. Further, the 2020 UKSA Space Sector Skills Survey[xi] highlights demand for large numbers of technical skills, and current shortfalls in the supply of skills in both technical and non-technical areas. It points to a lag between content of university courses and industry advances,

lack of resource within small Space businesses to supply internal training, and a shortage of conversion courses that support transfer into the Space industry.

In the past 12 months, businesses involved in Space-related industry sectors posted c.1,200 jobs, approximately one-third of those roles require either system engineers, software engineers, data engineers, data analysts and data scientists[xii]. These skills needs are mirrored in other industries, including within the higher education, IT, public administration, consultancy, finance, and environmental services sectors.

**In 2019/20 the region's universities enrolled significant numbers of students equivalent to just under 10% of the UK student population who will contribute to the future of responsible Space-enabled growth and prosperity** via (for example) climate, geography and environmental science, electronic and electrical engineering, communications and systems engineering, and computer science and information technology. For example, in 2019/20 the region's universities enrolled:

— More than 3,000 students in environmental science related subjects, including approximately 400 in geology, more than 600 in environmental science, and more than 1,000 students in physical geographical sciences;

# THE UK SPACE INDUSTRY EXPECTS THAT AN ADDITIONAL 30,000 HIGHLY SKILLED PEOPLE WILL NEED TO BE TRAINED TO SUPPORT UK SPACE INDUSTRY GROWTH AMBITIONS BY 2030.

[xi]  https://www.gov.uk/government/publications/Space-sector-skills-survey-2020-research-report.

[xiii]  UK wide data based on SIC codes 30.3 | 33.16 | 61.3.

— Almost 9,000 students in engineering related subjects including more than 2,000 students in electronic and electrical engineering, almost 1,000 in aerospace engineering, more than 700 in general and integrated engineering, almost 500 in mechatronics and more than 300 in communications and systems engineering;

— More than 8,000 students in computer science and information technology related subjects including c.4,500 in computer science, almost 800 students in software engineering and software design, almost 800 students in computer programming, artificial intelligence, machine learning and multimedia computing science.

