

## The West Midland Space Sector Strengths, Underpinning Assets, and Market

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2021

# The West Midlands space sector strengths, underpinning assets, and market opportunities



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Research Report

March 2021

The University of Birmingham

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## FOREWORD

Regions vary in terms of their current and future potential economic growth rates. This is partly explained by their competitive (dis)advantages, relative to other regions, which change over time. As new opportunities appear in the shape of new markets, emergent industries or growth sectors there are winners and losers.

The collective assets, employee skills, technologies, processes, products and services of local firms, together with local endowments such as infrastructure and skills, underlie both the current level of competitive (dis)advantage and the latent potential for a region to successfully adapt to new opportunities. This combination is unique for every region and underlies regional specialisation. This in turn can either act as a stepping-stone to new areas of specialisation, aligned to new opportunities, or cause path-dependency and an inability to adapt in the face of change.

Looking back in time at the development of the automotive manufacturing industry in the West Midlands, for example, we can see a clear picture of how combinations of private sector investment, a critical mass of engineering skills and university-industry collaborations accumulated over time to create a regional advantage in the R&D, production and exports of automotive technologies and products. Looking forwards to understand how new combinations of existing assets and capabilities might underpin future comparative advantages for the region is much more complex.

To reveal the latent competitive advantages of a regional economy requires an estimation of whether a critical mass of the right assets, technologies, skills, knowledge and expertise are locally present. We also have to understand how easy or difficult it is to recombine and reorient (pivot) these 'ingredients' (factor endowments) towards new kinds of technologies, products and services. Relatedness is important. If the step-change from one set of technologies, products or services to a new set is too big, a cluster of firms will be unable adapt to compete in the new industry.

This is what this study sets out to do. It explores whether a critical mass of the right assets, technologies, skills, knowledge and expertise are present in the West Midlands region and whether these might amount to a latent competitive advantage. There are additional questions about adaptability, or the ease or difficulty of recombining and reorienting these ingredients towards new kinds of technologies, products and services. But this mapping exercise is an important start. We have a deeper understanding of our foundations for attracting further investment and talent to build a new industrial cluster, as part of a wider regional economic growth plan.



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*Director of the West Midlands Regional Economic Development Institute (WM REDI) and City-REDI*

*Professor of International Business and Innovation*

## EXECUTIVE SUMMARY

When one thinks of outer space, there is a tendency to think of rockets and missions to the moon. There is a similar assumption, that the space sector is highly complex, largely unknown and unlike other sectors. This is true in part, given that space is a physical environment unlike any other, which poses distinctive technical challenges and financial risks. However, the production of space hardware and satellite applications is grounded in the economy in the same way as any other sector.

The UK space industry generates an income of £14.8bn annually, with more satellites produced in Scotland than in any European country. In the last decade, space has transformed into one of the UK's fastest growing and most venerable sectors. Trebling in size since 2010, at the last count the UK space industry now employs close to 42,000 people in all corners of the country and generates an income of nearly £15 billion every year. Reduced cost of launch, payload technology developments and increasing demand for data-centric applications are just some of the contributing factors to the rapid commoditisation of space in recent years. The UK will need to continue to grow and develop manufacturing capability and supply chains to support the necessary scaled production of space crafts to support the development of planned future "satellite constellations / mega-constellations", making the UK a hub for launch and access to space. The West Midlands has the potential to contribute to the UK's increasing capability.

The sector includes: (i) manufacturers of launch vehicles, ground systems and satellites; (ii) operators, who control the satellite when in orbit and sell communication bandwidth, position signals or observation data; and (iii) satellite application providers, who supply space-enabled services such as satellite television. These three groups of firms are referred to as 'sub-sectors' or 'segments' of the space sector (London Economics, 2015; Gov.UK, 2014). Launch providers also play a critical role in the global space sector and in the March 2021 'Integrated Review of Security, Defence, Development and Foreign Policy', the UK Government further committed to ensuring the UK has the "ability to launch British satellites from the UK by 2022".

With the increasing number of satellite-enabled applications (economic, environmental, social and defence-related), there is a marked trend towards greater dependence on space-based capabilities by governments, the public and commercial users. This growing dependence means an increased opportunity for new entrants in the global space sector market – including for firms in the West Midlands.

In response to this, the UK Space Agency 'Local Space Sector Cluster and Supply Chain Development' funding was founded to develop the maturity of 'early-stage' local space clusters across the UK. This 'seed corn funding' focussed on stimulating activities to provide evidence and analysis of the local ecosystem in order to progress the maturity of local space clusters, stimulate local advocacy and investment in Space and increase the uptake of space data and technologies. The 2020 funding was awarded to seven locations – including the West Midlands – to ensure space is a priority for regional economic growth and attract commercial investment from space companies to these areas.

Science Minister Amanda Solloway said (November 2020):

*"The UK's space sector has shown incredible resilience to the coronavirus pandemic and will continue to play a key role in our recovery – from creating high-quality jobs to finding unique ways to support our NHS. This funding will arm local leaders up and down the UK with the tools they need to put their local areas at the front of the commercial space race, while refuelling the tank of the UK economy and helping Britain realise it's ambitions as a global space superpower."*

This report outlines the key findings from the West Midlands project. The project has:

- mapped regional space activities in industry, academia and beyond
- developed a vision for how the region could become a major player in space industry – identified the regional specialisms and networking opportunities

- assessed the opportunities for the regional supply chain to join these developments and hence the realise growth potential for the region

There have been four key stages of research, these are:

- Phase 1 – Secondary Data Analysis of Space Sector Firms in the Region
- Phase 2 – Secondary Data Analysis of Underlying Assets in the Region
- Phase 3: Interviews with Key Stakeholders
- Phase 4: Local Space Leadership Group

### *Regional Space Activities in the West Midlands*

In 2018 the West Midlands space industry had a total income of £127m, representing 0.85% of UK turnover, and comprising 74 companies who employed 1,170 people. GDP of regional end-user sectors reliant upon satellite data and services was estimated at 22.51bn.

Utilising Standard Industrial Classification codes (30.3: Manufacture of air and spacecraft and related machinery; 33.16: Repair and maintenance of aircraft and spacecraft and 51.22: Space Transport) identified 85 West Midlands companies (who identify as operating in the space sector), up by 11 (15%) since 2018. Our analysis found that most firms identified as engaging in space manufacturing activities (72%), with smaller shares for space applications (20%) and ancillary services (8%). This is reflective of the strong regional strengths within advanced manufacture. Most companies (>65%) operated across more than one value chain sector.

The West Midlands (early-stage) space cluster does not have a ‘big champion’ or large space OEM (or Prime) that assemble satellites or launch vehicles, instead, there are a number of supply chain companies that manufacture hardware, materials, components and parts. From a total of 85 ‘space related’ companies in the West Midlands. 27 manufacturer a variety of specialist components, such as batteries, cabling, photographic equipment, specialist coating and solid fuel propulsion systems. For example, Hymatic engineering (Honeywell) specialises in “light-weight, reliable, low power, high-performance cryocoolers (e.g. those that cool instruments on satellites)”. These products are typically niche, specialised components and traditionally are not manufactured at high-volume.

These components are engineered to respond to the distinctive challenges posed by the ‘hostile’ outer space environment, intense pressure caused during spacecraft launch and collisions with ‘space junk’. This relies on the use of specialist material, including advanced ceramics. Ceramics provide a combination of hardness, chemical resistance, strength and high temperature operation not found in alternative materials such as metal, alloys and polymers. The UK advanced ceramics industry has a significant cluster in the Midlands, with a clear opportunity to grow. This is confirmed by research undertaken in 2020 by City-REDI and SQW. No other UK region has the equivalent mass of advanced ceramics specialist suppliers, end users and researchers. For example, Precision Ceramics based in Birmingham have designed and manufactured a series of highly technical ceramic components using ‘Shapal’ for the unmanned space-craft Cassini–Huygens sent to the planet Saturn.

There are a further 31 ‘space-related’ precision machining companies in the West Midlands. These companies do not only work in the space sector, but also work across other sectors including: aerospace, automotive, motorsport, energy, defence and nuclear. Many of these precision machining companies were set up to meet the demand of nearby Rolls Royce (based in the East Midlands). They rely on specialist tooling equipment and machines (such as EDM machines and 3D Printers, which are supplied by specialist ‘support’ companies (such as, Laserlines). The equipment and machine suppliers were not captured in our 85 space-related companies and is just one example of how the reach



of this sector is difficult to define and measure. Additionally, we spoke to a sample of West Midlands aerospace companies, who were “interested in learning more about the space sector and their standards and approvals process”, since there is a high degree of overlap between the two sectors.

To estimate the population of businesses that have the potential to diversify (pivot) into the space sector in the West Midlands, we use the concept of relatedness. Relatedness suggests that businesses operating in similar fields perform tasks with greater cognitive proximity. This means that a business is easier to diversify or pivot in an industry that is close to the existing production routines. To identify firms that are able to pivot, we utilised the hierarchical structure of the Standard Industrial Classification (SIC-07) information for the 85 companies we already have confirmed as being part of the space supply chain. To identify what firms may pivot, we assume that companies within the same 3-digit code to the 85 above form a population of companies with the highest potential to pivot. Our analysis suggests that up to 25% of businesses in the West Midlands (64,580 businesses) are in similar industries to the 85 companies we have identified highlighting the significant potential for the development of a space cluster in the region. The figures also show the regional strengths in both manufacturing and business support services with significant populations that could potentially become part of the local space cluster.

20 of the 85 companies identified are ‘downstream’ service providers including business service providers using EO data, data processing, hosting and related services, telecommunications equipment manufacturer and software solutions. These companies are difficult to capture, since most will not define themselves as a space company, but instead a “data” or “software solutions company”. For example, Borwell Ltd “works with data integration and providing software solutions”. Meanwhile, Geospatial Insight “take geospatial data, including satellite. Satellite imagery and we convert that risk intelligence, for the insurance, finance and utilities sector”. Another downstream application company in the West Midlands Energeo, focuses “entirely on the green and clean-tech sector... looking at solving problems using geospatial data combined with other sort of land based datasets or, or remote sensing”. Another, example of a downstream space company is Withers and Roger, an Intellectual Property company, which support companies through early-stage development, educating them on “knowing and securing their rights”. This is an example of an ‘ancillary service’ outlined in the space sector value chain and there are a number of such companies operating in the West Midlands that do not identify as ‘space sector companies’ and therefore were not captured in our analysis.

The 20 space-related West Midlands companies that we interviewed were in agreement that the biggest potential advantage of maturing the West Midlands space cluster for the existing businesses would be “being able to meet the right people and showing them what we can do”. They also saw it as a potential solution to “maintaining and keeping skilled people in the area”. There was excitement and enthusiasm amongst the companies on the potential to create a “mini Harwell in the West Midlands” and better connecting the academic excellence with the industrial base across the region to “establish this area as somewhere known for working on space projects”.

Within the West Midlands, we have identified latent space potential within:

- the upstream sector for space manufacture (materials, components, and assemblies), leveraging our nationally leading aerospace, automotive and rail supply-chains,
- downstream space application sectors, leveraging our specialisms in computer and data sciences, and
- end-user sectors for future mobility (aerospace, automotive, and rail), modern services (business, professional, and financial service sectors), data-driven health and life sciences, and agriculture 4.0

### *Underlying Assets*

The West Midlands Science and Innovation Audit (2017) identified three core strengths of the West Midlands Innovation Ecosystem:

- **A diverse, crosscutting research and innovation base** – comprising 12 universities (many consistently ranked in the top 20 nationally for the quality of their blue sky and applied research), 2 catapult centres (Manufacturing Technology Centre, and Energy Systems Catapult), 11+ science parks, 14+ incubators, and 10+ accelerators (the largest collection in the country)
- **An engine of private sector research and development** – with businesses across the West Midlands investing £2.3bn+ annually in R&D (2016), making up 10% of all UK Business Enterprise expenditure on R&D (BERD) and the 4th highest region in the UK.
- **Home to dense innovation networks and clusters** – of original engineering manufacturers, universities, and firms in strategic sectors. These can be found in: Birmingham, Coventry and Wolverhampton city centres; Edgbaston's life sciences cluster; the area surrounding Birmingham Airport; the automotive and future mobility cluster around Coventry and Warwickshire; Digbeth and Leamington Spa's 'Silicon Spa' cluster of computer game companies; and Malvern's emerging cyber-security cluster.

The collective assets, employee skills, technologies, processes, products and services of local firms, together with local endowments such as infrastructure and skills, underlie both the current level of competitive (dis)advantage and the latent potential for a region to successfully adapt to new opportunities. This combination is unique for every region and underlies regional specialisation. The 'MIT REAP framework' suggests a set of measures that captures the strengths of a specific region and identify its current level of competitive (dis)advantage. These measures are grouped into the following themes:

- **Human capital:** The workforce (from within a region, or attracted into a region) with relevant education, training and experience.
- **Funding:** The availability of public and private sector capital to support innovation and entrepreneurship.
- **Infrastructure:** The physical infrastructure (e.g. land, buildings, transport, connectivity) that is needed to support innovation and entrepreneurship at different stages.
- **Demand:** The level and nature of specialised demand for the outputs of innovation and entrepreneurial capacities supplied by different organisations in the system.
- **Culture and Incentives:** The social norms that shape acceptable career choices and the incentives that shape individual team behaviours.

### *Upstream sector strengths*

A unique strength of the West-Midlands is our manufacturing sector (aerospace, automotive, and rail). The West Midlands is a globally significant sector for advanced manufacturing, assembling a critical mass of globally competitive business and high-tech Small Medium Enterprises (SME's) operating across a range of transport-related sectors, and in particular aerospace, automotive, and rail. Within the region we have strong supply-chains mobilised around key capabilities (such as engines, electromechanical systems etc.). These industries (and in particular aerospace) share close similarities with space and thus demonstrate strong latent space potential.

- Manufacturing represents 16% of regional output (£22.1bn), with >300,000 jobs (10% of the regions work force) across more than 33,000 organisations.
- The Midlands hosts one of the world's major aerospace supply chain clusters, representing ~25% of the UK aerospace industries (7% of Europe's, and 3% of the world's) and >45,000 jobs (and >1200<sup>1</sup> apprenticeships) across 300+ organisations (>160 in the West Midlands). Half of these companies make sophisticated "flying parts," while the remainder make equipment for design, testing and manufacturing, or supply specialist services [Midlands Aerospace Alliance].

<sup>1</sup> Assuming ~25% of total industry apprenticeships

- The West Midlands represents >10% of sector turnover at ~£3.5bn (~£1bn GVA), with >90% exports [MAA].
- Key clusters are those centred around: aircraft engine manufacture at Rolls-Royce in the East Midlands, and electro-mechanical systems for control of aircraft moving parts, located in the West Midlands and organised around Collins Aerospace, Rolls-Royce Control Systems, Meggitt, and Moog.

The 'space manufacturing' sub-sector can be further broken down into a list of 'hardware and materials', 'component and parts', 'assemblies', 'sub-systems' and 'systems' for the manufacturing of satellites (Figure 2) and launch vehicles (Figure 3). These five tiers vary considerably in the degree to which they are specialised and bespoke to space manufacturing. For example, a large proportion of the hardware, materials, components and parts span other advanced manufacturing sectors (such as, automotive, rail, aerospace and medical). Therefore, existing manufacturing businesses in the West Midlands have the potential to diversify and 'pivot' into the space sector. A large proportion of our project growth of the West Midlands space cluster is based on this proposition.

For instance, the aerospace sector has many parallels with the space industry, working to strict and often bespoke specifications, requiring upfront investment with long lead times to a return, requiring extensive quality management testing and documentation, and operating within a complex regulatory and international trading environment. These capabilities and strengths provide a strong basis through which the (West) Midlands can capture a share of the national and global space manufacturing market, and in particular the materials and components (and sub-system) segment(s). These strengths/capabilities are not currently being leveraged, so resulting in lost opportunities. However, whilst many suppliers have the capability to participate within the space manufacturing supply chain, they are deterred from doing so due to their limited awareness of the sector and the opportunities, low production volumes and their bespoke nature, and requirements for strict quality management systems and documentation. Therefore, education and awareness-raising on the potential benefits and market opportunities.

The sector is supported by a **strong university base** offering courses, capabilities, and technology with direct and/or latent upstream space potential:

- 10 of the 12 university in the region offer 228 STEM courses relevant to the upstream space sector with 21,600 enrolments. The West Midlands has the third-highest enrolments for Engineering and Technology
- The majority of universities have strong links to the aerospace sector and advanced manufacturing industry, and vast knowledge and capabilities in these fields
- The larger universities (Birmingham, Warwick, Coventry) have an extensive history of working on upstream space research and close connections with key institutes such as the ESA, UK Space Agency etc.

However, the growth of the upstream space sector in the West Midlands is currently limited by:

- Lack of big company(s) or regional space assets within the West Midlands for supply chains and companies to cluster around and to take a lead (as they do for the aerospace sector).
- Limited available skilled resource trained for space manufacture, and in particular 'shopfloor' technicians/engineers for manufacture and assembly (driven in part by competition with other industries, such as automotive, aerospace etc.).
- Lack of training programmes that specifically address this skill gap for space manufacture (or able to meet anticipated future demand).
- Many companies have limited awareness and understanding of what the space sector is, how it operates, who the key stakeholders are, how to get involved etc. Many also lack understanding of the relevance of their products and services to space.
- Value chains are 'closed' to those already involved and are difficult to enter (due in part to the time, cost, and risk of on-boarding new suppliers) - suppliers find it difficult to raise their profile and 'get a foot in the door'.

- Poor awareness of academic specialisms, capabilities/facilities, and IP/technology leading to under-developed academic and industrial collaboration.

**To facilitate entry and growth of our manufacturing supply-chains within existing and future space value chains we have identified 3 key ‘must-win’ battles:**

- 1) early engagement and collaboration with space primes/OEMs and sub-system manufacturers – to unlock supply-chain opportunities,**
- 2) recognition, mobilisation, and alignment of regional supply-chain capabilities for space manufacture – to mobilise and structure regional capabilities, and**

**step-change enhancement of regional manufacturing offerings and capabilities, meeting existing and future unmet supply-chain needs – to achieve international recognition and leadership in our target specialisms, facilitating customer engagement and take-up, and thereby driving penetration and growth within global markets**

#### *Downstream sector strengths*

Whilst the West Midlands is home to a handful of downstream space application businesses, the region combines latent space application capabilities with important end-user sectors for space data/services, creating a powerful value-chain ecosystem for innovation, business growth, and end-user benefit. Our latent space application capabilities include data analytics, image analysis, artificial intelligence, machine learning, gaming technologies. The West Midlands holds particular strengths in key user sectors that have the potential to benefit significantly from space enabled data and services, including future transport (connected and autonomous vehicles, digital rail etc.), modern services, health and life sciences (connected data driven services), and agriculture 4.0 (precision agriculture and autonomous farming systems). Combining satellite-enabled applications (including, ubiquitous connectivity, remote sensing, and precision navigation and time), space-enabled systems and services have the potential to transform these end-user sectors, addressing major industrial and societal challenges and driving innovation, competitiveness, and growth.

The **regional universities** demonstrate both existing and latent capabilities for downstream space applications. Key areas of strength relevant to space applications include

- Sensors and measurement (e.g. Quantum Sensors and Timing – Birmingham), machine learning and artificial intelligence (e.g. Centre for applied artificial intelligence)
- Warwick Centre for Smart Systems and Artificial Intelligence and Cybersecurity Centre in Staffordshire,
- Image analysis and visualisation, augmented and virtual reality, cloud computing (e.g. Centre for Data Science – Coventry),
- Big data and data analytics (e.g. Warwick Data Science Institute, Data Analytics and AI Group – Birmingham City),
- Cyber-security (e.g. Centre for Cyber Security – Wolverhampton),
- Internet of Things (Emerging Device Technology Group – Birmingham), 5G and wireless technologies (e.g. Adaptive Communications Networks Research Group - Aston), robotics and automation (Robotics – Birmingham), and blockchain.

However, the growth of the upstream space sector in the West Midlands is currently limited by:

- Limited existing regional market for space applications.