Figure 5.3 Industry Skills Requirements
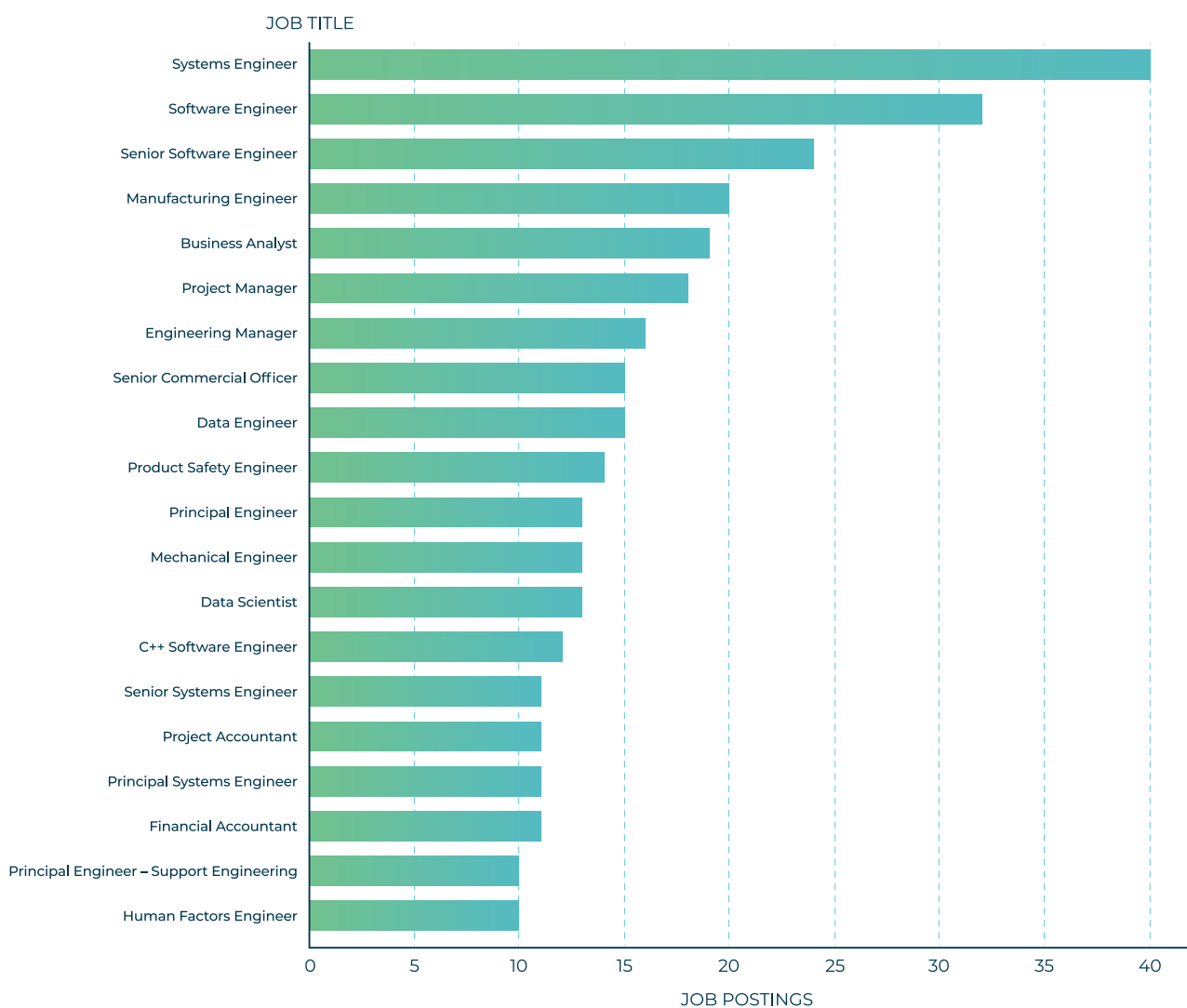


Source: Burning Glass (1,127 jobs posts | last 12 months | top 20 only)

## 5.5 Providing a competitive innovation-driven business environment

The region's research and innovation eco-system includes significant business incubation, start-up and scale-up support. The region has considerable experience and expertise in supporting spin-outs via innovation incubators and accelerators and wider support infrastructure such as Nexus, the 3M Buckley Innovation Centre (3M BIC), York Science Park, Sheffield Innovation Programme, and Bradford DHEZ.

Economic development and policy makers across the region are committed to realising the potential of Space for the region, offering a wide range of sector-agnostic supports for businesses in the region via Local Enterprise Partnerships, Combined and Local Authorities, including via initiatives such as Yorkshire Business, York and North Yorkshire Growth Hub, and regional Chambers of Commerce.

**YORKSHIRE IS HOME TO 14% OF ENGLAND'S ACADEMIC SPIN-OUTS OUTSIDE OF LONDON AND THE GOLDEN TRIANGLE REPRESENTING ALMOST 40% OF ACADEMIC SPIN-OUTS ACROSS NP11. THREE YORKSHIRE UNIVERSITIES ARE IN THE TOP 10 GENERATORS OF INCOME FROM INTELLECTUAL PROPERTY IN ENGLAND, AND YORKSHIRE IS ONE OF THE MOST SUCCESSFUL REGIONS AT CREATING SPIN-OFFS – HOME TO 16% OF SPIN-OFFS IN ENGLAND – A HIGHER PROPORTION THAN BOTH THE SOUTH EAST AND THE SOUTH WEST.**

## 5.6 Delivering wider environmental & societal benefits

The region's industry base and universities are also well placed to make effective use of satellite data and Space technologies to deliver wider climate, environmental and societal benefits. There are already several examples of the application of geospatial intelligence and satellite data for societal and environmental benefit in the region such as.

— The use of Earth Observation (EO) and atmospheric data for maximising the environmental benefit of the White Rose Forest, or helping to design and monitor climate change regulations and impacts;

— More effectively mitigating flood risk at Kingston-Upon-Hull or making water supply more resilient;

— Better understanding movement of people for accessing healthcare services; and / or

— Building a more comprehensive picture of the environmental impact of traffic flows within urban areas;

# A growth strategy for unlocking the Space sector in Yorkshire

Here we summarise findings from our detailed eco-system mapping study before outlining our proposed approach to supporting the UK Space sector using industrial capability and academic expertise across Yorkshire. It puts forward a series of actions with indicative timeframes and estimated resource requirements that will drive forward our ambitions for the Space industry in the region, the UK and globally.