- Under-developed end-user awareness and understanding of space capabilities, applications, and benefits (art of the possible), creating barriers to user engagement and adoption.
- Access to and cost of space data and services, compounded by the lack of sovereign space capabilities.
- Concerns surrounding the privacy and (cyber) security of space data and services.
- Existing markets are small and niche, creating barriers to investment and growth. This is compounded by inferior public and private finance for space applications compared in the UK to competitors in Europe and the US.
- Whilst the region produces employees and graduates with the required skills for downstream space applications, these are increasingly being poached by companies outside the region (such as London) that can offer higher salaries (combined with remote working practices), creating a skills gap.

Furthermore, whilst the West Midlands holds key strengths in the fields of computer and data sciences, there are relatively few businesses in the region operating within the space applications value-chain segment (primarily due to its emergent nature), limiting our innovation and growth potential.

There are challenges associated with performance, accessibility, and cost of space data are anticipated to reduce in time with growing UK (and international) space assets, which must be carefully aligned with use case requirements and roadmaps.

**To facilitate growth of downstream space application and user sectors we have identified 3 key ‘must win’ battles:**

- 1) engagement with key end-users to raise awareness, explore potential applications, and demonstrate the use and benefits of space enabled systems and services – to stimulate market demand and enable benefits of space to be realised,**
- 2) growth of space application start-ups (and pivots) – to generate a regional capability to meet this demand and capture market share, and**
- 3) step-change enhancement of regional offerings and capabilities within our end-user market niches – to achieve international recognition and leadership in our target specialisms, facilitating growth within global markets.**

**Stimulation of end-user markets will be key to driving growth of the region’s downstream capabilities and services.**

### *Regional space strategy*

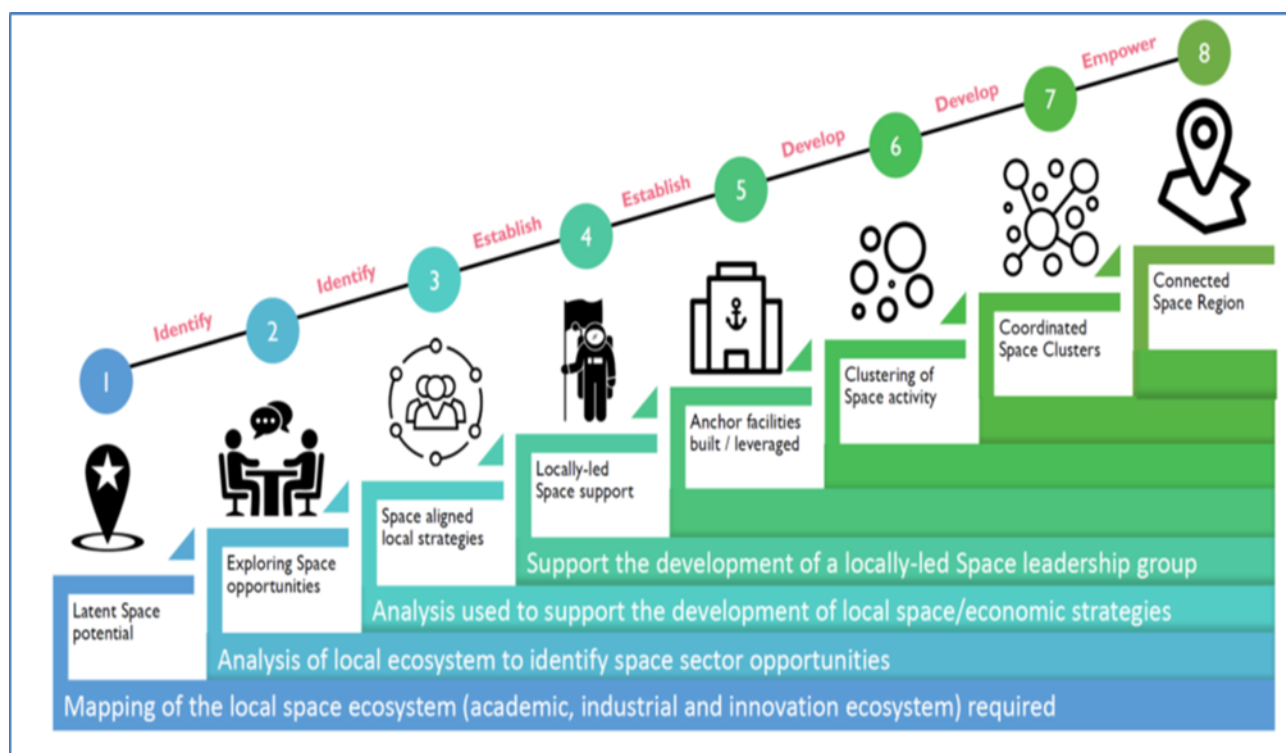
The West Midlands Space Cluster seeks to address the challenges and achieve sector growth by:

- Mobilising regional stakeholders, assets, and expertise that have relevance to the space industry
- Forging partnerships and collaboration with key stakeholders, assets, and expertise that lie beyond our region (including national/regional space clusters, centres of excellence, universities etc.)
- Raising awareness of the space industry and the capabilities of our region
- Facilitating networking between the cluster members and across national and international value chains

- Forming working groups to lead application areas of importance to the region, driving foresight and strategy, informing decision making and policy, and supporting lobbying activities.
- Providing business services that support companies to enter and flourish within the national and international space market
- Facilitating engagement of the workforce with the space industry and access to training programmes for retraining and upskilling of the workforce in areas of need (and to meet future demand)
- Facilitating access to grant, equity, and loan finance for research, innovation, and business growth
- Implementing structured programmes of activity to realise strategic policy objectives

Our approach has followed the 8 phases of the cluster roadmap. Our initial work as part of the UKSA project has enabled us to initiate the first four phases. So far, we have:

- 1) Identified our core areas of strength in terms of latent space potential,
- 2) Identified key upstream and downstream opportunities to apply and develop this potential,
- 3) Developed a top-level regional space strategy, and
- 4) Established a locally-led Space Leadership Group, mobilising stakeholders from government, industry, and research/academia.



The next phases of activity are to:

- 5) Establish anchor facilities at the heart of our cluster, leveraging key existing regional assets, and exploring the need for need dedicated facilities,
- 6) Establish clusters of space activity around our regional strengths and opportunities,
- 7) Coordinate cluster activities towards defined strategic goals, and
- 8) Integrate and empower our clusters within a connected space region.

It is important to note that these activities are not sequential, but rather run concurrently to continuously build and develop the cluster.

### *Our Vision*

The ambition to develop a local space cluster in the West Midlands that closely aligns with existing regional policy, including the Local Industrial Strategy, Digital Roadmap and Made Smarter Programme. We envisage a future where the West Midlands plays a pivotal role in the UK space industry:

- a globally leading supply-chain representing ~10% of UK space manufacturing,
- a thriving downstream space applications sector representing ~10% of the UK market,
- achieving international recognition with strong exports markets (>12.5% GDP)
- attracting new business to the region and significant inward investment (>£300m),
- investing >£300m in research and innovation,
- supporting growth in the region, targeting £1.64bn direct GDP growth, a further £40bn+ of GDP reliant upon satellite services, and >3,000 new jobs, and
- providing high quality training (3,000+ additional skilled people / apprenticeships).

Co-ownership of the strategy by regional stakeholders will be essential for its success. It is envisaged that the Space Cluster will be initially launched and operated in collaboration with the Midlands Aerospace Alliance, an organisation already representing many of our key stakeholders, from a sector that draws many parallels with the space industry, that has direct experience in the clustering and coordination of sector specific activities, and already delivers a range of programmes supporting businesses to pivot into adjacent markets.

### *Next Steps*

The outcomes from this work is a route to increasing the maturity of the West Midlands space cluster. Our research has revealed the latent competitive advantages of what a future West Midlands space cluster could build on, through identifying the available assets, technologies, skills, knowledge and expertise that are present in the West Midlands region. We now have a deeper understanding of our foundations for attracting further investment and talent to develop a West Midlands space cluster, as part of a wider regional economic growth plan.

Within the scope of our UKSA project we have mobilised key regional (and national) stakeholders; identified our regional strengths with latent space potential; understood how these align with opportunities presented by the emerging space industry; explored the challenges and barriers to addressing these opportunities; defined a vision for the future West Midlands space industry; and identified key actions to the realisation of this vision. These activities have resulted in a top-level strategy and business case that enable the opportunity in the West Midlands to be understood. A summary of the cluster options and their associated teams, goals, outcomes, and ROM costs are shown in **'Business Case Executive Report'**. We invite the West Midlands Combined Authority and local LEP leads to review these options and consider a feasible level of investment to help us realise the potential growth opportunities of the West Midlands Space Cluster.

Moving forward, one potential option is to 'do nothing'. Under this scenario, it is highly unlikely that the West Midlands share of the space market would increase beyond its existing position (~1% share of the UK market) and is in fact more likely to decrease as other regions rise to the opportunity. If we do not act quickly enough, it is also likely that we will lose any competitive advantage gained through our regional strengths and will move into a position of playing 'catch-up'.

A far better strategy is to take action to gain competitive advantage and leadership through our strengths. Our action plan is centred on several core activities that provide a basis upon which the cluster will be built. The first recommended core activity will fund the development of a detailed cluster strategy and supporting business case. This will provide a more detailed assessment of the policy objectives, strategy, operational structure, costings, management structure, and business case for developing the space cluster. The detailed business case will be used to secure investment for the development of the cluster. Secondly, we recommend the recruitment of a cluster CEO to establish the foundational components of the cluster and lead its continued development and growth. This will include the establishment of the operational and management structures and procedures, identification and leverage of regional assets, the definition of the cluster policy objectives and strategy, establishment of working groups around key policy objectives/thematic areas, and implementation of networking and awareness raising events. Finally, we recommend the recruitment of one or more thematic leaders who will act as cluster champions for specific priority areas and will proactively drive progress towards the achievement of key policy objectives. These roles (CEO and thematic leaders) may be part of a separate entity or hosted by existing regional organisation, such as, local universities, the MTC or Midlands Aerospace Alliance. We have also identified a range of 'optional activities' that facilitate, reinforce, and accelerate realisation of our policy objectives and maximise impact. These include: Dedicated Innovation Consultancy Vouchers; Skills and Training; Space Incubator / Accelerator; Cluster Facilities; and Structured Programmes.

We also need to do further research to understand how easy or difficult it is to recombine and reorient (pivot) existing skills and capabilities towards new kinds of technologies, products and services. For example, we need to unpack whether a step-change from supplying other advanced manufacturing sectors (such as, aviation and automotive) to the upstream space sector is too big for existing West Midlands advanced manufacturing businesses. We have partnered with the Manufacturing Technology Centre (MTC) on a follow-on piece of research to provide a detailed readiness assessment of 10 non-Space sector companies for possible pivoting into the sector against repurposing module. The findings from this research will help to address these questions. To complement these readiness assessments, further funding could support a 'deep-dive' into the specific capabilities of another West Midlands sector (such as, automotive), to explore to what degree there is an overlap between the hardware, materials and component parts used in space manufacturing and other sectors. This research would help us to test our estimations of population of businesses that have the potential to diversify (pivot) into the space sector in the West Midlands.

Further research is also needed to fully understand the alignment / or misalignment between the R&D projects and education programmes of local universities and the priorities of local firms. This is important to help shape national and local R&D investment policies and other interventions, which, under conditions of limited resources, need to accurately target particular growth policies towards places with particular kinds of comparative and competitive potential. To help address this gap, we have funded the MTC to do a follow-on piece of work to compare and contrast the UoB and University of Warwick space specialisms against existing West Midland business capabilities. Further funding could support a follow-on-piece of research to replicate this across the other local universities.



## 1. INTRODUCTION

In the last decade, space has transformed into one of the UK's fastest growing and most venerable sectors. Trebling in size 2010, at the last count the UK space industry now employs close to 42,000 people in all corners of the country and generates an income of nearly £15 billion every year. Space has the potential to drive growth and productivity across many areas of the wider UK economy, as a strategic "enabler of growth in other sectors" (Gov.uk, 2015) and 'critical national infrastructure'<sup>2</sup>. In response to this, the UK Space Agency 'Local Space Sector Cluster and Supply Chain Development' Funding was founded to develop the maturity of 'early-stage' local space clusters across the UK.

This 'seed corn funding' focussed on stimulating activities to provide evidence and analysis of the local ecosystem in order to progress the maturity of local space clusters, stimulate local advocacy and investment in Space and increase the uptake of space data and technologies. The 2020 funding was awarded to seven locations – including the West Midlands– to ensure space is a priority for regional economic growth and attract commercial investment from space companies to these areas.

The aim of the West Midlands project was to provide:

1. a detailed understanding of its current space sector strengths, underpinning assets, market opportunities and local priorities
2. a clear strategy and plan for how its space potential can be realised - including what support, guidance and investment is required
3. how it could participate in and contribute to a nationally linked network of Space clusters and hubs to benefit the whole of the UK.

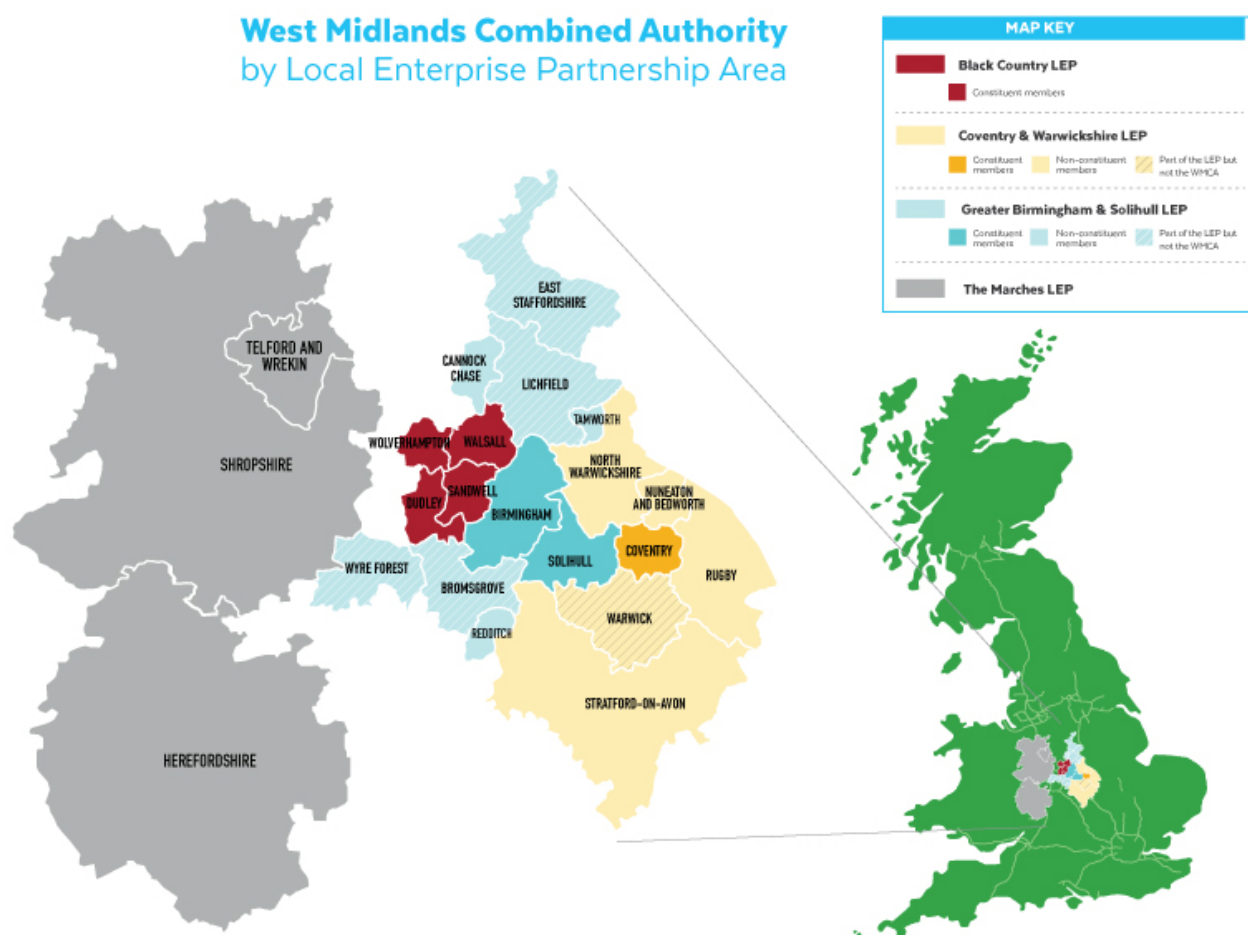
The outcomes from this work is a route to increasing the maturity of the West Midlands space cluster. This is an important national initiative to both enhance the UK's position in the global space technology sector and promote regional growth. These will translate leading R&D into applied technologies and better job opportunities for the region as a whole.

Andy Street, the Metro Mayor of the West Midlands, said:  
*"This is an immensely exciting avenue to explore, which could potentially create more jobs, improve skills, and boost the West Midlands' economy. Exploration of the global space technology sector is especially welcome at this challenging time as we start plotting our region's economic recovery from the coronavirus pandemic."*

<sup>2</sup> The loss or compromise of 'critical national infrastructure' would result in a: i) major detrimental impact on the availability, integrity or delivery of essential services; and (ii) significant impact on national security, national defence or the function of the state (CPNI, 2016).

## 1.1 Geographical Area of Interest: The West Midlands Combined Authority (WMCA)

The ‘West Midlands Combined Authority’ is our specific geographic area of interest and includes the Black Country LEP, Coventry and Warwickshire LEP and Greater Birmingham and Solihull LEP together with the following local authorities: Cannock Chase, North Warwickshire, Nuneaton and Bedworth, Redditch, Rugby, Shropshire, Stratford-on-Avon, Tamworth, Telford and Wrekin, and Warwickshire (see the map below). The WMCA is an administrative body created in 2016 for the participating authorities to collaborate and take collective decisions to receive additional powers and funding from the government ([Hoole, 2020](#)). The WMCA’s main priority areas are economic growth, transport, housing and skills and are led by Mayor Andy Street who was elected in 2017 on a three year term (the 2020 West Midlands mayoral election was postponed to 2021 due to COVID-19). Nevertheless, our study of space-related businesses and local universities did expand into the West Midlands region (known as a NUTS1 region for statistical purposes). This includes the Marches LEP and the shaded areas in the map below that are part of the various LEP’s but not the WMCA. The West Midlands region is one of the largest conurbations outside London, its central location puts it at the heart of the UK’s transport networks and international connections.



## 1.2 The Space Sector

When one thinks of outer space, there is a tendency to think of rockets and missions to the moon. There is a similar assumption, that the space sector is highly complex, largely unknown and unlike other sectors. This is true in part, given that space is a physical environment unlike any other, which poses distinctive technical challenges and financial risks. However, the production of space hardware and satellite applications is grounded in the economy in the same

way as other sectors. Consequently, features of its manufacturing and service activities are common across other sectors, such as consumer electronics, automotive and aviation.