Our research has evidenced boundless enthusiasm among industry, academia and policy stakeholders to realise these opportunities, yet our research also repeatedly highlighted a series of barriers to growth including (among others):

— A disconnect between the region's industry base and the national decision-making centre for UK Space policy

— Lack of national awareness regarding the contribution that Yorkshire companies can make to the UK Space industry

— Lack of detailed understanding among Yorkshire businesses regarding UK Space supply chain needs and opportunities

— The need for an obvious and permanent 'front door' into the region's universities and commercial Space community

— Regional underrepresentation in the value of research and innovation funding secured in Yorkshire within Space and other sectors

Ultimately our study highlighted a pressing need for a central coordinating function for the Yorkshire region that can help to overcome these barriers – facilitating a thriving regional ecosystem capable of realising the economic opportunities of Space. The remainder of this Section introduces Space Hub Yorkshire – outlining its vision and establishing a tangible set of short and longer-term ambitions and actions.
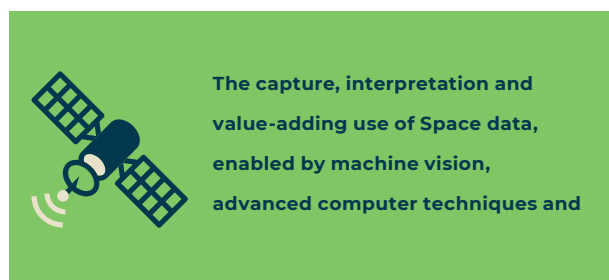
## 6.1 Our vision

### UNLOCKING SPACE
for the people and businesses of Yorkshire

Connecting, Promoting & Guiding **INNOVATION**

Raising **SKILLS**

Raising **ASPIRATION**

Championing **INCLUSION**

Delivering **PROSPERITY**

We aim for Yorkshire to become a user-led champion for Space technology and applications – leveraging existing regional industrial and academic capabilities in Earth observation, advanced computer techniques, advanced manufacturing and precision engineering, quantum technology and telecommunications to develop innovative user-led Space systems and satellite applications. This innovation will be fuelled by a new generation of skilled engineers, computer scientists and software developers, trained by some of the UK's very best further and higher education institutions.

## 6.2 Our strategic economic focus

Bringing together the region's industrial and academic capabilities sets a strategic focus for Space Hub Yorkshire around three core economic opportunities, namely:

The capture, interpretation and value-adding use of Space data, enabled by machine vision, advanced computer techniques and

Connectivity, future communications infrastructure and secure communications, enabled by quantum technologies, electronics,

Development of Spacecraft systems, payload instrumentation and future communications infrastructure enabled by advanced and additive

There are recognised overlaps across the themes – for example, regional capability in advanced manufacturing, electronics and communications are relevant to both Spacecraft systems, payloads and the ground infrastructure required to support future Space communications and satellite operations. Within the Downstream segment where ubiquitous connectivity, data and secure communications meet, Space Hub Yorkshire will also ensure a strong focus on end-users and operational effectiveness.

## 6.3 Our strategic functions, purposes & priority actions

Here we set out the three core functions through which Space Hub Yorkshire activity will be delivered. The three functions have been established based on evidence returned from the mapping study and directly address the barriers to growth set out in the introduction to this Section.

### 6.3.1. Strategic Functions

To effectively leverage Space-enabled opportunities in the region we will invest to take action via three core functions:

— **SHY SPACE CAMPUS:** Maximise the significant contribution that the region's schools, colleges and universities have to make to the UK Space industry – contributing world-class knowledge through research, world-class skills through teaching and professional development, and inspiration through educational outreach.

— **SHY SPACE AGENCY:** Provide an effective and properly resourced coordinating body that effectively engages with, influences, promotes and disseminates opportunities from organisations such as UKSA, the Catapult Network, ESA, MoD, and the wider UK Government and other UK and non-UK government bodies, including inward investment and export activity.