The UK space industry generates an income of £14.8bn annually, with more satellites produced in Scotland than in any European country. The sector includes: (i) manufacturers of launch vehicles, ground systems and satellites; (ii) operators, who control the satellite when in orbit and sell communication bandwidth, position signals or observation data; and (iii) satellite application providers, who supply space-enabled services such as satellite television. These three groups of firms are referred to as ‘sub-sectors’ or ‘segments’ of the space sector (London Economics, 2015; Gov.UK, 2014). Launch providers also play a critical role in the global space sector and in the March 2021 ‘Integrated Review of Security, Defence, Development and Foreign Policy’, the UK Government further committed to ensuring the UK has the “ability to launch British satellites from the UK by 2022”.The sector also includes:

- ancillary services – specialised services that support manufacture, operations, and applications.
- users – those not directly involved in space related activities but are reliant upon satellite/space data, signals, and services.
- non-users – those who are not reliant upon space data/services but indirectly benefit (from space related activities)

A picture of the space value chain today (Figure 1) is provided below:

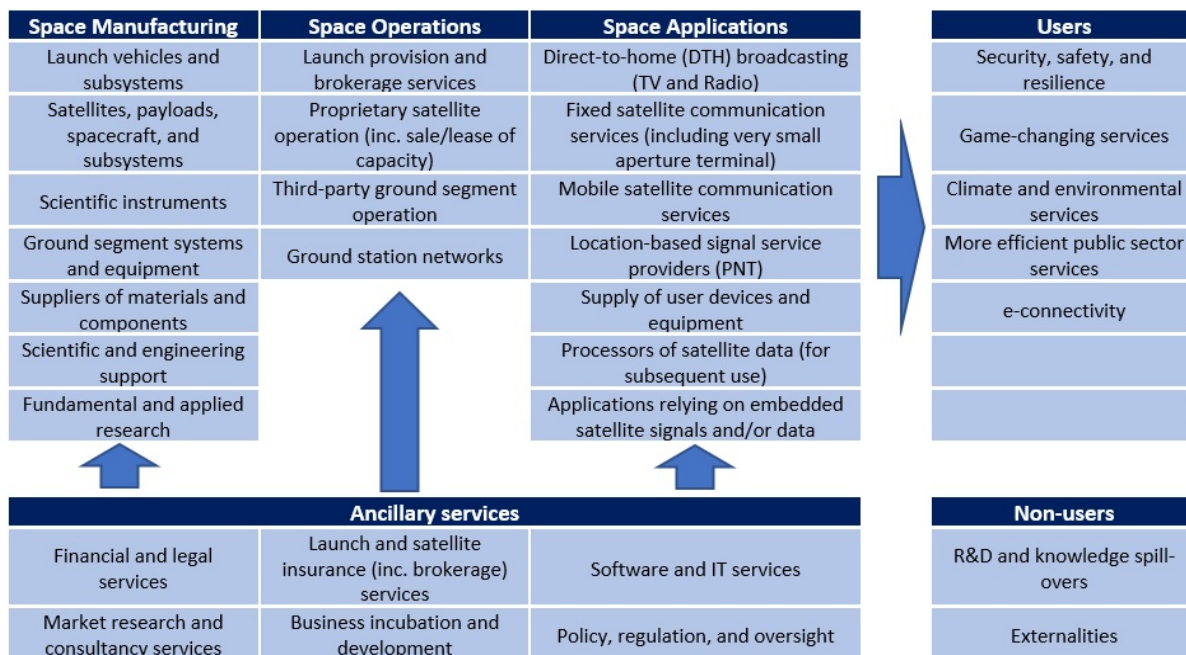
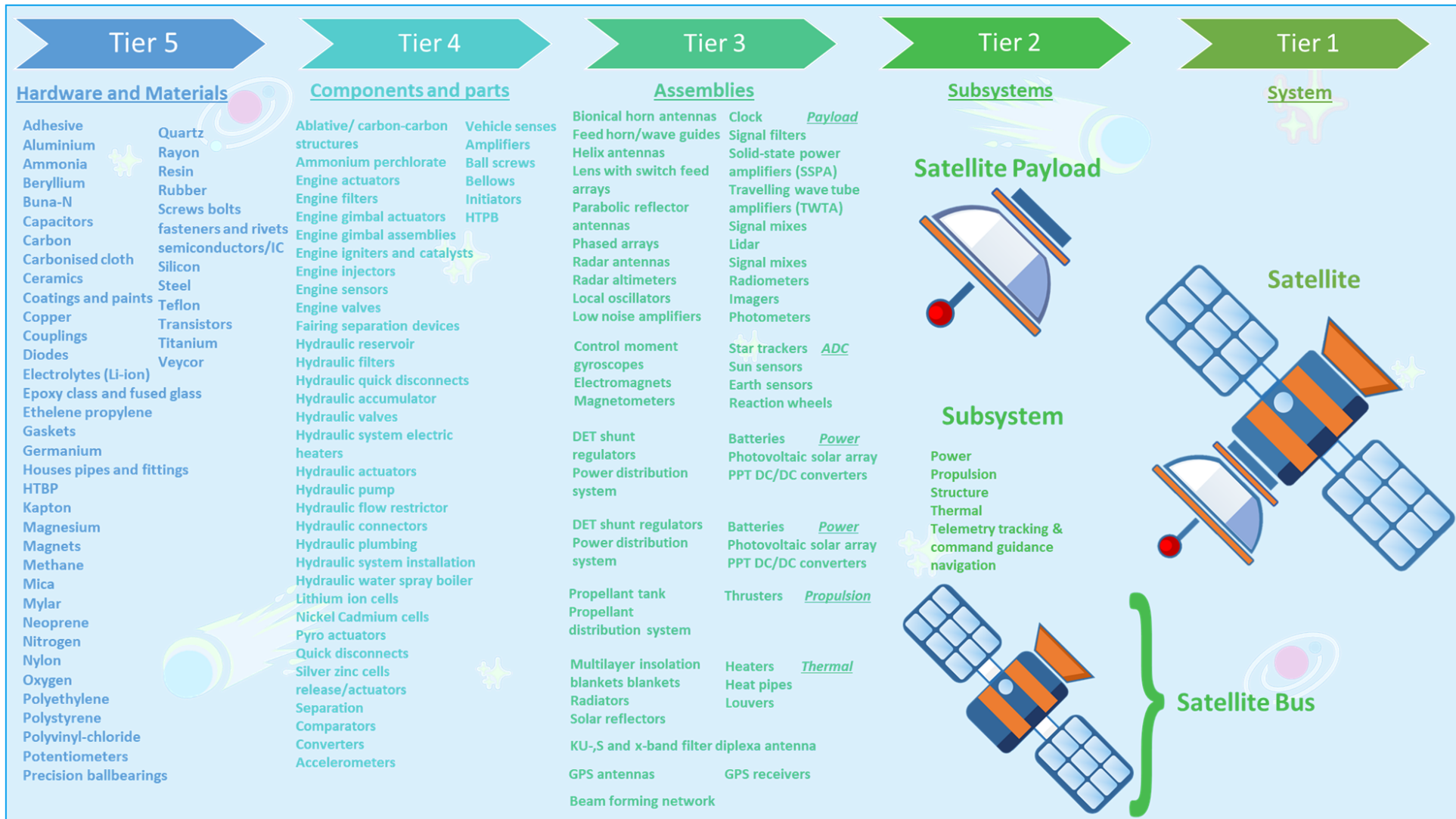


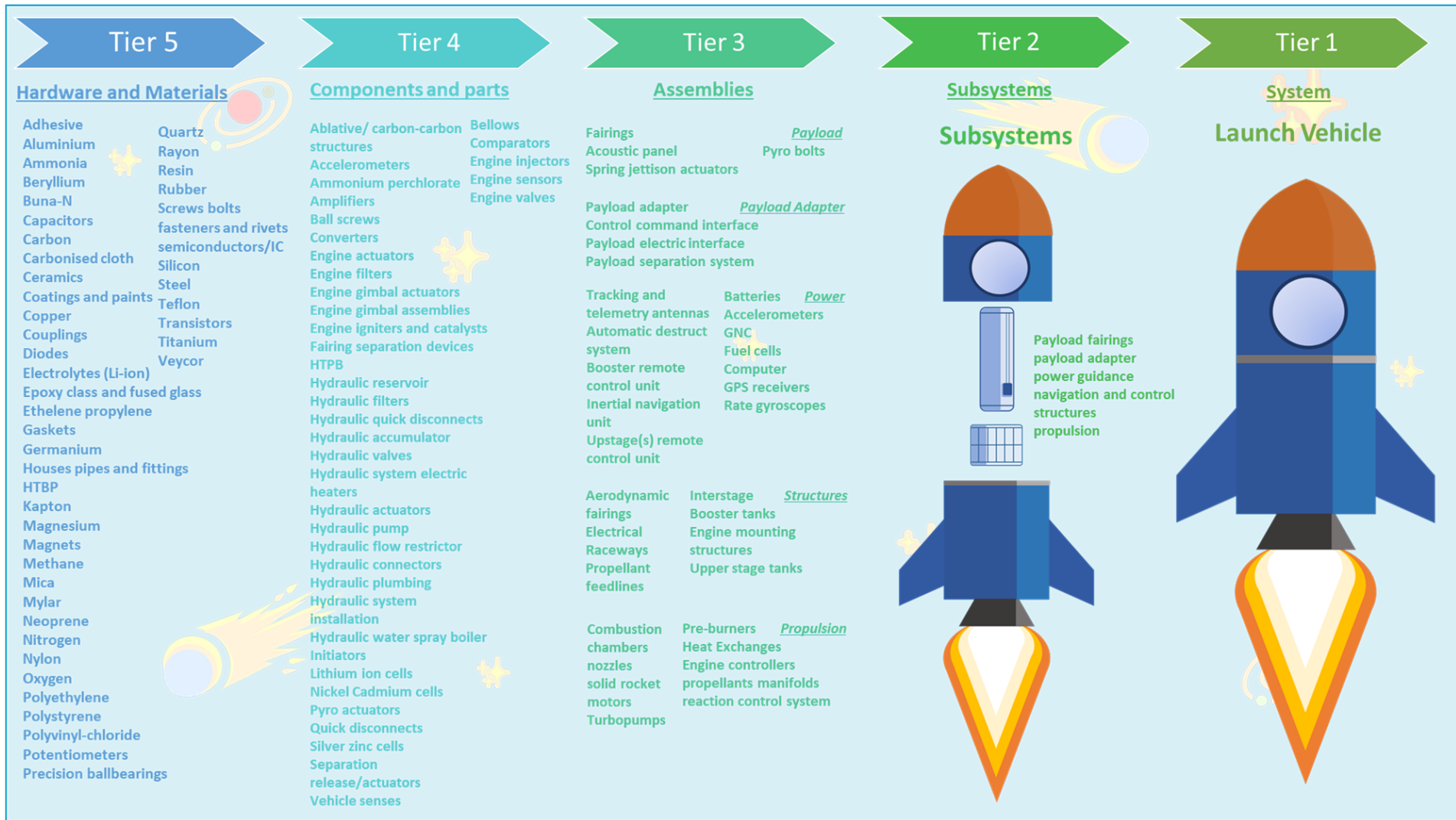
Figure 1. Space value chain (London Economics Report)

The 'space manufacturing' sub-sector can be further broken down into a list of 'hardware and materials', 'component and parts', 'assemblies', 'sub-systems' and 'systems' for the manufacturing of satellites (Figure 2) and launch vehicles (Figure 3). These five tiers vary considerably in the degree to which they are specialised and bespoke to space manufacturing. For example, a large proportion of the hardware, materials, components and parts span other advanced manufacturing sectors (such as, automotive, rail, aerospace and medical). Therefore, existing manufacturing businesses in the West Midlands have the potential to diversify and 'pivot' into the space sector. A large proportion of our project growth of the West Midlands space cluster is based on this proposition.



**Figure 2:** List of 'hardware and materials', 'component and parts', 'assemblies', 'sub-systems' and 'systems' for the manufacturing of satellites.

**Author:** Alice Pugh, adapted diagram from Bryce Space.



**Figure 3:** List of 'hardware and materials', 'component and parts', 'assemblies', 'sub-systems' and 'systems' for the manufacturing of launch vehicles.

**Author:** Alice Pugh, adapted diagram from Bryce Space.

## The Importance of the Space Industry and UK Strategy

Space has become a critical infrastructure and dependency for governments, societies, and economies global. Today, the space market is valued at >\$366bn and is forecast to reach \$558bn by 2026 [Bryce]. Globally<sup>3</sup>, more \$10 trillion of economic activity is reliant upon satellite services. ~90% of modern military capabilities are dependent on space in some way. Most of the UN “essential climate variables” are monitored by space-based systems, and all 17 UN Sustainable Development Goals benefit in some way from satellite-enabled services.

Space is a sector of strength for the UK within which we punch far beyond our weight. The sector<sup>4</sup> is valued at >£14.8bn with a 3.3% CAGR, representing ~5.1% of the global market. Over £5.5bn in export trade is made annually to Europe, North America, Asia, and Oceania. The sector directly employs ~42,000 people across 948 organisations with a 2.6x labour productivity compared to the UK average (high-value sector). Areas of existing strength include small satellite manufacture and downstream space applications. The UK seeks to build on these strengths through a bold and ambitious space strategy<sup>5</sup>. Key policy objectives are to:

- Secure 10% of the global Space market by 2030, growing our revenue from £14.8bn to £40bn,
- Double the value of GDP from industries supported by satellite services from £300bn to £600bn,
- Contribute £3bn to the economy from increased investment in research, science and innovation,
- Create an ecosystem attracting £3bn in inward investment and £500m per year equity investment,
- Stimulate up to £1bn of private investments in UK Space infrastructure using smart government procurement,
- Generate additional £5bn in export revenues,
- Attract and train up to 30,000 additional skilled people.

To realise these objects the UK is focusing national efforts on four sector priorities: 1) Connectivity Services (from autonomous vehicles to healthcare services), 2) Earth Information Services (leveraging new satellite capabilities to enable smarter services around the world), 3) In-Space Robotics (for in-orbit applications and services), and 4) low-cost launch capabilities. As part of this strategy, the governments ambition is to increase prosperity for all, creating opportunity in every part of the UK.

### New Space (Space 2.0) – The emerging Opportunity

Over the last decade the space industry has undergone a sustained period of change. Technological advancement has driven exponential growth in satellite/spacecraft performance, and new manufacturing, launch and operation capabilities, leading to the reconfiguration of value chains and market disruption. The commercial space industry has been reinvented by new companies, such as SpaceX, Virgin Galactic, Blue Origin, One Web, Kymeta, and Planet, which in turn is driving changing within the incumbents, such as Lockheed Martin, Airbus, Boeing, Northrop Gruman, and McDonald-Detwiler.

Key technologies that have driven change include:

- Lower cost and more capable launch vehicles/services (~50% reduction in launch costs = \$1M / satellite), significantly improving the accessibility of space (democratisation of space).
- Lower cost ground antenna systems capable of satellite tracking, enabling commercial use/operation of new Low-Earth-Orbit (LEO) small- and cube- satellite constellations.

- Advanced digital coding systems, enabling enhanced transmission capabilities (4->7 bits/Hz), use of new spectrum frequencies (Ka-, Q/V-, W-/E- bands), and improved efficiencies (~10-fold) in the use/reuse of available frequencies.
- New (small) satellite production capabilities (assembly lines), utilising advanced manufacturing processes (additive manufacturing), standardised components, and integrated quality testing; enabling faster and lower cost manufacture of satellites at higher volume.

These drivers have led to greater diversity in launch and satellite/spacecraft systems with exponential growth in performance and functionality. The UK will need to pivot and develop manufacturing capability and supply chains to support the necessary scaled production of space crafts to support the development of planned and future “satellite constellations / mega constellations”, and make the UK a hub for launch and access to space. The West Midlands has the potential to contribute to the UK’s increasing capability.

Within the West Midlands we have identified latent space potential within:

- the upstream sector for space manufacture (materials, components, and assemblies), leveraging our nationally leading aerospace (automotive and rail) supply-chains,
- downstream space application sectors, leveraging our specialisms in computer and data sciences, and
- end-user sectors for future mobility (aerospace, automotive, and rail), modern services (business, professional, and financial service sectors), data driven health and life sciences, and agriculture 4.0

### 1.3 Research Methodology

There have been four key stages of research, as outlined below.

#### Phase 1 – Secondary Data Analysis of Space Sector Firms in the Region

This activity aimed to identify, classify and catalogue local space assets and their capabilities. It specifically accessed data on space sector firms in the region and compared it with other sources to create a list of firms. The sources of data were as follows:

- Descriptive registers of company data such as the FAME/Orbis database from Bureau van Dijk as well as the Companies House register. These database provide information on size, location etc. at the company level.
- Other attempts at mapping the space industry based on work such as:
  - London Economics’ “Size & Health of the UK Space Industry 2018” re-port. The 2018 report uses data from 948 space industry businesses
  - Innovate UK’s Knowledge Transfer Network “Space & Satellite Applications UK Landscape” project that identifies and maps 808 space sector firms
  - Membership information from space related institutions such as the UK Space Trade Association and the Space Growth Partnership.
  - Employer information from specialised jobs websites such as [www.spacecareers.uk](http://www.spacecareers.uk)
  - Information from local stakeholders such as the West Midlands Growth Company, the local Chambers of Commerce and LEPs (add some names based on the geography we are using)

#### Phase 2 – Secondary Data Analysis of Underlying Assets in the Region

This activity aimed to identify, classify and catalogue local space assets and their capabilities. It specifically accessed data on space sector firms in the region and compared it with other sources to create a list of firms. The sources of data were as follows:



- Mapping of the Local Innovation Ecosystem - This draws on some ongoing research by City-REDI on the West Midlands Innovation Ecosystem, as part of the MIT's global 'Regional Entrepreneurship Acceleration Programme' (REAP). This programme is aimed at helping UK regions with achieving greater productivity, employment and returns from research.
- Accessing the existing innovation centres / technology hubs and are whether they are clustered around any particular themes of relevance to space.
- Researching the local university landscape and whether there is a space sector relevant research specialisms This builds upon research interviews with representatives from: university of Birmingham, University of Warwick, BCU. Aston, Harper Adams University, Coventry and the 'Space Academic Network'. As part of this activity, we have also assessed the available degree programmes at the different institutions. We also met with the West Midlands STEM learning representative to understand the activities that go on in promoting the space sector in schools.

### Phase 3: Interviews with Key Stakeholders

Forty Interviews were conducted with key stakeholders to help identify: (i) priorities for local public and private sector investment; (ii) existing space advocates; (iii) the opportunities for maturing the West Midlands space cluster; (iv) the barriers to developing the West Midlands space cluster.

The following stakeholders were interviewed online (via zoom) and selected using the local space leadership group:

- 10 interviews with policymakers, focussing on: What do they think about space, opportunities and obstacles in developing a cluster?
- 20 interviews with existing firms, focussing on: Pros/cons/importance of local area. What does the sector need to develop as a cluster?
- 10 interviews (potential investors), focussing on: Pros/cons/importance of local area. What does the sector need to develop as a cluster?

### Phase 4: Local Space Leadership Group

The project team brought together local stakeholders from industry and academia to coordinate, drive and champion local space sector activity. There were regular meetings on a 6-week basis and these were chaired by the local government authority (WMCA) with the responsibility and decision-making power for delivering economic growth. This group were used as a review/steering board for the recommendations made from the report to ensure that the analysis is fair, representative and rigorous.

Six types of stakeholder groups were invited to the Local Space Leadership Group, including:

- I. local authorities and institutions (LEPs/ CAs, etc);
- II. local businesses and clients of Space;
- III. educational institution;
- IV. private sector investors;
- V. innovation centres / technology hubs;

## 1.4 Report Structure

The structure of this report divides into four sections. First, we focus on the 'space sector strengths in the West Midlands'. This draws on the findings from our secondary data analysis of space sector firms in the region, as well as, our interviews with key stakeholders. It characterises the existing space sector in the West Midlands and outlines the

potential market opportunities for growth. The next section outlines the 'West Midlands innovation ecosystem'. This is based on the outcome from our secondary data analysis of underlying assets in the region. It outlines the existing regional policy context; the West Midlands' key strengths relating to human capital, funding, infrastructure, market demand and culture and incentives; and finally the space-related course and projects led by the region's universities. This section also includes two expert commentaries, one on 'meeting skills needs for the space sector' and the other on 'the role of universities in the development of space-related innovation clusters'. The report then outlines our regional space strategy, defining our vision and suggested roadmap of activities/options. Finally, the report summarises the key findings in a 'conclusion' and outlines next steps and any research gaps.

Alongside this report, there are a further three 'Executive Reports' to refer to. These provide a greater level of detail on specific sections.

- The West Midlands Regional Policy Overview (Executive Report) – section 3.1.
- The University Asset Mapping Report (Executive Report) – section 3.3.
- The Space Cluster Business Case (Executive Report) – section 4.

## EXPERT COMMENTARY

### The principles of Smart Specialisation and Cluster Development (within the context of developing a West Midlands Space Cluster)

Professor Raquel Ortega Argiles

Smart Specialisation strategies and cluster policies are significant policy instruments of regional policy, designed to guide regions and cities in their efforts to spur and nurture regional entrepreneurial and innovation activities, bring talent together and attract investments in key regional activities. It should be seen as a process to create real local value-added by increasing regional competitiveness on the domains where regions can compete globally, which seems to be the adequate framework for designing and developing a West Midlands Space Cluster.

#### Principles of Smart Specialisation

Smart Specialisation is an **approach to economic development** through a more strategic and targeted public investment that leverages private and public initiatives and investments at the forefront of regional growth agendas and pathways. It is a good yardstick for identifying local growth priorities. These strategies set out the agendas for integrated, place-based economic transformation to guide local innovation-related investment and industrial transformation. They:

- focus policy support and investment on key national or local priorities, challenges and needs for knowledge-based and industrial development;
- build on each region's strengths, competitive advantages and potential for excellence;
- support technological as well as practice-based innovation and aim to stimulate the private sector investment;
- get stakeholders fully involved and encourage all forms of innovation and experimentation; and
- are evidence-based and include sound monitoring and evaluation systems.

These strategies focus on experimentation aiming to generate new specialisations to drive the wider process of **regional structural economic transformation**. They act as an opportunity for regions to set up a coherent framework for stimulating structural change in the regional economy according to the investment's geographical and thematic context and industrial opportunities.

The process should aim at upgrading innovation capabilities; increasing private R&D; increasing the number of innovative companies in a region; increasing revenue from new products and services; providing better, more tailor-made support services for SMEs; improving international exposure and commercial track-record of clusters; improving access to finance for SME innovation; better positioning regional industries in international value chains and transforming the regional industrial landscape towards future-proof emerging industries. Truly smart specialisation strategies should involve all stakeholders within a culture of cooperation and partnership that develop joint roadmaps and multi-level approaches to stimulate complementary investments to enable local clusters with global potential to develop into world-class clusters.

Smart Specialisation, in general, can be understood as a **place-based policy prioritisation process** based on increasing innovation capabilities, entrepreneurial opportunity and excellence in research and innovation, moving towards a sustainable and innovation-oriented growth strategy. This policy prioritisation choices should be based on regional competences and capabilities via processes of **entrepreneurial discovery, related technological diversification, embeddedness and connectivity**.

In practice, these strategies are based on supporting regions in finding ways of **diversifying their innovation potential**, avoiding fragmentation and duplication/imitation. It should be based on the accumulation of critical mass (i.e. modern clusters creation) by involving actors as anchors in the innovative regional cycle.

Policies must be tailored to the local context, acknowledging that there are different pathways for regional innovation and development. By:

- a) rejuvenating traditional sectors through higher value-added activities and new market niches (mining in Silesia, shipbuilding in Skane);
- b) modernising by adopting and disseminating new general-purpose technologies (logistics in Flanders);
- c) diversifying technologically from existing specialisations (technical, scientific, skills) into related fields (aeronautics in Toulouse to GPS technologies);
- d) developing new economic activities through radical technological change and breakthrough innovations (tourism in the Balearic Islands); and
- e) exploiting new forms of innovation such as open and user-led innovation, social innovation and service innovation (historical heritage in Italy).

### The role of clusters

Modern clusters in the context of smart Specialisation focus on productivity and innovation as key drivers of competitiveness. They aim at fostering **regional embeddedness** with a view to capitalise on the advantages of proximity and critical mass in related industries. Specifically, they focus on sectors with clear growth potential for innovation, aiming to exploit emerging linkages between economic activities that can cut across traditional cluster boundaries. Traditional clusters can come close to "**smart specialisation domains**" if they stimulate new types of knowledge spillovers with a high leverage effect on the regional economy's growth pathways.

These growth strategies demand comprehensive efforts to mobilise resources in order to accelerate innovation and industrial transformation in areas of growth potential. Regions are a driving force in this, as favourable place-based business conditions help incentivise actors in the real economy, notably small and medium-sized enterprises (SMEs). Clusters are a powerful tool for reaching out to specialised SMEs and related innovation actors and increasing their competitiveness.

The full potential of clusters is unlocked when policies and SME support measures are in place that can structure the **co-creation process and thus direct public and private investment towards smart Specialisation**. This requires linking up the main players in the regional ecosystem and involving a wide range of stakeholders and overcoming potential sectoral, regional and departmental silos. Regions that succeed in achieving this and that can tackle the economic complexity of the process through clusters will usually be those that subsequently benefit from economic resilience and higher employment growth. However, cluster initiatives and programmes in order to be successful should ensure coordination and connection from other traditional policies with similar objectives and the trade-off and the trade-offs between being too narrowly focused (i.e. networking) or too thinly spread (i.e. financial support lacking critical mass).

### The role of cooperation

Innovation and entrepreneurship are more likely to occur at the intersection of different disciplines and sectors.

In Smart Specialisation, it is crucial to exploit the cooperation and investment opportunities across regional and international borders by **developing common roadmaps** and **investing in joint pilots and demonstrator projects** to enable local clusters to develop their local, regional and global potential. Given the economic and political context, there is growing importance to remain competitive in an increasingly global world. Therefore, when developing and implementing these modern cluster strategies, regions should focus on synergies with other transnational initiatives to maximise the impact of their investments.

Developing Smart Specialisation strategies should be an essential exercise for the regional stakeholders as it is necessary to reconcile the diverse interest of science, academia and the private sector from entrepreneurs, SMEs to multinationals. While innovation tends to emphasise new versus old, high-tech versus low- medium-tech, or start-up over established family businesses, Smart Specialisation is more inclusive and tries to build on the inherent strengths and or comparative advantages that every region possesses.

Cooperation across industries and the interplay between private and public actors, including universities and research organisations, are essential to any regional economic transformation process.

However, it fails for public authorities to be responsible for implementing the conditions for cooperation. They should be keenly aware of the importance of innovation and the new collaborative role they play – mixing established strengths with new strategies and technologies, tapping into entrepreneurial insights and experience, and creating unique environments for new growth opportunities.

Public authorities should put this into practice by:

- modernising, streamlining and improving their processes and structures;
- becoming catalysts for action, hubs for collaborative projects involving many diverse actors, and facilitators of the journey of "entrepreneurial discovery";
- providing the groundwork and strategic investments for public-private partnerships to succeed; and
- having an international perspective to:
  - coordinate investment strategies and roadmaps with other regions in the country;
  - cooperate with partners regions to facilitate co-investment and pool resources and efforts;
  - create synergies with relevant international initiatives.

### **The role of government**

In this context, the role of government is that of an enabler that provides incentives and encourages entrepreneurs and other organisations such as universities and research institutes to become involved in identifying regions' specialisations. Priorities must be set and supported through a targeted investment agenda linked to these emerging specialisations and innovation pathways.

Governments need to facilitate the 'entrepreneurial discovery process' that the smart specialisation framework envisages ensuring industrial exploration, experimentation and discovery of new opportunities to become a 'fast follower' of the market signals generated by this process. Thus accelerating the industrial transformation in these lead industries by lifting barriers and creating specific qualities of a business environment with a unique and lasting advantage to facilitate the emergence and growth of new clusters.

Besides, an effective monitoring system needs to be put in place to evaluate and assess government support effectiveness to ensure that limited public funds are directed to where they can add the most value in terms of creating jobs and growth and supporting industrial transformation.

## 2. SPACE SECTOR STRENGTHS IN THE WEST MIDLANDS

In 2018, the West Midlands space industry had a total income of £127m, representing 0.85% of UK turnover, comprising 74 companies that employed 1,170 people. GDP of regional end-user sectors reliant upon satellite data and services was estimated at 22.51bn (see table 1). This positions the West Midlands within the middle of the regional table but significantly behind London, the South East, and the East of England.

Region	Number of Organisations	... of whom have their headquarters in the region	Income (2016/17), £m	% Share of UK Market (by turnover)	Employment (2016/17)	GDP of end-user sectors reliant upon satellite data and services, £bn
London	218	172	9,484	64.16%	12,286	69.73
South East	368	269	2,364	15.99%	9,023	43.54
East of England	146	102	2,088	14.12%	4,379	30.38
South West	173	99	184	1.24%	1,333	21.99
Scotland	132	83	140	0.95%	7,555	24.87
West Midlands	74	40	127	0.86%	1,170	22.51
Yorkshire and the Humber	44	24	102	0.69%	1,302	19.20
East Midlands	83	54	77	0.52%	868	17.79
North East	34	22	75	0.51%	907	6.39
Wales	47	27	67	0.45%	517	8.14
Northern Ireland	26	15	40	0.27%	145	8.69
North West	75	35	33	0.22%	2,360	26.60
Crown Dependencies	4	<i>Redacted</i>	<i>Redacted</i>	<i>Redacted</i>	<i>Redacted</i>	<i>N/A</i>
<b>TOTAL</b>	<b>1,424</b>	<b>948</b>	<b>14,792</b>	<b>/</b>	<b>41,929</b>	<b>299.83</b>

### 2.1 Space Sector Jobs and Businesses in the West Midlands

To measure space sector jobs and businesses we use ONS' Business Register and Employment Survey (BRES) and the UK Business counts. The former is a representative survey of 80,000 enterprises providing employment information by Standard Industrial Classification (SIC - 2007 revision) code whilst the latter is an excerpt of the Inter-Departmental Business Register (IDBR), which is a registry of firms covering more than 90% of the economic activity in the UK.

The SIC - 2007 codes we focused on were 30.3: *Manufacture of air and spacecraft and related machinery*; 33.16: *Repair and maintenance of aircraft and spacecraft* and 51.22: *Space Transport*. These codes ensure that we exclusively measure firms in the space sector. The complexity of operations and the interconnectedness of the industry mean though that solely focusing on these SIC codes, significantly underestimates the size and importance of the sector. However, this is preferred to the alternative of including related SIC codes such as engineering or satellite telecommunication providers, which would skew our findings by incorporating satellite broadcasters and consultancy services in the Space sector.

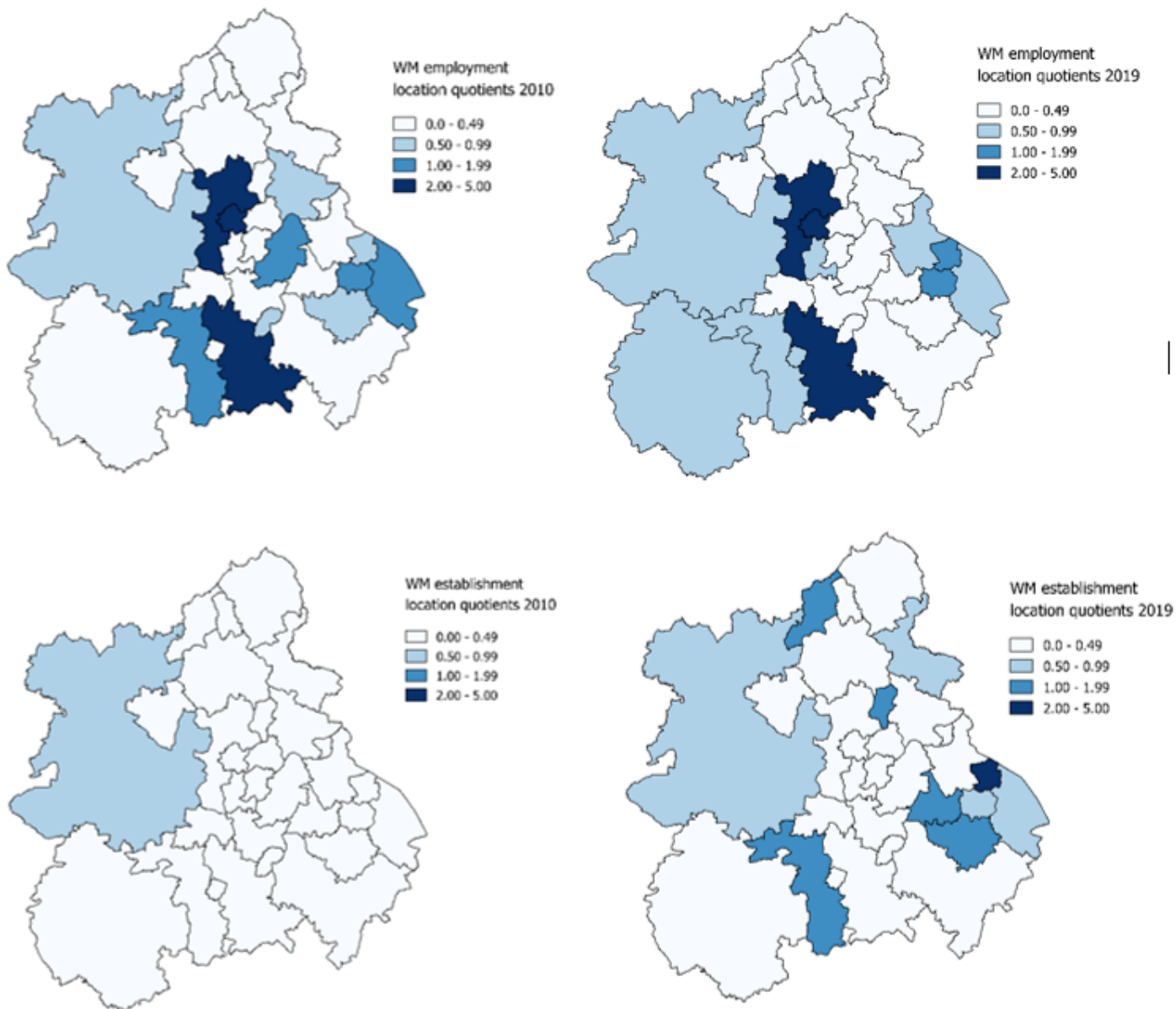
The Location Quotients<sup>3</sup> (LQ) show the relative specialisation in the sector compared to the national average. Values above 1 show above average concentration in the sector whilst below 1 suggest there is a smaller than average share of space sector employment in a local authority. LQs also show the relative importance of a sector locally. South Staffordshire, Wolverhampton and Wychavon show particularly high concentrations of space sector activity, although

<sup>3</sup> Defined as the ratio of the local to the national share of an industry

reduced compared to 2010. Simultaneously, several areas with small concentrations have seen increases of their LQ between 2010 and 2019. These figures suggest that space sector activity in the region is less concentrated in space.

Establishment figures show an increase of space sector units in the aforementioned SIC codes. It is important to note that for disclosure purposes, these numbers are rounded to the nearest five and this could explain some of the null figures in both 2010 and 2019. Despite this, there is a notable increase in the number of establishments between 2010 and 2019, accompanied by the relevant increases in LQs.

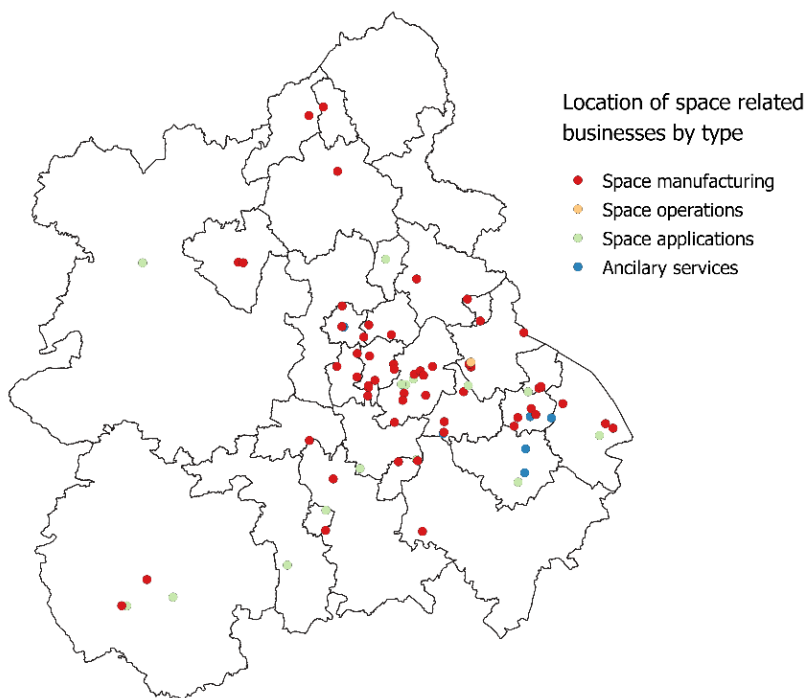
The maps below outline the LQ changes between 2010 and 2019 in terms of employment and businesses in the West Midlands.



**Figure 4:** The LQ changes between 2010 and 2019 in terms of employment and businesses in the West Midlands  
**Author:** Tasos Kitsos

As discussed above, SIC codes cannot fully capture the extent of businesses and employment involved in the space sector. To complement these findings we utilise sources of information involving online searches of business databases and membership information. Taping on some of these sources, we are able to identify and map 85 West Midlands establishments engaging in space sector activities. We match these firms against the London Economics “The UK Space Sector” report Supply chain (shown below).

The findings suggest that most of the firms identified (Figure 5) engage in space manufacturing activities (72%) with smaller shares for space applications (20%) and ancillary services (8%). These could highlight self-selection in the firms we were able to identify, or indeed point at the strengths and opportunities of the space sector in the region. Going forward, we believe that this inventory can be expanded with more information in order to offer to more comprehensive view of the sector in the region.



**Figure 5:** Location of space-related businesses by type in the West Midlands

**Author:** Tasos Kitsos

The West Midlands (early-stage) space cluster does not have a ‘big champion’ or large space OEM (or Prime) that assemble satellites or launch vehicles, instead, there are a number of supply chain companies who manufacture hardware, materials, components and parts. From a total of 85 ‘space related’ companies in the West Midlands. 27 manufacturer a variety of specialist components, such as batteries, cabling, photographic equipment, specialist coating and solid fuel propulsion systems. For example, Hymatic engineering (Honeywell) specialises in “light-weight, reliable, low power, high-performance cryocoolers (e.g. those that cool instruments on satellites)”. These products are typically niche, specialised components and traditionally are not manufactured at high-volume.

These components are engineered to respond to the distinctive challenges posed by the ‘hostile’ outer space environment, intense pressure caused during space craft launch and collisions with ‘space junk’. This relies on the use



of specialist material, including advanced ceramics. Ceramics provide a combination of hardness, chemical resistance, strength and high temperature operation not found in alternative materials such as metal, alloys and polymers. The UK advanced ceramics industry has a significant cluster in the Midlands, with a clear opportunity to grow. This is confirmed by research undertaken in 2020 by City-REDI and SQW. No other UK region has the equivalent mass of advanced ceramics specialist suppliers, end users and researchers. For example, Precision Ceramics based in Birmingham have designed and manufactured a series of highly technical ceramic components using 'Shapal' for the unmanned space-craft Cassini–Huygens sent to the planet Saturn. Shapal Hi-M Soft™ is a ceramic which combines good heat resistance, high mechanical strength and bending strengths of 30 kg/m giving a perfect combination of properties for spacecraft. The Moog Space and Defence Group, is another example of a business exploring the use of advanced ceramics in the development of their space vehicles including high reliability, cost effective spacecraft buses, and propulsive secondary payload adapters. Furthermore, Lucideon is a private company based in Stoke-on-Trent and is a global leading materials testing and commercialisation business. A subsidiary company of Lucideon, AMRICC, houses pilot lines that helps companies exploit new advanced ceramics technologies and commercialise new products. Its ambition is to significantly grow these facilities. Through AMRICC, Lucideon is also leading on the vocational curriculum development for advanced ceramicists with leading Midlands skills providers.

There are a further 31 'space-related' precision machining companies in the West Midlands. These companies do not only work in the space sector, but also work across other sectors including: aerospace, automotive, motorsport, energy, defence and nuclear. Many of these precision machining companies were set up to meet the demand of nearby Rolls Royce (based in the East Midlands). They rely on specialist tooling equipment and machines (such as EDM machines and 3D Printers (such as, Laserlines), which are supplied by specialist 'support' companies. The equipment and machine suppliers were not captured in our 85 space-related companies identified above and is just one example of how the reach of this sector is difficult to define and measure. Additionally, we spoke to a sample of West Midlands aerospace companies, who were "interested in learning more about the space sector and their standards and approvals process", since there is a high degree of overlap between the two sectors.