— **SHY SPACE NETWORK:** Provide a platform for information exchange and networking, enabling the region's industry base to make connections, learn from best practice and build supply chains

**6.3.2. Strategic Purpose and Priority Actions**

Based on our consultation with industry we have further defined the SHY role via a set of strategic purpose statements under each core function

Through the **SHY SPACE CAMPUS** we will be:

— **An effective coordinator** of regional Space activity across industry, research, teaching and policy, securing commitment from the region's key stakeholders to tangible and practical mechanisms for ensuring a continued focus on Space-enabled activity.

— **A go-to location** for high-impact research enabled by world-leading scientists and exceptional research facilities.

— **An inspirational** Space skills training environment, enabling current and future Space industry careers.

Through the **SHY SPACE AGENCY** we will be:
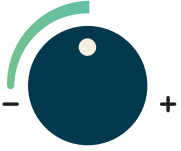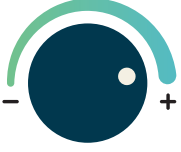
— **A strong and effective advocate** for Space related research and industry opportunities enabled by effective and tangible relationships with UK Space leadership.

— **A champion** for Space start-ups and scale ups and an effective ally to established SMEs and corporates seeking to add value to the UK Space industry.

— **A global leader** on the use of Earth observation and geospatial data for positive climate action, and at the forefront of the global Space climate debate.

— A **pro-active enabler** of inward investment and exports.
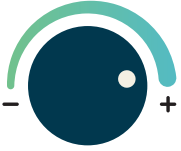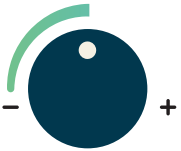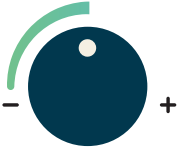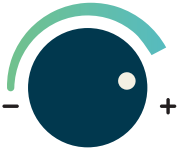
Through the **SHY SPACE NETWORK** we will be:

— **A Space supply chain protagonist**, producing detailed supply chain evidence and market forecasts that help leverage supply chain opportunities for the region's advanced, additive, and electronics manufacturing businesses and precision engineering firms.

— **A catalyst** for new satellite and geospatial data markets by enabling access to and interpretation of satellite and geospatial intelligence at scale.

— **A driving force** behind ubiquitous connectivity and secure communications, offering technical research and industry expertise, ground infrastructure component design and manufacturing capability.
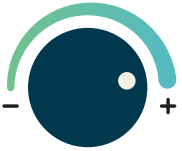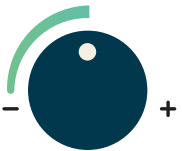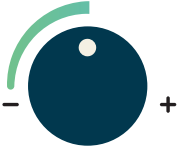
**UNDER EACH CORE FUNCTION WE HAVE DEFINED A SERIES OF SHORT AND LONGER TERM ACTIONS TO BE DELIVERED WITHIN REALISTIC TIMESCALES, DETAILED OVERLEAF.**
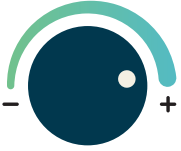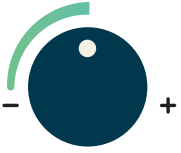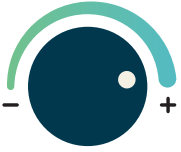
AGENCY