20 of the 85 companies identified are 'downstream' service providers including business service providers using EO data, data processing, hosting and related services, telecommunications equipment manufacturer and software solutions. These companies are difficult to capture, since most will not define themselves as a space company, but instead a "data" or "software solutions company". For example, Borwell Ltd "works with data integration and providing software solutions". Meanwhile, Geospatial Insight "take geospatial data, including satellite. Satellite imagery and we convert that risk intelligence, for the insurance, finance and utilities sector". Another downstream application company in the West Midlands Energeo, focuses "entirely on the green and clean-tech sector... looking at solving problems using geospatial data combined with other sort of land based datasets or, or remote sensing". Another, example of a downstream space company is Withers and Roger, an Intellectual Property company, that support companies through early-stage development, educating them on "knowing and securing their rights". This is an example of an 'ancillary service' outlined in the space sector value chain and there are a number of such companies operating in the West Midlands that do not identify as 'space sector companies' and therefore were not captured in our analysis.

The 20 space-related West Midlands companies that we interviewed were in agreement that the biggest potential advantage of maturing the West Midlands space cluster for the existing businesses would be "being able to meet the right people and showing them what we can do". They also saw it as a potential solution to "maintaining and keeping skilled people in the area". There was excitement and enthusiasm amongst the companies on the potential to create a "mini Harwell in the West Midlands" and better connecting the academic excellence with the industrial base across the region to "establish this area as somewhere known for working on space projects".

Table 2 provides a summary of the regional space companies identified.


**Table 2 Key West Midlands Companies with Identified Space Activities**

<b>Collins Aerospace Plc</b> <i>Actuation &amp; Propeller Engineering</i>	<b>Roxel (UK Rocket Motors) Ltd</b> <i>Manufacture of solid fuel propulsion systems</i>	<b>Precision Technologies International Ltd</b> <i>Precision Machining - components</i>
<b>Mackart Engineering Ltd</b> <i>Additive Manufacturers (polymers/composites)</i>	<b>Westley Group</b> <i>Metals and Materials Supplier</i>	<b>GKN Aerospace</b> <i>Precision Machining – rockets and turbines</i>
<b>The Motorsport Industry Association</b> <i>Association</i>	<b>Righton Blackburns</b> <i>Metals and Materials Supplier</i>	<b>MJ Sections Limited</b> <i>Precision Machining - Sheet Fabrication</i>
<b>Midlands Aerospace Alliance</b> <i>Association</i>	<b>Talisman Plastics</b> <i>Metals and Materials Supplier</i>	<b>PZA Systems Ltd</b> <i>Satellite Telecommunications Consultancy</i>
<b>SPACE Skills Alliance</b> <i>Business services</i>	<b>Titanium Industries UK Ltd</b> <i>Metals and Materials Supplier</i>	<b>ETL Systems Ltd</b> <i>Satellite telecommunications equipment</i>
<b>Geospatial Insight Ltd</b> <i>Business Services using EO Data</i>	<b>Meggitt (UK) Ltd</b> <i>Precision Machining</i>	<b>Global RadioData Communications Ltd</b> <i>Satellite telecommunications equipment</i>
<b>Energieo Ltd</b> <i>Business Services using EO Data</i>	<b>Nasmyth Coventry Ltd</b> <i>Precision Machining</i>	<b>Trakm8 Ltd</b> <i>Satellite telecommunications equipment</i>
<b>Erebus UK Ltd</b> <i>Business Services using EO Data</i>	<b>Momentum Engineering Ltd</b> <i>Precision Machining</i>	<b>IMR Technologies UK Ltd</b> <i>Satellite telecommunications equipment</i>
<b>Tekdata Ltd</b> <i>Manufacture of cabling and interconnections</i>	<b>A &amp; M EDM Ltd</b> <i>Precision Machining</i>	<b>Mobell (Mobal)</b> <i>Satellite telecommunications equipment</i>
<b>Aras Software Ltd</b> <i>Data processing and related activities</i>	<b>Accura Engineering Ltd</b> <i>Precision Machining</i>	<b>Polar Electro</b> <i>Satellite telecommunications equipment</i>
<b>Mix Telematics Europe Ltd</b> <i>Data processing and related activities</i>	<b>Advanced Chemical Etching Limited</b> <i>Precision Machining</i>	<b>Spectra Group</b> <i>Satellite telecommunications</i>
<b>Amphenol Invotec Ltd</b> <i>Printed Circuit Boards</i>	<b>AE Aerospace Ltd</b> <i>Precision Machining</i>	<b>Speedcast</b> <i>Satellite telecommunications</i>
<b>TLM Laser Ltd</b> <i>Laser Products</i>	<b>ANT Industries</b> <i>Precision Machining</i>	<b>ACL Satellite Broadband</b> <i>Satellite telecommunications</i>
<b>InnoLas UK Ltd</b> <i>Laser Products</i>	<b>Arrowsmith Engineering Ltd</b> <i>Precision Machining</i>	<b>Borwell Ltd</b> <i>Software Solutions</i>
<b>Excel Precision (Birmingham) Ltd</b> <i>Machine Tool Manufacturer</i>	<b>Graves Aircraft Components Limited</b> <i>Precision Machining</i>	<b>Altair Engineering Ltd</b> <i>Software Solutions</i>
<b>Westley Engineering Ltd</b> <i>Machine Tool Manufacturer</i>	<b>JJ Churchill Ltd</b> <i>Precision Machining</i>	<b>AEON Engineering Ltd</b> <i>Software Solutions</i>
<b>Heller Machine Tools Ltd</b> <i>Machine Tool Manufacturer</i>	<b>Parker Precision Ltd</b> <i>Precision Machining</i>	<b>NewSPACE Systems Pty Ltd</b> <i>Specialised design activities</i>
<b>Yamazaki Mazak UK Ltd</b> <i>Machine Tool Manufacturer</i>	<b>Reginson Engineering Ltd</b> <i>Precision Machining</i>	<b>Teer Coatings Limited</b> <i>Specialist coatings &amp; equipment</i>
<b>Cube Precision Engineering Ltd</b> <i>Machine Tool Manufacturer</i>	<b>Summit Engineering (Birmingham) Ltd</b> <i>Precision Machining</i>	<b>Indestructible Paint</b> <i>Specialist paints and coatings</i>
<b>Mettis Group Limited</b> <i>Machining Forged Components</i>	<b>Wyken Tools Ltd</b> <i>Precision Machining</i>	<b>Surface Finishing Engineering Limited</b> <i>Turnkey Systems for Surface Treatment</i>
<b>Mettis Aerospace Limited</b> <i>Machining Forged Components</i>	<b>Harris RCS</b> <i>Precision Machining</i>	<b>Technoset Ltd</b> <i>Component cleaning and testing</i>
<b>Mettis Aerospace (Holdings) Limited</b> <i>Machining Forged Components</i>	<b>Electro Discharge Ltd</b> <i>Precision Machining</i>	<b>Coventry University</b> <i>University</i>
<b>Bromford Industries Ltd</b> <i>Precision Machining</i>	<b>Columbia Precision Ltd</b> <i>Precision Machining</i>	<b>WUSAT University of Warwick</b> <i>University</i>
<b>Steatite Ltd</b> <i>Batteries and communications</i>	<b>Paragon Engineering &amp; Logistics Ltd</b> <i>Precision Machining</i>	<b>MTC</b> <i>University</i>
<b>UTC Aerospace</b> <i>Heat transfer &amp; fluid management systems</i>	<b>Burcas Ltd</b> <i>Precision Machining</i>	<b>University of Birmingham</b> <i>University</i>
<b>Air Liquide</b> <i>Medical and industrial gases</i>	<b>MGS Precision</b> <i>Precision Machining</i>	<b>University of Wolverhampton Science Park Ltd</b> <i>University</i>
<b>Buzzard Cameras Ltd</b> <i>Imaging equipment for satellites/drones</i>	<b>CCR (Wednesbury) Ltd</b> <i>Precision Machining - Cold Rolled Rings</i>	<b>University of Wolverhampton Science Park Ltd</b> <i>University</i>
<b>Novocomms Limited</b> <i>Imaging equipment for satellites/drones</i>	<b>Exactaform Cutting Tools Ltd</b> <i>Precision Machining - Composites</i>	<b>Energy Tubes Ltd</b> <i>Manufacture of Welded Tube Products</i>
<b>Staubli UK Ltd</b> <i>Robotic systems</i>	<b>D &amp; S Engineering (Coventry) Limited</b> <i>Precision Machining - Optics &amp; Hydraulics</i>	/

## 2.2 Upstream Component Manufacturing in the West Midlands

Space manufacture is dominated by a handful of companies. To enter the market suppliers must engage with prime/OEM (or sub-system) manufacturers at an early stage in the design cycle (so that their offerings may be incorporated into the (sub-)system specifications) and demonstrate compliance with the customer quality management systems and processes, a costly exercise for both the OEM (and sub-system) manufacturer and supplier. Due to the effort, cost, and risk of on-boarding new suppliers, manufacturers naturally gravitate towards their established suppliers, creating a barrier to entry and the perception of a closed supply chain. On the other hand, whilst many suppliers have the capability to participate within the space manufacturing supply chain, they are deterred from doing so due to their limited awareness of the sector and the opportunities, low production volumes and bespoke nature, and requirement for strict quality management systems and documentation.

A unique strength of the West-Midlands is our manufacturing sector (aerospace, automotive, and rail). Within the region we have strong supply-chains mobilised around key capabilities (such as engines, electromechanical systems etc.). These industries (and in-particular aerospace) share close similarities with space and thus demonstrate strong latent space potential.

- Manufacturing represents 16% of regional output (£22.1bn), with >300,000 jobs (10% regions work force) across more than 33,000 organisations.
- The Midlands hosts one of the world's major aerospace supply chain clusters, representing ~25% of the UK aerospace industries (7% of Europe's, and 3% of the worlds) and >45,000 jobs (and >1200<sup>4</sup> apprenticeships) across 300+ organisations (>160 in the West Midlands). Half of these companies make sophisticated "flying parts," while the remainder make equipment for design, testing and manufacturing, or supply specialist services [Midlands Aerospace Alliance].
- The West Midlands represents >10% of the sector turnover at ~£3.5bn (~£1bn GVA), with >90% exports [MAA].
- Key clusters are those centred around: aircraft engine manufacture at Rolls-Royce in the East Midlands, and electro-mechanical systems for control of aircraft moving parts, located in the West Midlands and organised around Collins Aerospace, Rolls-Royce Control Systems, Meggitt, and Moog

The aerospace sector draws many parallels with the space industry, working to strict and often bespoke specifications, requiring upfront investment with long lead times to a return, requiring extensive quality management testing and documentation, and operating within a complex regulatory and international trading environment. These capabilities and strengths provide a strong basis's through which the (West) Midlands can capture share of the national and global space manufacturing market, and in particular the materials and components (and sub-system) segment(s). These strengths/capabilities are not currently being leveraged resulting in lost opportunities. However, whilst many suppliers have the capability to participate within the space manufacturing supply chain, they are deterred from doing so due to their limited awareness of the sector and the opportunities, low production volumes and bespoke nature, and requirement for strict quality management systems and documentation.

The West Midlands Aerospace Alliance identifies its regional competences in fig.6.

<sup>4</sup> Assuming ~25% of total industry apprenticeships

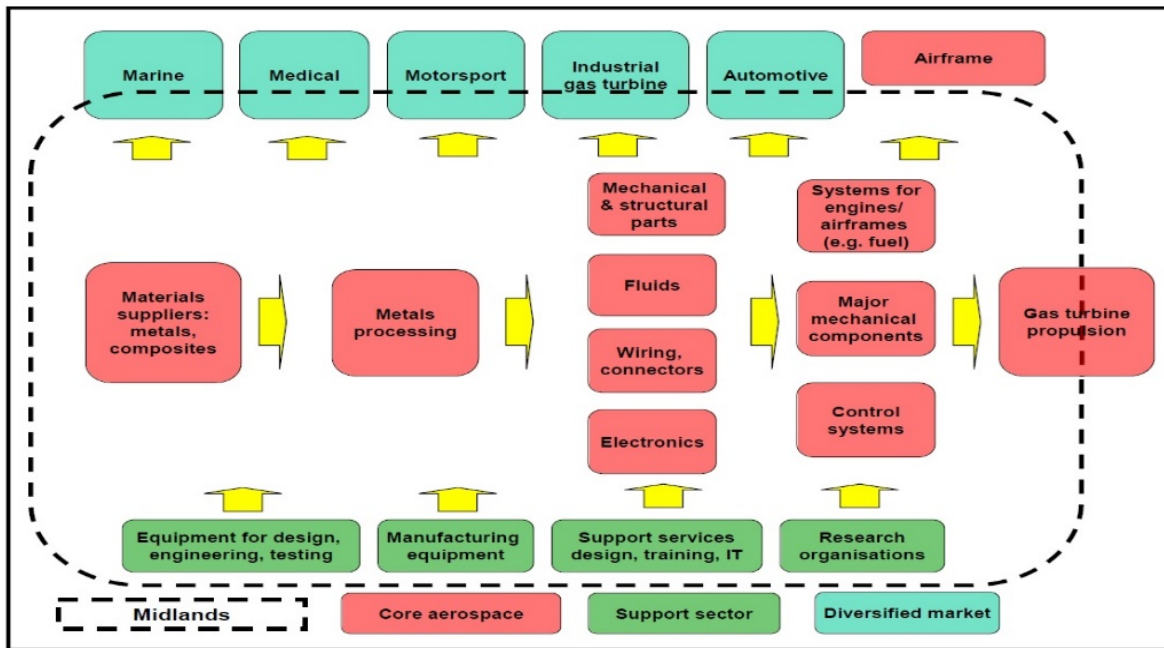


Figure 6. Midlands aerospace competencies, as defined by the Midlands Aerospace Alliance

### Potential to pivot

To estimate the population of businesses that have the potential to diversify (pivot) into the space sector in the West Midlands, we use the concept of *relatedness*. Relatedness suggests that businesses operating in similar fields perform tasks with greater cognitive proximity. This means that a business is easier to diversify or pivot in an industry that is close to the existing production routines.

To identify firms that are able to pivot, we utilise the hierarchical structure of the Standard Industrial Classification (SIC-07) information for the 85 companies we already have confirmed as being part of the space supply chain. To identify what firms may pivot, we assume that companies within the same 3-digit code to the 85 above form a population of companies with the highest potential to pivot.

The table below (Table 3) shows the number of firms in the West Midlands that fall under these 3-digit codes with the UK numbers added for comparison. The table suggests that up to 25% of businesses in the West Midlands are in similar industries to the 85 companies we have identified highlighting the significant potential for the development of a space cluster in the region. The figures also show the regional strengths in both manufacturing and business support services with significant populations that could potentially become part of the local space cluster.

**Table 3:** The population of businesses that have the potential to diversify (pivot) into the space sector in the West Midlands

Industries with potential to pivot	WM	UK
211 : Manufacture of basic pharmaceutical products	15	220
222 : Manufacture of plastics products	675	5,645
241 : Manufacture of basic iron and steel and of ferro-alloys	105	810
242 : Manufacture of tubes, pipes, hollow profiles and related fittings, of steel	70	335
245 : Casting of metals	95	425
251 : Manufacture of structural metal products	610	4,825
255 : Forging, pressing, stamping and roll-forming of metal; powder metallurgy	155	560
256 : Treatment and coating of metals; machining	2,195	17,400

257 : Manufacture of cutlery, tools and general hardware	345	1,820
259 : Manufacture of other fabricated metal products	730	4,135
263 : Manufacture of communication equipment	95	1,170
265 : Manufacture of instruments and appliances for measuring, testing and navigation; watches and clocks	205	2,300
267 : Manufacture of optical instruments and photographic equipment	20	340
272 : Manufacture of batteries and accumulators	10	70
279 : Manufacture of other electrical equipment	80	800
282 : Manufacture of other general-purpose machinery	525	3,525
284 : Manufacture of metal forming machinery and machine tools	185	825
303 : Manufacture of air and spacecraft and related machinery	70	960
329 : Other manufacturing	560	4,655
331 : Repair of fabricated metal products, machinery and equipment	1,110	13,535
465 : Wholesale of information and communication equipment	455	5,395
467 : Other specialised wholesale	3,125	26,380
469 : Non-specialised wholesale trade	1,225	12,245
612 : Wireless telecommunications activities	135	1,855
613 : Satellite telecommunications activities	15	185
620 : Computer programming, consultancy and related activities	10,265	169,155
631 : Data processing, hosting and related activities; web portals	280	5,045
682 : Renting and operating of own or leased real estate	5,200	63,730
701 : Activities of head offices	870	10,200
711 : Architectural and engineering activities and related technical consultancy	7,515	96,050
721 : Research and experimental development on natural sciences and engineering	350	5,695
741 : Specialised design activities	1,325	23,935
749 : Other professional, scientific and technical activities n.e.c.	3,260	45,760
829 : Business support service activities n.e.c.	14,910	113,005
842 : Provision of services to the community as a whole	485	6,975
854 : Higher education	135	2,515
941 : Activities of business, employers and professional membership organisations	310	4,170
960 : Other personal service activities	6,865	82,290
Total firms with potential to diversify	64,580	738,940
Total number of firms		3,212,7
% of companies with potential to pivot	259,465	80
	24.9	23.0

### Upstream space manufacture SWOT analysis

We have engaged with key stakeholders in the space manufacturing sector to understand our key strengths, weaknesses (and challenges), opportunities, and threats.

## S

## STRENGTHS

**Key regional strengths for space manufacture include:**

- A small network of supply chain companies who already provide materials and components to the space sector
- Extensive existing manufacturing supply chain that could potentially 'pivot' into the space sector, with:
  - experience operating in the aerospace, automotive and rail sector(s) to stringent specifications and quality management controls, and complex regulatory and trading environment
  - strong global exports and reputation
  - existing offerings and capabilities directly suited to space manufacture (high performance materials; precision, advanced and smart manufacture etc.)
- Active regional clustering within the manufacturing sector, including the Midlands aerospace alliance, Made in the Midlands, Make UK (Midlands),
- High profile manufacturing research and innovation centres, including: the Manufacturing Technology Centre (MTC); Warwick Manufacturing Group (WMG); and High Temperature Research Centre (HTRC)
- Strong academic research capabilities
- Strong business support capabilities within the region:
  - IP management (essential for space due to need for transparency)
  - Established network of west midlands growth hubs – GBS, CW, Stoke & Staffs, BC, Marches, Worcestershire
- Strong manufacturing skills base and existing skills support:
  - Skills Factory – employer-led education and training designed to address shortfalls in key technical skills (e.g. advanced manufacturing).
  - Elite Centre for Manufacturing Skills - demand-led apprenticeships and short-course training provision.
  - Advanced Manufacturing Training Centre (AMTC) – provision of advanced apprenticeship programmes in the field of advanced manufacturing

These regional strengths are complimented by **strong national drivers** for OEM's (aerospace, defence, and space) to source more in the UK.

# W

## WEAKNESSES

### Key regional weakness and challenges to growth of space manufacture include:

- Lack of big company(s) or regional space assets within the West Midlands for supply chains and companies to cluster around and take a lead (as they do for the aerospace sector).
- Many manufacturing companies within the west midlands reside within the “long tail” (lower value) part of the value chain.
- Limited available skilled resource trained for space manufacture, and in particular ‘Shopfloor’ technicians/engineers for manufacture and assembly (driven in part by competition with other industries, such as automotive, aerospace etc.).
- Lack of training programmes that specifically address this skill gap for space manufacture (or able to meet anticipated future demand).
- Many companies have limited awareness and understanding of:
  - What the space sector is, how it operates, who the key stakeholders are, how to get involved etc. The relevance of their products and services to space.
  - Regulatory, certification, or international trading (licensing) requirements and how to comply with these.
  - Existing and future programmes, opportunities, requirements, and challenges - Limited public awareness of space (2.0) and what the UK is doing in this sector.
- Poor engagement and transparency from OEMs/primes/subsystem manufacturers:
  - Value chains are ‘closed’ to those already involved and difficult to enter (due in part to the time, cost, and risk of on-boarding new suppliers) - suppliers find it difficult to raise their profile and ‘get a foot in the door’.
  - This creates barriers to early engagement of suppliers at the design stage (to get their materials and components designed into the specification), an essential requirement to becoming an eventual supplier.
- Poor awareness of academic specialisms, capabilities/facilities, and IP/technology leading to poor academic and industrial collaboration.
- Lack of specific business support within the west midland to facilitate access to or growth within space markets.
- Limited access to finance for: 1) early-stage research; and/or 2) upfront development costs; and specialist support to help with bids. Time to market is long (years). Require upfront investment with a long period to reward (ROI). Barrier for many companies.
- Traditionally, the space sector involves low production volumes, bespoke user requirements, with strict quality testing / documentation requirements. This may deter many suppliers from participating in the value chain, especially suppliers who are geared to manufacture for high-volume markets.

# O

## OPPORTUNITIES

### Key regional opportunities within the space manufacturing sector include:

- Transition towards low-cost volumetric production of launch vehicles and satellites utilising advanced manufacturing processes and more standardised components.
- Adoption of Industry 4.0 technologies for enhanced efficiencies, productivity, and quality management.
- Global recognition and leadership - rapid growth of both domestic and international space manufacturing markets through leveraging / pivoting existing strengths / capacity.

# T

## THREATS

### Key threats to our regional space manufacturing sector include:

- Competition from domestic and global competitors seeking to achieve recognised leadership within our target niches.
- Competition from lower-wage economies who are increasingly able to meet quality, performance, and delivery requirements.
- Potential conflict / competition with other space clusters who seek growth within our target niches.



To facilitate entry and growth of our manufacturing supply-chains within existing and future space value chains we have identified 3 key 'must-win' battles:

- 1) early engagement and collaboration with space primes/OEMs and sub-system manufacturers – *to unlock supply-chain opportunities,*
- 2) recognition, mobilisation, and alignment of regional supply-chain capabilities for space manufacture – *to mobilise and structure regional capabilities,* and
- 3) step-change enhancement of regional manufacturing offerings and capabilities, meeting existing and future unmet supply-chain needs – *to achieve international recognition and leadership in our target specialisms, facilitating customer engagement and take-up, and thereby driving penetration and growth within global markets*

## EXPERT COMMENTARY

### The Diversification of related sectors (within the context of developing a West Midlands Space Cluster)

Professor Raquel Ortega Argiles

The development of new industries or technologies across the geographical space is characterised by path and place dependence: new activities are more likely to emerge in domains whose organisational routines are cognitively close to those that already exist in a given location. **Considering the mix of advanced manufacturing industries, skills, technologies, components, and local institutions, developing a space cluster for the West Midlands seems to be an opportunity for regional diversification in the region.**

Regional diversification refers exclusively to regions' ability to develop new varieties of technologies. More generally, it may also concern developing new varieties of goods, industries and scientific knowledge. In the context of Smart Specialisation, Diversification can be understood as the dynamic process of change and the transformation of regional structures, while specialisation refers to domains in which given regions concentrate their expertise in this process of regional industrial renewal. These regional diversification processes should evolve and do not concentrate exclusively on a single domain to avoid industrial lock-in scenarios.

**West Midlands region should pursue diversified specialisation processes, concentrating their efforts in given domains of local specialisation. Focusing in areas of advanced manufacturing such as the automotive industries or advanced manufacturing, in areas of higher added-value services such as business and professional services or logistics, but at the same time, continuously endeavour to diversify and replace existing specialisations with new (and improved) ones such as space technologies, electric vehicles, railway technologies.** These processes normally are dependent on existing regional capabilities, allowing related new and existing varieties to emerge consistently as an essential driving force for new industrial pathways. Related varieties of goods, technologies and industries appear when their development requires similar knowledge, applying similar techniques and/or similar raw materials (for example, auto and aerospace components are related because they are manufactured using similar technologies, skills and materials).

**Modern clusters are instrumental in creating industrial regeneration and related technological and skill diversification in a region.** In the context of Smart Specialisation, modern clusters are defined as the concentration of economic activities in groups of related industries in a specific location connected through multiple linkages and spillovers. In particular, the development of clusters facilitates the process of regional diversification because:

- There are positive effects in productivity and innovation levels associated with critical mass due to higher Specialisation and competitive pressure.
- There are positive effects related to the cross-industry nature of value chains and innovation ecosystems due to economies of scope, i.e. benefiting from related industries and at the same time spurring local growth in employment in these industries.
- Positive externalities arise based on the interactions and linkages between local businesses, institutions, talent base and local markets being stronger in related industries.
- Clusters emerge based on the opportunities for specific and related companies to invest, succeed and grow. They result from a cumulative process of "success breeds success" where one business's success paves the way for others to follow.

- They can integrate research/innovation projects funded through the cluster initiative with market development activities and with customers and private or public users, primarily via "living labs" and global value chain activities.

**Developing a space cluster for the West Midlands is not an easy task as successful clusters come in all shapes and sizes.** As there is no one-size-fits-all cluster model (i.e., industrial cluster, research-driven cluster, launched through a government policy or without public intervention, mature or emerging cluster) and a "best practice" does not exist, West Midlands must find the best cluster shape to build competitive advantages based on its local strengths and assets combined with global networks' inspirations and trends but also based on the experience of successful local clusters.

**Design and developing a cluster space within the West Midlands do not end in its implementation and require a strategic approach for its evolution and cluster cooperation.** The most successful clusters are the ones that are interregionally connected with other related clusters (i.e. space clusters in other parts of the world) or complementary clusters (i.e. technological, skills or scientifically related – advanced manufacturing clusters, logistic clusters). Cluster cooperation can appear when solutions and demands with actors from other clusters can further promote commercialisation, value chain opportunities and accelerate innovation uptake. This should be understood to be related only to radical innovation that is new to the world and covers value-chain innovation, where an existing innovation is brought to a new field of application and triggers change.

## 2.3 Downstream Space Application Businesses in the West Midlands

Whilst the West Midlands is home to only a handful of downstream space application businesses, the region combines latent space application capabilities with important end-user sectors for space data/services, creating a powerful value-chain ecosystem for innovation, business growth, and end-user benefit. Our latent space application capabilities including, data analytics, image analysis, artificial intelligence, machine learning, gaming technologies. Combining ubiquitous connectivity, remote sensing, and precision navigation and time, space enabled systems and services have the potential to transform end-user sectors, addressing major industrial and societal challenges and driving innovation, competitiveness, and growth. There is a real opportunity to build on the existing digital infrastructure in the region to further the growth of the downstream application sector.

### Stakeholder Feedback

“We need to leverage the data and digital community that we do have in the region, it's very strong, it's going to get even stronger with the arrival of 5G in the region” (Space Leadership Group Meeting).

“I think now more than ever, what we're seeing is the digital revolution. And I think that the key point here is around supporting the businesses that already exist and possibly do already supply to the space supply chain, but to really kind of engage with them much more to understand that there are many commercial opportunities that are emerging at the moment” (Space Leadership Group Meeting).

The West Midlands holds particular strengths in key user sectors that have the potential to benefit significantly from space enabled data and services, including future transport (connected and autonomous vehicles, digital rail etc.), modern services, health and life sciences (connected data driven services), and agriculture 4.0 (precision agriculture and autonomous farming systems).

However, space applications in these downstream user sectors are currently limited by:

- end-user awareness of space enabled capabilities,
- space application provider awareness of unmet end-user needs and challenges,
- performance limitations of existing space assets, and
- accessibility and cost of space data

Furthermore, whilst the West Midlands holds key strengths in the fields of computer and data sciences, there are relatively few businesses in the region operating within the space applications value-chain segment (primarily due to its emergent nature), limiting our innovation and growth potential. The challenge is being able to identify these downstream space application businesses, since: *“data companies do not recognise themselves as space companies. So part of your exercise has to be to try and get those companies that don't self-identify a space”* (Space Leadership Group Meeting).

Whilst challenges associated with performance, accessibility, and cost of space data are anticipated to reduce in time with growing UK (and international) space assets, these must be carefully aligned with use case requirements and roadmaps.

### Downstream Space Applications SWOT analysis:

We have engaged with key stakeholders across the downstream space application sector to understand our regional strengths, weaknesses, opportunities, and threats.

**Key regional strengths for space applications include:**

**S**

**STRENGTHS**

- UKs largest technology and digital sector outside London, representing 14,000+ businesses mobilised across existing industry clusters, such as Innovation Birmingham (tech and digital), Warwickshire ‘Silicon Spa’ (gaming technologies), Birmingham and Solihull (Data driven healthcare and technologies), and Malvern (cyber security).
- Strong academic and research capabilities within key areas of enabling science and technology relevant to downstream space applications (from sensors to value added data services)
- Existing government and regional authority engagement and capabilities:
  - West Midlands Office for data analytics (supporting policy and decision making)
  - West Midlands Police seen as national leaders in the use of data analytics, cloud computing, and digital transformation.
  - High Potential Opportunity (HPO) schemes led by Department for International Trade to boost foreign direct investment (FDI) within areas relevant to downstream space applications.
- Strong regional value-chains for sectors relevant to downstream space applications, spanning customer/market demand through to solution providers, manufacturing and service supply-chains, business support etc.
- Established network of west midlands growth hubs and broader business support services.
- West Midlands (multi-city) 5G testbed and future mobility zone with a broad portfolio of flagship applications and networks, including connected and autonomous vehicles, medical and emergency services, construction, and industry 4.0; providing an ideal ecosystem for the development, take-up, and testing of applications utilising space data and services.

**Key regional weakness and challenges to growth of space applications include:**

**W**

**WEAKNESSES**

- Limited existing regional industry for space applications.
- End-user awareness and understanding of space capabilities, applications, and benefits (art of the possible), creating barriers to user engagement and adoption.
- Access to and cost of space data and services, compounded by the lack of sovereign space capabilities.
- Concerns surrounding the privacy and (cyber) security of space data and services.
- Existing markets are small and niche, creating barriers to investment and growth. This is compounded by inferior public and private finance for space applications compared to competitors in Europe and the US.

- Whilst the region produces employees and graduates with the required skills for downstream space applications, these are increasingly being poached by compar skills gap.

**Key regional opportunities within the space applications sector include:**

**O**

**OPPORTUNITIES**

- Regional strengths within key end-user sectors with high growth potential for space applications:
    - Automotive ('Connected and Autonomous Vehicles' and 'Road Traffic Management').
    - Rail ('Connectivity', Rail Traffic Management', and 'Infrastructure and Hazard Monitoring').
    - Modern Services ('Insurance Services' and 'Property Technology').
    - Health and Life Sciences (from '(Tele-/e-) healthcare services within remote locations', and 'Connectivity and navigation of emergency services', to 'Healthcare modelling and prediction' and 'Disease surveillance and control').
    - Agriculture (from 'Precision Farming' and 'Agricultural Logistics', to 'Connected and Autonomous Farm Machinery).
- (see case studies 1-5 below)*
- High potential for new business within downstream space application sectors, facilitated by established technology and digital industry base, combined within key research strengths within areas of enabling science and technology, and a strong innovation ecosystem and business support services.

**Key threats to our regional space applications sector include:**

**T**

**THREATS**

- Competition from outside the UK. We are still playing catch-up with European competitors who have access to better finance and assets.
- Cost of existing (space) data and services create barriers to the viability of many downstream applications.
- Lack of sovereign capabilities create a vulnerability to the access of data and services.
- Resilience of space assets to malicious attack leading to loss of essential space data.
- The capabilities, capacity, and/or reliability of space data and services (connectivity, PNT, EO), and/or sector skill base, does not grow with downstream needs and demand.

To facilitate growth of downstream space application and user sectors we have identified X key 'must win' battles:

- 1) engagement with key end-users to raise awareness, explore potential applications, and demonstrate the use and benefits of space enabled systems and services – *to stimulate market demand and enables to benefits of space to be realised*
- 2) growth of space application start-up's (and pivots) – *to generate a regional capability to meet this demand and capture market share*
- 3) step-change enhancement of regional offerings and capabilities within our end-user market niches – *to achieve international recognition and leadership in our target specialisms, facilitating growth within global markets*



### 3. THE WEST MIDLANDS INNOVATION ECOSYSTEM

The ambition to develop a local space cluster in the West Midlands that closely aligns with existing regional policy, including the Local Industrial Strategy, Digital Roadmap and Made Smarter Programme. This section will first outline these regional policies and their relevance to our regional space strategy. The section will outline the core strengths of the region, specifically relating to its human capital, funding, infrastructure, market demand and culture and incentives. Finally, the section will outline the local university strengths, exploring space-related research and degree programmes.

#### 3.1 Existing Regional Policy

##### Alignment with regional priorities

Our vision aligns closely with key regional strategies and priorities:

##### West Midlands Local Industry Strategy

The 2019 ‘West Midlands Local Industry Strategy’ identified the region as:

*“a distinctive economy – creative and innovative, with global supply chain strengths, a diverse and young population, well connected, trading, and entrepreneurial.”*

Key **market opportunities** and **sector strengths** for the region include:

Major new market opportunities			
<b>Future of mobility</b>	<b>Data driven health and life sciences</b>	<b>Creative content, techniques, and technologies</b>	<b>Modern Services</b>

Sector strengths			
<b>Low carbon technology</b> Energy and clean growth	<b>Aerospace</b> Precision component manufacturing	<b>Logistics / transport technology</b> Future mobility	<b>Metals and materials</b> Innovative supply chains
<b>Life sciences</b> Devices, diagnostics, real life testing	<b>Professional skills</b> Skills and a full services sector	<b>Rail</b> Digital rail, High Speed 2	<b>Construction</b> Offsite modern manufacturing, Land remediation
<b>Creative</b> Games, Next generation content, process and product design and designer maker	<b>Food and drink</b> Machinery, food and fluid control technology, Photonics R&D	<b>Automotive</b> Battery development, Drive train, CAV	<b>Tourism</b> Shakespeare’s England, Commonwealth Games, Business, City of culture

These market opportunities and sector strengths translate into strong latent space potential within both upstream and downstream value-chain sectors.

##### Digital Roadmap

The West Midlands's Digital Roadmap highlights how digital connectivity is going to be vital to the region's economic bounce back post-COVID 19. It is described as the *"golden thread that links all of our industries – Advanced manufacturing, automotive, life sciences, professional services, construction, low carbon, transport, healthcare, public services"*, as they are being transformed by the power of digital technologies. Satellite enabled applications are central to digital connectivity and therefore supporting the development of a West Midlands space cluster directly aligns with the '5 Missions for 2021 – 2026' identified in the roadmap:

1. Securing access for everyone to digital opportunities, particularly those in poverty
2. Sharing and using data to improve people's lives
3. Becoming the UK's best-connected region
4. Realising the potential of digital to transform our economy and build economic resilience
5. Using digital public services to build a fairer, greener, healthier region

### **Made Smarter Programme**

Connected to the digital roadmap is the Made Smarter Adoption programme, which supports the digitisation of Manufacturing. The programme provides expert support to companies to upskill and reach a higher digital readiness level, supporting the adoption of industrial digital technology. By supporting adoption of industrial digital technology, such as robotics and automation, additive manufacturing or the Internet of Things, the programme will help level up regions by enabling manufacturers to increase their productivity, create high-skilled well-paid jobs and reduce their emissions. The key technologies associated with automation and the Internet of Things include satellite-enabled communications, global positioning satellites (GPS), and space based sensors. To realise these digital opportunities, investments are to be made in artificial intelligence, machine learning and data analytics, technologies which satellite-enabled application companies depend on. Therefore, space technology will both be a contributor and beneficiary of the Made Smarter Programme.

### **West Midlands Innovation Programme (MIT REAP-UK)**

The West Midlands Innovation Programme seek to "develop and support an innovation ecosystem that fosters entrepreneurship, drives up levels of business innovation and the exploitation of research and development, targeting varying needs in different parts of the region". A West Midlands Space Cluster aligns with the key pillars of the West Midlands Innovation Programme (WMIP):

- Networks and linkages – joining-up, leveraging, and supporting existing business support networks and programmes (relevant to our regional space strategy),
- Investment programmes – mobilising a range of finance products/mechanism to support growth of the regional space sector,
- Intelligence – exploring the space industry ecosystem and identifying and filling gaps in the innovation and entrepreneurial capacity,
- Culture – building an innovation culture by facilitating and showcasing the importance and impact of the regional space industry.

The cluster also supports a number of the 'must win' battles identified by the WMIP:

- Coherent regional funding strategy (aligned to space),
- Coordinated business support (building on existing programmes),
- Digitisation of manufacturing (space supply chain),

- Showcasing the region.

In line with the WMIP strategy we will target:

- Innovation and business advancement with “long-tail” supply chain firms with potential to supply to (and advance up the supply chain within) the emerging UK and global space industry,
- Innovation driven enterprises that are actively, or open to, exploring space opportunities,
- Start-up and scale-up firms that are experiencing high growth episodes.

### 3.2 Underlying Assets

The West Midlands Science and Innovation Audit (2017) identified three core strengths of the West Midlands Innovation Ecosystem:

- **A diverse, crosscutting research and innovation base** – comprising 12 universities (many consistently ranked in the top 20 nationally for the quality of their blue sky and applied research), 2 catapult centres (Manufacturing Technology Centre, and Energy Systems Catapult), 11+ science parks, 14+ incubators, and 10+ accelerators (the largest collection in the country)
- **An engine of private sector research and development** – with businesses across the West Midlands investing £2.3bn+ annually in R&D (2016), making up 10% of all UK Business Enterprise expenditure on R&D (BERD) and the 4th highest region in the UK.
- **Home to dense innovation networks and clusters** – of original engineering manufacturers, universities, and firms in strategic sectors. These can be found in: Birmingham, Coventry and Wolverhampton city centres; Edgbaston’s life sciences cluster; the area surrounding Birmingham Airport; the automotive and future mobility cluster around Coventry and Warwickshire; Digbeth and Leamington Spa’s ‘Silicon Spa’ cluster of computer game companies; and Malvern’s emerging cyber-security cluster.

This is underpinned by significant physical infrastructure by universities, industry, and public sector organisations that have invested across the West Midlands.

The collective assets, employee skills, technologies, processes, products and services of local firms, together with local endowments such as infrastructure and skills, underlie both the current level of competitive (dis)advantage and the latent potential for a region to successfully adapt to new opportunities. This combination is unique for every region and underlies regional specialisation. The [‘MIT REAP framework’](#) suggests a set of measures that captures the strengths of a specific region and identify its current level of competitive (dis)advantage . These measures are grouped into the following themes:

- **Human capital:** The workforce (from within a region, or attracted into a region) with relevant education, training and experience.
- **Funding:** The availability of public and private sector capital to support innovation and entrepreneurship.
- **Infrastructure:** The physical infrastructure (e.g. land, buildings, transport, connectivity) that is needed to support innovation and entrepreneurship at different stages.
- **Demand:** The level and nature of specialised demand for the outputs of innovation and entrepreneurial capacities supplied by different organisations in the system.
- **Culture and Incentives:** The social norms that shape acceptable career choices and the incentives that shape individual team behaviours.

The MIT REAP West Midlands Team has developed a simple set of metrics to evaluate the current state of the West Midlands ecosystem and paired them with the above themes. An analysis of these indicators has helped to identify the ‘comparative advantage’ of the West Midlands and will help inform decisions on local Business Support for the growth of a future Space Cluster. A summary of this analysis is identified in the following sub-sections.

## Human Capital

The region supports a substantial engineering and manufacturing skill set which is being utilised in the automotive and aerospace manufacturing sectors, but could also lend itself to the growth of a future space cluster. The high prestige and quality of the scientific research institutions in the West Midlands helps attract talent and is central to many of the region's technology clusters. Birmingham produces 39.1 STEM graduates per 1000 people which is far higher than the UK average of 19.8. This is important since a higher quality of STEM education leads to a higher rate of more advanced technological breakthroughs made. The important distinction here is retention of these graduates. The problem appears to be that although the region is producing graduates they may not be staying, only 33.5% of the region's population (861,700 people) have a degree level qualification (NVQ4+). To reach the UK average of 40.2%, an additional 173,249 need to be upskilled.

There are a wide range of business support programmes available to help individuals with their start-ups run by both universities and councils. There is also a variety of specific sector support activities such as **'SuperTech's no-code 'Seeds' programme'**, aimed at working within the business, professional and financial services sector to help bring ideas for tech-enabled services to reality in a quicker, cheaper and more effective way. There is also training available in entrepreneurship and in business leadership, but this is fragmented. A recent development in the region is the launch of the **BEIS small business leadership programme** which is delivered by 3 of the region's universities.