CAMPUS

SPACE HUB
YORKSHIRE

NETWORK

| | Space Hub Yorkshire CAMPUS | | |
|---|---|---|---|
| **ACTIONS** | **STAKEHOLDER SUPPORT** | **TIMEFRAME** | **EASE OF IMPLEMENTATION** |
| C1. Establish the Space Hub Yorkshire Virtual Space Campus.<br><br>By establishing the Space Hub Yorkshire Virtual Space Campus we will provide an obvious 'front door' for access to Space related research, teaching and outreach across the 12 Yorkshire universities.<br><br>Identify a dedicated point of contact for Space related activity (a Space Desk) at each university, resourcing requirements, and an effective, low-burden mechanism for coordinating regional SHY Space Campus activity. | UKSA, Catapults, Yorkshire Universities, regional Universities | **3 MONTHS** from the commencement of our SHY Analyst | **EASY TO IMPLEMENT** |
| C2. Continue our inspirational outreach programme to establish a programme of inspirational outreach activity including regular talks by Space scientists, engineers and entrepreneurs at regional schools and colleges, and secure funding for a 'Space Innovation Fringe' showcasing the economic, societal and environmental value of Space.<br><br>Working closely with the Yorkshire Space and Satellite Centre to complement the development of their outreach programme. | Yorkshire Space and Satellite Centre, regional Schools and Colleges, Local Government Library Services, Yorkshire Universities, regional museums | **3 MONTHS** from the commencement of our SHY Analyst | **HARDER TO IMPLEMENT** |
| C3. Continue and develop our Space Internship Network across Yorkshire region. This will provide students the opportunity to work in paid summer placements supervised by leading academics and innovative Space industry companies. Space industry companies have stated that a) their most talented recruits come through internship pathways, and b) due to recent growth in the Space sector there is increasing demand for talented STEM graduates causing existing job opportunities to remain unfilled.<br><br>Provision of a matchmaking service but with a SHY Internship Fund to part subsidise SMEs and third sector, £4k per 6 weeks internship x 12 per annum | Yorkshire Universities, regional Space industry businesses | **3 MONTHS** from the commencement of our SHY Analyst | **HARDER TO IMPLEMENT** |

| ACTIONS | STAKEHOLDER SUPPORT | TIMEFRAME | EASE OF IMPLEMENTATION |
|---|---|---|---|
| C4. Develop links between Yorkshire Universities and the funders of HE research such as DSTL, EPSRC, and NERC. | Yorkshire Universities | **3 MONTHS** from the commencement of our SHY Analyst | HARDER TO IMPLEMENT |
| C5. Connect Space industry companies to opportunities for vocational skills development in FE colleges such as the new Digital T levels. Promote opportunities on the SHY website. | FE Colleges, regional Space industry businesses | **IMMEDIATE** | HARDER TO IMPLEMENT |
| C6. Develop and publish the Virtual Space Campus Prospectus - a pan-university resource that highlights the major Space-related research, teaching and outreach activity across the region, including (for example) research institutes, undergraduate and postgraduate courses, doctoral training opportunities, conversion courses, internship opportunities, continuous professional development. | Yorkshire Universities and regional colleges | **9 MONTHS** from the commencement of our SHY Analyst | 75% DIFFICULTY |
| C7. Building on the successful RISE programme in Sheffield, design and develop a SHY RISE programme for the region, is a unique business support initiative focussed on enabling small and medium sized enterprises (SMEs) to grow through the employment of graduate talent. RISE is effective in helping SMEs overcome the barriers faced in graduate recruitment and equipping them with the tools and know-how to become successful graduate employers. Since 2013 RISE has supported more than 400 regionally based SMEs successfully recruit over 500 graduates. Many of those businesses have gone on to report increases in turnover, productivity, innovation and growth as a result.<br><br>This programme will allow Space SMEs to benefit from Space related graduate training programmes that is otherwise restricted to larger established graduate employers. | Yorkshire Universities, regional Space industry companies | **6 MONTHS** from the commencement of our SHY Analyst | EASY TO IMPLEMENT |

| Space Hub Yorkshire AGENCY | | | |
|---|---|---|---|
| **ACTIONS** | **STAKEHOLDER SUPPORT** | **TIMEFRAME** | **EASE OF IMPLEMENTATION** |
| A1. Establish the Space Hub Yorkshire Board to include strategic representatives with strong connections to national Space, defence and cyber security leadership. <br><br> Undertake options appraisal to assess the legal entity options for Space Hub Yorkshire, with support from Space Applications Catapult and appropriate legal representatives. <br><br> Continue the UKSA Space Cluster Network meetings. | UKSA, Catapults, DASA, ADS, NCSC, Space Leadership Council, regional LEPs, regional Universities | **3 MONTHS** from the commencement of our SHY Analyst | **HARDER TO IMPLEMENT** |
| A2. Further develop the SHY website to ensure that it fully reflects the ambitions of this emerging strategy and the needs of private, public and third sector stakeholders. <br><br> Take advice from a third party web developer to ensure that the site attracts national and international interest for FDI opportunities etc. | Regional Space industry companies, regional LEPs, Local Government, Yorkshire Universities etc | **IMMEDIATE** | **EASY TO IMPLEMENT** |
| A3. Increase visibility of ESA representation in Yorkshire. | ESA, UKSA, Catapults, DASA, ADS, NCSC, Space Leadership Council, regional LEPs, regional Universities | **3 MONTHS** from the commencement of our SHY Analyst | **EASY TO IMPLEMENT** |
| A4. Build on our initial Inward Investment strategy by working collaboratively with DIT and Local Enterprise Partnerships to identify inward investment targets and high potential export markets within a detailed SHY Space sector investment and export plan. <br><br> Further develop links with overseas Space Programmes including Australia, USA and UAE. <br><br> Develop links Space Sector Export Academy. | Regional LEPs, DIT, overseas agencies, UKSA | **6 MONTHS** from the commencement of our SHY Analyst | **75% DIFFICULTY** |

| ACTIONS | STAKEHOLDER SUPPORT | TIMEFRAME | EASE OF IMPLEMENTATION |
|---|---|---|---|
| A5. Foster collaboration with North West, North East, Space North, national and international stakeholders and other actors. | Regional Space industry companies, universities, public sector stakeholders | **9 MONTHS** from the commencement of our SHY Analyst | **HARDER TO IMPLEMENT** |
| A6. Further develop our information exchange capability by providing a dedicated capacity within universities and Local Enterprise Partnerships to provide a coordinating function for information regarding Space related grants, contracts, funding, skills and opportunities such as those with ESA, UKSA, DASA and promote these on the SHY website. | Regional LEPs, Yorkshire Universities | **3 MONTHS** from the commencement of our SHY Analyst | **EASY TO IMPLEMENT** |
| A7. Working with the Satellite Applications Catapult and the University of Leeds, implement the Space Enterprise Lab in University of Leeds' Nexus innovation hub. This will provide access to resources, virtual demonstrations and Catapult experts and technology dedicated to the Space community in Yorkshire. | Catapult, University of Leeds | **3 MONTHS** from the commencement of our SHY Analyst | **EASY TO IMPLEMENT** |

## Space Hub Yorkshire NETWORK

| ACTIONS | STAKEHOLDER SUPPORT | TIMEFRAME | EASE OF IMPLEMENTATION |
|---|---|---|---|
| N1. Building on a recent Business Sprint pilot with a regional SME, establish the SHY Business Sprint Initiative. Co-funded by the UK Space Agency, Local Enterprise Partnerships and participating businesses, this initiative will adopt the successful model deployed by the Catapult to provide intensive support to up to 10 Space sector businesses each year to test the feasibility of new space enabled products and services, develop commercial strategies, establish clear routes to market and (where relevant) prepare for external investment.<br><br>Funding provided by UKSA, regional LEPs and participating businesses. | UKSA, Catapult, regional Space industry companies | **9 MONTHS** from the commencement of our SHY Analyst | HARDER TO IMPLEMENT |
| N2. Develop and coordinate a larger programme of regular workshops and showcase events that raise the profile of regional space capability including a programme of space technology horizon scanning research studies and technology briefings. | Yorkshire Universities, regional Space industry companies | **3 MONTHS** from the commencement of our SHY Analyst | EASY TO IMPLEMENT |
| N3. Design and develop the Knowledge Exchange for Yorkshire Space (KEYS) Programme - a Research Translation Fund.<br><br>This will bridge the gap between industry and academia through a series of co-designed technology demonstrator projects, subject to funding. We will curate a portfolio of Space academics and their area of expertise, and Space industry and their areas of interest.<br><br>This work package will facilitate the growth of a strong, sustainable and collaborative regional Space industry network, linking up expert researchers and pioneering companies to grow an integrated, data driven, and innovative approach to Space sector growth and development. | Yorkshire Universities, regional Space industry companies | **12 MONTHS** Design to be undertaken inside 3 months from the commencement of our SHY Analyst with programme to start thereafter | HARDER TO IMPLEMENT |