### SuperTech's no-code 'Seeds' programme launches

The West Midlands has become the first region globally to invest in latest 'no-code' technology to help drive economic growth. SuperTech Seeds is a new programme specifically aimed at professionals working within the business, professional and financial services sector to help bring ideas for tech-enabled services to reality in a quicker, cheaper and more effective way. Founded on no-code skills development, SuperTech Seeds supports anyone, no matter their previous technological abilities, to create web and mobile applications. No-code is being seen as a way of quickly and effectively solving business problems, launching new services and products and creating new enterprises - key in the world of tech and business start-ups.

SuperTech Seeds is for:

- professionals with a seed of an idea but with no access to tech to progress OR
- professionals who want to experiment with an MVP and test the market sooner OR
- those who want to upskill in technology without learning to code

## Funding

The West Midlands is identified as a 'business-led innovation region'. This reflects the above-average levels of private sector investment in R&D in the region. However, strong evidence now points to the disproportionate levels of public R&D expenditure dedicated to London and the South East and identifies the West Midlands as a region which receives well below an equivalent, per-capita allocation. Nevertheless, there are encouraging signs that the Government has recognised this and is beginning to consider how to respond to these disparities in how funding is allocated.

A report from HMRC on companies raising funds<sup>5</sup> showed that spinout companies from the Midlands Universities offer a potentially attractive portfolio for investment, built from a collective investment in research of £550m p.a. The portfolio has generated £15m cash returns for MI universities in the past five years, with the remaining university equity currently valued at £30m. The 'paper value' of the companies is £440m. The spinouts already raise a collective average of over £60m investment a year and are currently seeking around £105m. Add in the relevant university-affiliated businesses in the Midlands and investment capital demand is potentially over £300m/year).

The recent Midlands Engine Investment Fund (MEIF) has provided an important boost to regional funding, the £93m reserved for the very risky 'proof-of-concept' (seed) and venture stage (scale-up) equity investment over its initial investment period of five years to 2022. Most of the Midlands Innovation universities have established, or invested in, small (<£5m) regional seed funds in the past. However, there are only three significant regional venture capital firms managing such funds in the Midlands (Mercia, Midven and Foresight) and despite these funds' useful contributions, they have been small. Therefore, the region still requires larger funds that can make sequential investments of the right scale and timing; and a fund management structure that stays aligned with the needs of the universities. Organisations such as '**Minerva Business Angels**' are actively working to address this gap.

### Minerva Business Angels – Warwick's Dynamic Angel Group

Minerva Business Angels started in 1994 to support the tenants of the University of Warwick Science Park and has grown into the UK's largest syndicated networks. Minerva has supported ~100 businesses and help raise over £63m and looks to support companies raising from £150,000 to £3m. Minerva focuses on tech businesses, both start-ups and scale-ups, and has grown by establishing collaborative relationships with other universities such as Aston, Birmingham, Loughborough, Liverpool John Moores, Nottingham Trent, and Nottingham. It also works with Sci-Tech Daresbury Park and the Black Country Growth Hub to deliver investment groups in their areas as well Warwick Business School to deliver Minerva London at The Shard. Minerva recently launched two new specialist groups. A Creative & Digital Angel Group (the first outside of London, if not the only one of its kind in the UK) and the Super Start-Up Club. Super Start-Up Club is designed to support the best start-ups to achieve their potential in the Midlands, and also to help the members of MICRA West Midlands spinouts accomplish the same (MICRA is a collaboration between the Intellectual Transfer Offices of Aston, Birmingham, Cranfield, Keele, Leicester, Loughborough, Nottingham and Warwick universities to bring their best IP to the market).

### Infrastructure

The West Midlands region benefits from its central location and being one of largest urban areas outside London. Its central location at the heart of the road and rail network, together with Birmingham International Airport, means that it is well connected to the rest of the UK and international markets. There is intra-regional variation for super-fast, ultra-fast and Full Fibre availability. The West Midlands is behind the UK average of 6% for full fibre availability (% of premises). The figures in Walsall are 7.2% and 3.3% in Birmingham and Coventry. However, in Wolverhampton they are 0.7% and 0.8% in Sandwell and Dudley. There is huge potential in using digital technologies to support the growth and scale up of the region's businesses. **WM5G** has helped position the region as a place to come but there is still a reluctance in businesses up taking technologies of this type.

<sup>5</sup> Enterprise Investment Scheme Seed Enterprise Investment Scheme and Social Investment Tax Relief (2019) HMRC

## West Midlands 5G (WM5G)

West Midlands 5G is part of the wider government Urban Connected Communities Project and an Associate Partner of UK5G. West Midlands 5G (WM5G) has been established to accelerate the benefits of 5G throughout the region– for local people, public services and businesses. WM5G is a multi-million-pound programme that both the West Midlands Combined Authority (WMCA) and the Department for Digital, Culture, Media and Sport (DCMS) have set-up to develop the UK’s first region-wide 5G testbed. Their ongoing projects include work in the areas of health and social care, transport and manufacturing, with wide-reaching implications in the West Midlands and beyond. From connected ultrasound to self-drive vehicles, WM5G is opening up new pathways of possibility through 5G. The West Midlands and Birmingham have reaped the rewards of WM5G’s Infrastructure Acceleration programme and have been ranked highest in a new 5G mobile coverage study by an independent telecoms advisory company.

There are 11 United Kingdom Science Park Association (UKSPA) member sites in the West Midlands (four of which are part of the University of Warwick Science Park network) providing a highly competitive land and property offer for firms seeking space for start-up and grow-on space. There are science parks focused on particular sectors and disciplines (e.g. Innovation Birmingham Campus on the digital and technology sectors, Birmingham Research Park on biomedical, and Stoneleigh Park on science-based rural industries). Some science parks have a broader remit to focus on supporting technology-rich and science-based firms across sectors – e.g. the science parks associated with Coventry, Warwick and Wolverhampton universities. The geographic spread is important as start-ups frequently prefer to be close to home or their ‘parent’ organisation.

Often operating as part of science parks, business incubators and start-up accelerators provide flexible property and value added business support services to new start-up firms. They are predominantly physical workspaces providing facilities, lab space and technical equipment. They are run on a not for profit basis receiving their funding primarily from government and lottery grants in addition to rents for their premises. By providing free or low cost workspaces, incubators try to facilitate business survival, growth and success for young entrepreneurs and their start-ups. In contrast to incubators, start-up accelerators tend not to provide workspaces though meetings might take place in co-working locations. They provide cohort based start-up support and training focusing on services rather than physical space. Founders are supported in developing their business plan, investor pitch prototypes and market [testing](#). The duration of the support is generally fixed. It lasts usually three to twelve months and is thus shorter than in [incubators](#).

**Below are some examples of Business Incubators, Accelerators and Research Centres that can be found in the region and available to potential space sector companies.**

### **BetaDen**

Based at Malvern Hill Science Park, BetaDen, is the first tech accelerator in Worcestershire supporting emerging technologies including AI, Hazard Intelligence, Biometrics, Cyber and 5G. It is co-located with one of the UKs first 5g testbeds which provides a platform for businesses to develop the next generation technology, such as the internet of things and industry 4.0. Set-up by Worcester County Council in 2018 and publicly funded by the EU (ERDF) and local government (Worcester LEP), BetaDen offers entrepreneurs, start-ups and scale up businesses a nine month programme including mentoring, business advice, events plus free office space, access to 5G testbed and Proof of Concept grant funding worth £10,000. Located in the south of the West Midlands and close to GCHQ in Cheltenham, their initial emphasis was on cyber security firms spilling over from Gloucestershire but attracting now businesses from Birmingham, Oxford and Southampton. These are often spin-outs from universities or bigger companies. In regards to the space sector, BetaDen is located in the immediate vicinity of Qinetiq and Collins Aerospace and interested in exploring partnerships with industry as part of a supply focus and working together with innovative partners.

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### **Innovation Birmingham Campus**

Established by Aston University, owned by Birmingham City Council and since three years ago wholly owned by commercial property developer Bruntwood SciTech, the Innovation Birmingham Campus is one of the oldest Science Parks in the UK. It is the region's leading digital tech campus and home to over 170 entrepreneurs, start-ups and scale-ups innovating in areas including battery charging, fluid quality monitoring, drones, imagery, VR, AR and remote training delivery. It is centrally located and close to Aston and Birmingham City University and provides access to investors, including the £250M+ Midlands Engine Investment Fund, skills and talent through close links to universities. Digital tech start-ups can benefit from free co-working space and commercial opportunities in their Serendip Smart City Incubator which is funded by private corporates to increase their R&D capacity. It hosts Innovate@HS2, the accelerator programme for HS2 that works with the Connected Places Catapult to develop innovative digital products and services, 5SPRING, the UK's first 5G commercial application accelerator led by Telefonica where companies can build business cases for the use of 5G, and explores electric VTOL jet technology for transport links between SciTech's cities. Innovation Birmingham Campus had a number of events organised by the European Space agency pre-COVID.

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### **Ignite Incubators**

The University of Warwick Science Park (UWSP) start-up programme, *Ignite Incubators*, offers office space and practical help for tech companies with high growth potential. They are located at the University of Warwick, in Binley and Warwick, close to Coventry with its tradition in automotive and the Silicon Spa game developer cluster in Warwick. The three Ignite incubators each provide offices for 18 start-ups on a 12-month license with all costs built into an escalating structure plus a virtual incubator. Ignite Incubators allow start-up and early stage companies to tap into the resources of UWSP: Access to finance (*A2F*), access to investors (*Minerva Business Angels*) and access to markets (*Techmark*). UWSP runs *Business Ready*, a support service for tech-based businesses offering them both, business and technical support, which is funded by the EU (ERDF) and Warwickshire County Council. Over three years the Science Park has supported 240 start-ups 1,171 businesses and created 218 jobs. Located at UWSP are a number of companies working on space applications, for example, dSpace, Lyra Electronics and RCD Except as well as a significant cluster of enabling technology companies with space technology being a potential application.

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### **The Staffordshire Advanced Materials, Incubator & Accelerator Centre**

The Staffordshire Advanced Materials, Incubator & Accelerator Centre (SAMIAC) at Staffordshire University supports incubation and accelerates growth in the advanced materials sector and is part of UK Research Innovation (UKRI). It is situated within Staffordshire University's Enterprise Zone in Stoke-on-Trent and offers eleven incubator offices in close proximity of a dedicated Advanced Materials Lab. Example of equipment are Quantum Efficiency Measurement System (QEM), Laser Induced Breakdown Spectroscopy (LIBS), Particle Size Analyser, Micro indentation and micro scratch testing. For companies in the early stages of their development, there are five dedicated pods of office space allocated in the Hatchery. In addition, Staffordshire University graduate entrepreneurs are supported by a year long programme of business support and development, *be inspired at Staffordshire University* (biSU), including training, mentoring, workshops and grants. Over five years, they have supported 166 entrepreneurs to set up a new company.

Author: Dr Juliane Schwarz

Located in Coventry, the West Midlands is also home to the **Manufacturing Technology Centre (MTC)**. MTC is one of the seven innovation and technology Centres that form the High Value Manufacturing Catapult (HVMC). Each centre operates as its own independent organisation under the HVMC umbrella, mandated and partially funded by the UK government to accelerate manufacturing across different markets through the adoption of advanced technology, processes and materials. The MTC is a leading centre of excellence for automation, industrial robotics and digital manufacturing. The 20,000m<sup>2</sup> facilities they have developed are configurable for confidential work, and the MTC engage with their commercial members (over 100), industry and academia to develop and prove new manufacturing processes and technologies. Working directly with partners, the MTC collaborates openly developing, delivering and



managing R&D projects into the space sector and other industrial markets (Energy, Defence, Aerospace and Agriculture). Along with its partners, the MTC has significant experience in establishing National Innovation Centres in industrial disciplines including robotics and manufacturing since opening their doors in 2010.

### Manufacturing Technology Centre

As part of the UK Catapult network, the Manufacturing Technology Centre (MTC) enable Industrial sector growth through application of State of the art Manufacturing processes, and development of the art of the possible Manufacturing Technologies. The MTC is the representative for the wider High Value Manufacturing Catapult on all Space sector activities providing a single point of entry for the sector.

The MTC has developed relevant capability and worked in the Space sector over a number of years, but has recently (September 2020) accelerated its Space sector effort identifying opportunities for development, application and commercialisation of technologies (particularly robotics) to support the advancement of the space sector. Moreover, leveraging its position within the government ecosystem, the MTC is able to shape and influence policies at ministerial level to generate the necessary support to attract investment.

The MTC Space Sector Strategy identifies 4 main areas where they have identified an industry requirement that is aligned with the internal MTC capabilities:

1. **Economies of scale** - Lean operation/ Automation / Discovery - craft built to production
2. **Production scale up** – Supply chain tools and resilience, robotics, simulation and modelling, supply chain tools
3. **Sustainable Space Initiatives** – Alternative options for Space Debris management (e.g. Technology and manufacturing processes for recycling, repurposing and refurbishing)
4. **Application of COTS technology** - Increased accessibility to On-Orbit capability and benefits

The MTC has a number of past/ongoing projects in relation to Space and Robotics, which can be leveraged as the West Midlands space cluster develops.

### Market Demand

The West Midlands region filed 148 patents in 2018/2019 which is above the national average. The West Midlands is also the 3rd largest value export region in England and exports more than Wales and Northern Ireland. In the West Midlands Combined Authority (3 LEP area) the following sectors are in a greater proportion (in terms of percentage number of jobs) when compared to the national average:

- advanced manufacturing and engineering (11.4% vs 8.0%),
- the public sector including education (13.1% vs 12.9%),
- logistics and transport technologies (5.9% vs 4.9 %),
- life sciences and health care (13% v 12.7%) and
- retail (16.6% v 15.3%).

This suggests that the domestic market is attractive enough for the products/services of a new enterprise to form in these sectors. Based on the strength in these sectors the Local Industrial Strategy has also identified 4 major market opportunities for the region. These are Creative content, techniques and technology; Data-driven health and life sciences; Future of mobility; and Modern Services. As discussed in the case study boxes in section 2 of this report, there is a great deal of overlap between these major market opportunities and the downstream applications for satellite-enabled services.

### *Culture and Incentives*

The WMCA had a business base of 170,475 active enterprises, this has increased at a faster rate than the UK average growth (3.3% compared to 0.5%) since 2017. However, there were 18,805 enterprise births in 2013 in the WMCA (3 LEP), 42.1% (7,910) were still active in 2018. This is slightly below the UK survival rate of 42.4%. The latest report by the Enterprise Research Centre observed that data from successive UK Innovation Surveys suggests that the proportion of innovation active firms fell 58 per cent during the last recession (2008-10) with parallel falls in product/service innovation (26.6 per cent), process innovation (22.6 per cent). Therefore, the region, should expect sharp falls (perhaps a third) in the proportion of innovating firms post the COVID-19 pandemic (Roper, 2020). This aligns with a recent TechNation survey of 116 scaling tech companies, which found that 77% of these businesses had reported that they expected cash flow to be impacted by recent events, 80% of companies said they expected securing new customers to become a challenge, with 40% of companies saying they planned to lay off staff. Changes to the factors driving innovation will affect the type of changes introduced. For example, investment in capital equipment are expected to decrease. Additionally, the ERC's study observed "firms' willingness to invest in intangibles will fall sharply with implications for future innovation and growth". These investments include the marketing of innovations, design, external knowledge, and training are expected to decrease. However, a positive response from the survey showed that respondents agreed that businesses in the region were generally innovative and had been innovating.

The innovation culture in the west midlands is supported by a variety of networks, most notably those managed by the Innovation Alliance West Midlands who provide networks to promote innovation activity in a variety of sectors and promote innovations regionally. Crucially, there are a number of space-related networking groups that already exist in the region, including '**R&R space**', the '**West Midlands branch of the British Interplanetary Society**', and '**Midlands Innovation**'. These groups collectively promote engagement and interest with space technology in the West Midlands and their specific focuses are outlined in the case study boxes below.

## R&R Space Ltd

“Fostering innovation and connecting new skills with the space industry”

It is the mission of R&R Space Ltd to push the boundaries of space technology and innovation by engaging people and ideas. We achieve this through new and exciting concept events and training.

It is our aim to inspire a new wave of entrepreneurs and space explorers by unlocking their potential and linking them with new skills to build the future of space.

R&R Space is founded by two space enthusiasts and aspiring entrepreneurs, Ryan Laird and Ryan Bradley-Evans who share a common vision of humanity’s place in space.

### Our Vision

We believe that humanity’s future lies in space. But that future will only come to pass with the collaboration of different industries, all bringing together people with different ideas, strengths, interests and cultural backgrounds. We want to prepare for our future in space by training new skills, connecting different industries, making lasting connections, and increasing public awareness and interest.

### Our Values

- **Community and collaboration:** We seek to ensure a safe and welcoming environment at all our events, enabling personal growth, leading to partnerships and the development of lasting relationships.
- **Diversity:** We know it takes people with different ideas, strengths, interests and cultural backgrounds to achieve greatness. We are strong believers that successful innovation comes from a mix of skillsets and backgrounds,
- **Equal opportunities and inclusivity:** Our events will seek to be inclusive of gender, sexual orientation, disability, race and religion. We have a zero tolerance approach to harassment in any form at our events.
- **Sharing skills and cultivating new ideas:** We believe that in order to prepare for humanity’s future in space, we need to bring together different skill sets and interests, connecting people from different industries and backgrounds.
- **Environmental sustainability:** We share a concern for our environment and the world around us. We seek to use recyclable or compostable materials as much as we can at our events.

## West Midlands Branch – the British Interplanetary Society

The British Interplanetary Society is an international membership society and registered charity that is devoted to initiating, promoting and disseminating new concepts and technical information about space flight and astronautics. Founded in 1933, the British Interplanetary Society is the world's longest established organisation devoted solely to supporting and promoting the exploration of space and astronautics.

The BIS headquarters are located in Central London, within 5 minutes' walk from Vauxhall Underground, Rail and Bus Stations – enabling easy access for visitors to the Society. We also have International and UK based branches.

The Society has local branches across the Globe and local groups. Local Groups include BIS West Midlands <https://www.bis-space.com/bis-west-midlands-branch-uk/>

BIS Branches, the most active of which is the West Midlands which is ideally situated to assist in the creation and support of the West Midlands Space Cluster,.

Of particular interest for the creation of the West Midlands Space Cluster is that the UK's biggest "Free" Space event "Space Day" run by the West Midlands branch and hosted by the Hive at Worcester <http://www.thehiveworcester.org/>

For nearly 90 years, the BIS has supported the development of visionary concepts in spaceflight, and offered unique opportunities to network and connect within the space industry. The BIS is known in the "Space" community for its great thought-provoking Magazines and ground breaking/fascinating Technical projects.

## Midlands Innovation

Midlands Innovation is a collaboration between the eight research intensive universities in the Midlands. Our ambition is to drive cutting-edge research, innovation and skills development that will grow the high-tech, high-skilled economy of the Midlands and the UK.

The Midlands Innovation partners have collective strengths in the academic disciplines that apply to 'space' in its broadest sense.

These range from advanced materials and aerospace engineering, astrophysics and earth observation/environment, through to laser physics, management, manufacturing, metrology, planetary exploration, space instrumentation and space system design.

These collective strengths are supported by space and space-related research equipment and facilities that include additive manufacturing, anechoic chambers, cleanrooms, High Performance Computers, mechanical workshops, optical characterisation, surface analysis tools, ultra-precision machining/metrology, vacuum bakeout, vector network analysers and wind tunnels.

The group come together to explore opportunities for collaborative research, discuss training and skills needs for the space sector and how best to utilise the diverse range of space-related equipment housed across the partnership.

Working in partnership with organisations such as ‘STEM Learning’ is also essential for developing interest in the space sector amongst young people and providing them with the appropriate skills. This will help to create a future talent-pool within the West Midlands that is interested in working in either the upstream or downstream space sector.

*“From my experience speaking to thousands of young people through my digital youth initiative, I see a lot of talent but too little support. So we need to make sure industry support is in place for these young people to gain vital careers advice, industry skills and experience. Pre-skilling the regions youth now will be essential to filling current and future digital skills shortages, and setting our digital economy up for success”.*

Kari Lawler - Young West Midlands Combined Authority Digital Lead

STEM Learning is the number one provider of professional development and STEM support for teachers in the UK. ESERO-UK, also known as the UK Space Education and Resource Office, aims to use the context of space to open doors for young people by delivering engaging, world-class teaching in science, technology, engineering and mathematics (STEM).

ESERO-UK ([www.stem.org.uk/esero](http://www.stem.org.uk/esero)) is funded by the [European Space Agency](#), and the [UK Space Agency](#). The ESERO offices offer a full range of tailor-made resources and activities to primary and secondary school teachers and students.



Hundreds of space context teaching resources from primary to post-16



Professional development for teachers face-to-face and online



Competitions and challenges for young people



Profiles of careers in space shared across schools

**West Midlands in figures**

1 dedicated Space Lead for region

2 STEM Ambassador Hubs

149 Space STEM Ambassadors in the region from 23 organisations across the West Midlands

Over 130 teachers attended space themed CPD in 2020

Target of 150 teachers to engage in space themed CPD in 2021

Contact: Eva Fryc, Regional Network Lead, West Midlands [e.fryc@stem.org.uk](mailto:e.fryc@stem.org.uk) 07748 181211

## EXPERT COMMENTARY

### Meeting Skills Needs for the Space Sector

Professor Anne Green

*Introduction:* The space sector is experiencing continuing growth. As such, it should be an attractive sector for new entrants to the labour market. Also, at a time when various other sectors have seen a downturn in demand due to the Covid-19 crisis, job opportunities in the space sector should appeal to workers with relevant skills seeking to move elsewhere and to those interested in upskilling and/or reskilling. Yet the space sector faces skills deficiencies. In part this is due to the high level, specialised nature and mix of skills required, and to the demand for similar skills from other sectors. This underscores the need for firms in the space sector – nationally and regionally – to consider carefully what more they can do to meet their skills needs. This means examining recruitment, training, skills utilisation and retention. This study provides information on the number and types of higher education courses in the West Midlands of relevance to the upstream and downstream space applications, while the [2020 Space Census](#) and the [Space Sector Skills Survey 2020](#) provide recent insights into skills issues in late 2019 and early 2020 at national level. All of these sources are drawn on here.

*Types of skills needed:* The space sector is characterised by a highly qualified workforce, often with graduate and postgraduate qualifications. While some space sector firms require one or more specific space specialisms – such as satellite imagery processing and interpretation, orbital mechanics, launch operations, space system engineering, etc., there is also strong demand for generic technical skills – such as data science, AI techniques, software engineering, etc. These generic technical skills are also in demand across a range of manufacturing and services sectors. An underpinning breadth of scientific understanding, primarily in maths and physics, is particularly important in the space sector. Yet ‘scientific’ skills alone are insufficient for many roles in the space sector. Other skills, such as ‘agility’ and communication and collaboration skills, are increasingly valuable for businesses, along with commercial awareness and business acumen. Moreover, given that on the job learning plays an important role in the space sector, there is a need for mentoring and teaching skills. The challenges of hiring people with a ‘hybrid skills’ set (i.e. both sector specific specialisms and non-sector specific skills) is exacerbated when recruiting for those roles requiring a specific combination of skill sets. Findings from the Space Sector Skills Survey 2020 reveal a demand for ‘transferable skills’ as well as for ‘specialised skills’ amongst firms in the space sector recruiting staff late 2019 and early 2020. In a similar vein, [an analysis of 812 early career UK space sector job adverts](#) using a competencies taxonomy, identified software development and data analysis skills as the technical skills that were most sought after. The same analysis reveals a high demand for interpersonal and communication skills. Chiming with the findings of an [Industrial Strategy Council report on the UK Skills Mismatch examining the economy as a whole](#), the space sector requires both technology and people (including management and leadership) skills.

*Skills deficiencies:* Skills deficiencies comprise skills gaps in the existing workforce (i.e. in the internal labour market) and skill shortages on the external labour market. According to the Space Sector Skills Survey 2020 the most frequently cited skills gaps in scientific, engineering or technical functions in the existing space sector workforce were in software engineering, radio frequency engineering, systems engineering, engineering or electronics design, electronic engineering at professional level, and AI and machine learning. The most commonly cited difficulties for those space sector businesses citing difficulties recruiting on the external labour market were first, applicants lacking required experience; secondly, applicants lacking required specialist skills, knowledge or qualifications; and thirdly Brexit reducing the ability to attract people from Europe. These answers are indicative of wider skill shortages on the external

labour market in the UK. The fact that ‘lack of required experience’ was the most commonly cited difficulty may be indicative of a preference to recruit rather than to train, which is evident across the UK economy more generally. The fourth and fifth most commonly cited reasons for recruitment difficulties were competition from businesses in other sectors, followed by competition from businesses in space-related activities. These responses indicate the wider demand for skills sought in the space sector. This includes the programming skills that are so sought after in the space sector. They may be symptomatic of a fear of poaching, which in turn may lead to some reluctance to invest in training.

*Supply of graduates:* The asset mapping in the West Midlands for this report highlights a strong higher education base in the region. Focusing first on upstream activities, across 12 universities there are 228 related courses (the majority in engineering-related subjects) and 21,600 enrolments. Some universities (e.g. Birmingham and Warwick) have experience of European Space Agency funded projects and there are some good examples of links with industry stakeholders (including the University of Warwick Satellite Engineering project), including projects focusing on product development to help small businesses (e.g. the Enabling Technologies and Innovation Competencies Challenge Project at Aston). There are also a large number of downstream activities, with 12 universities teaching 491 related courses (including in business studies, engineering and technology and computer science) and 80,110 enrolments. Yet there are concerns that courses in universities, though space-oriented, lag behind industry developments in the context of rapidly advancing technologies and/or lack specificity to the space sector’s particular needs. Indeed, 40% of companies in the Space Sector Skills Survey 2020 reported gaps in current training provision, primarily at the graduate/post-graduate level, so suggesting a need for the development of postgraduate training courses aimed at developing specific skills. Yet the Survey also reveals that graduates are in plentiful supply – especially for entry-level positions.

*Attracting recruits for the space sector:* While the space sector has traditionally focused on recruiting highly qualified postgraduates and undergraduates, disproportionately from higher socio-economic groups and from privately educated backgrounds. To supplement the more traditional talent pipeline, it is important not to overlook other potential labour pools, including recruits with A levels and workers with experience in other sectors. Employers – especially smaller firms – prefer recruits with direct experience of working in the space sector, so narrowing recruitment. This desire for experience places some onus on the space sector to develop internship and placement programmes. Research suggests that there is a perception that entry to the sector is difficult without specialist skills, which may put off potential applicants. Recognising that shortcomings in recruitment are a barrier to growth, other sectors in the West Midlands, such as the professional and business services sector, are working to broaden their recruitment activities to attract, and benefit from, a more diverse talent pool. The 2020 Space Census shows that women are significantly under-represented in the space sector, reflecting wider trends amongst STEM students and graduates. In the West Midlands there is particular potential to harness skills from a relatively large population of young women and men. However, the evidence suggests that the space sector is characterised by an inward-focused approach to recruitment. Work by the Space Skills Alliance on [assessing the quality of space job adverts highlights that whereas most adverts provided clear information on](#) job title, company background, job description, and person specification, they tended to be much less clear about salary details, benefits, diversity statements and the transparency of the recruitment process. These latter factors all impact on the diversity of candidates who apply. This suggests that there is scope to revise conventional recruitment methods to reach and attract a wider pool of potential applicants.

*Retention:* The results of the Space Sector Skills Survey 2020 show that in addition to recruitment, retention is a problem for some companies in the space sector. It seems that retention challenges are starkest in large companies. Once space sector employees have a few years’ experience they become more valuable to other space sector businesses (given the preference outlined above for workers with directly relevant experience.) Moreover, after three-six years working in the space sector some graduates realise that their work experience means that their value has increased also for employers outside the sector and with their technical and other skills, which are in demand elsewhere, they can earn more outside the sector. Uncompetitive pay is the most frequently cited reason in the Space

Sector Skills Survey 2020 amongst those firms experiencing staff retention difficulties. While space sector firms often provide competitive pay to highly-qualified entrants, pay rates may be less attractive as experience increases and so space firms are vulnerable to poaching for higher pay by firms within and beyond the sector.

*The challenge ahead:* Given that the space sector requires high level specialised technical and transferable skills, many of which that are in demand across the economy, it is likely to face ongoing competition for skills. Furthermore, Brexit may mean that the UK space sector may be less attractive to European Union workers, who comprised the majority of foreign nationals working in the sector. [Previous research has identified key limitations of the current space skills pipeline](#) as encompassing a lack of awareness of the space sector, lack of opportunities to develop experience, and the mismatch between teaching useful knowledge in universities.

*Opportunities:* Yet there are opportunities to address skills needs in the space sector in the West Midlands (and beyond). There is scope to widen recruitment beyond conventional channels. The professional and business services sector in the West Midlands has successfully broadened non-graduate recruitment to take on people with A levels and to utilise apprenticeships – including degree apprenticeships – to a greater extent than was formerly the case. In doing so, it has begun to diversify its workforce. Employers and education and training providers have adjusted their training programmes accordingly. In the space sector the absence of a training-supported entry route for young people at the ‘A’ level point has been identified already. In a context of continued growth within the sector the time would be ripe to implement this. A further key source of new talent is skilled workers with transferable skills in engineering and advanced manufacturing (notably the aerospace and automotive sectors which are particularly important in the West Midlands). Here there is potential for existing firms to pivot into the space sector. With the addition of a ‘space’ dimension to existing technical qualifications and transferable skills, there would be scope for workers made redundant/ otherwise looking to change jobs to move into the space sector. Hence, alongside looking to a broader talent pool for recruitment, there is need to address current limitations in the training infrastructure, as indicated above. In the university sector evidence from Industrial Strategy Council research on [Rising to the UK’s Skills Challenges](#) suggests that many companies value strong relationships with higher education institutions where they can help shape the curriculum and collaborate on course development and programme design, as well as offering regular placement opportunities. There are examples in the West Midlands (e.g. from the Warwick Manufacturing Group) that could be built on here. In this way students’ exposure to, and work experience in, the space sector would stand them in good stead. With regard to retention, in addition to looking at ways of making pay more competitive, non-pecuniary avenues for keeping and further developing skills include creating opportunities to work on new projects. A multi-pronged strategy to meeting skills needs for the space sector is required – current approaches are not up to the task.



### 3.3 Local University Strengths

  
**10 Universities**  
teaching Upstream  
related subjects

  
**7 Universities**  
Activity participating in  
Upstream research

  
**228**  
Related Upstream  
Courses

  
**21,600**  
Related Upstream  
Enrolments

  
**2<sup>nd</sup>**  
Largest number of  
engineering enrolments  
(outside of London)

  
**3<sup>rd</sup>**  
Largest number of upstream  
undergraduate enrolments  
(outside of London)

**Author: Alice Pugh**

### Upstream Space Related Courses

The space industry workforce is extremely highly skilled, with 75% or 3 in 4 employees possessing at least a bachelor's degree. 13% of employees hold a vocational qualification (i.e. Higher National Certificate (HNC) or the Higher National Diploma (HND)), with the remaining 11% having other qualifications such as, space-specific diplomas from the ESA or other space related institutions. Therefore, the average qualification level of space industry employees is higher than any sector covered by ONS Census data for England and Wales, and this spans all of the value chain in the industry. It is highly important therefore, to understand the qualification levels of the West Midlands workforce in regards to university subjects related to both the upstream and downstream space industry.

According to Space Careers.UK<sup>6</sup> the main degrees to enter the upstream space industry are mainly STEM subjects, such as: Physical Sciences (Astronomy, physics, chemistry etc.); Maths and Engineering. Within the West Midlands there are currently 12 University Institutes providing undergraduate courses. In total across the region there are 228 courses provided at 10 of the 12 universities related to the upstream space industry. Coventry University had the most undergraduate enrolments associated with the upstream Space Industry, at 4,835 enrolments, followed by University of Birmingham and the University of Warwick. The majority of enrolments for upstream related subjects was in Engineering and technology at 13,090 enrolments out of a total of 21,600 upstream related enrolments across the Universities, or 61% of total enrolments. Compared to the 9 other regions in England, the West Midlands has the 4<sup>th</sup> largest number of enrolments into upstream related subject areas, as seen in figure 5. However, whilst the West Midlands is 4<sup>th</sup> in enrolments in total for these subject areas, it does significantly better in Engineering and Technology, where it climbs to 3<sup>rd</sup>. It is not surprising that the West Midlands has a large number of Engineering and Technology enrolments, as the West Midlands has a robust Advanced Manufacturing Industry, centred around automotive manufacturing and aerospace sectors. This is important as no successful upstream project can be completed without high quality engineering know how<sup>7</sup>.

<sup>6</sup> [Space Careers.uk](https://spacecareers.uk): Undergraduate degrees associated with the Upstream within the industry

<sup>7</sup> ESA, 2020. [Access](#)

## Downstream Space Related Courses

As the downstream is the utilisation of objects sent into space for commercial products and services on Earth<sup>8</sup>, there are a large number of graduate jobs that could feed into the downstream. Downstream activities usually involve activities such as: Earth Observation (Weather, Geology, Climate Change, Maritime etc); Navigation; Telecommunications; Human Space flight Technologies; Space Weather; and Data collection and storage<sup>9,10</sup>. Again, much like in the case of upstream subject enrolment, Coventry University is also seeing the most enrolments in downstream related subject's comparative to the other universities in the region, with 26% of enrolments taking place at Coventry University across all the universities across the region. With the majority of enrolments in downstream related subjects across the region, being in Business and administrative studies (39%), Engineering and technology (20%) and Computer Science (13%). Compared to universities in other regions within England the West Midlands saw the 4<sup>th</sup> most enrolments in undergraduate courses related to the downstream. The West Midlands has the 3<sup>rd</sup> largest number of enrolments for Computer Science, 2<sup>nd</sup> largest outside of London.

## Upstream Space Related Projects and Research

The Universities with the West Midlands have strong ties to the advanced manufacturing sector and whilst some of the universities may not have participated in upstream space industry projects or research, some of the research they do conduct or participate in could be easily utilised or pivoted to be relevant to the upstream space industry. Some University researchers may not even be aware that their work can be utilised by the space industry. This section exhibits the projects, research and partnerships that some of the universities in the region have engaged with historically that hold relevance to the upstream space industry.

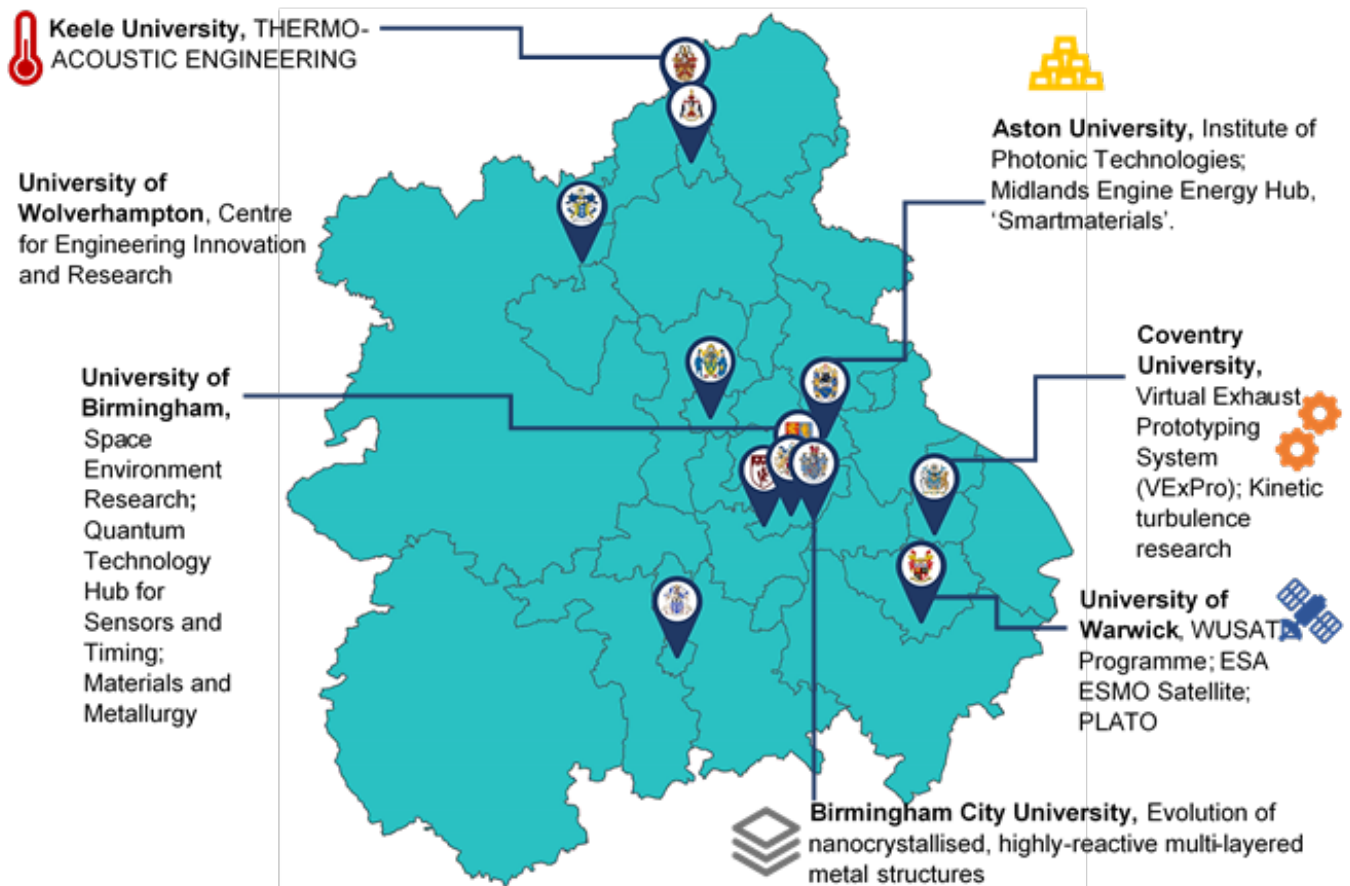
Overall, whilst not all universities in the region have directly participated in research in the upstream space industry, they may have the potential to, as majority of the university do teach subjects relating to the upstream space industry. The majority of these universities also have strong links to the aerospace and advanced manufacturing industry, and a vast knowledge of expertise in these industries. This knowledge and skills is highly likely to be transferable to the upstream space industry, whether it be conducting research into new space materials or designing and making small components for satellites or rockets. As the space industry grows it may be that these university become aware of the skills that they offer, however at the moment there it appears that some universities in the region are unaware of the expertise that they hold that could be applied to the industry. However, the larger universities Birmingham and Warwick, do have an extensive history of working on upstream space research in the past and have made strong connection with institutes such as the ESA. Overall, there is a strong skills knowledge in this area in engineering, technology and advanced manufacturing which, could be easily utilised in the future to help with innovations within the upstream space industry.

<sup>8</sup> Department for Business, Energy & Industrial Strategy

<sup>9</sup> ESA, 2019: Downstream Gateway. Access:

[https://www.esa.int/About\\_Us/Corporate\\_news/Downstream\\_Gateway\\_bringing\\_space\\_down\\_to\\_Earth#:~:text='Downstream'%20means%20all%20those%20activities,the%20European%20economy%20or%20society](https://www.esa.int/About_Us/Corporate_news/Downstream_Gateway_bringing_space_down_to_Earth#:~:text='Downstream'%20means%20all%20those%20activities,the%20European%20economy%20or%20society).

<sup>10</sup> OI Space Incubator, 2020: Downstream Space. Access: <https://www.oispace.co.uk/downstream-space-sector/>



**Figure 7:** Examples of Upstream-related projects / research capabilities in the West Midlands

**Author:** Alice Pugh

The sector is supported by a **strong university base** offering courses, capabilities, and technology with direct and/or latent upstream space potential:

- 10 of the 12 university in the region offer 228 STEM courses relevant to the upstream space sector with 21,600 enrolments. Whilst ranking centrally within the UK for all STEM subjects, the West Midlands has the third highest enrolments for Engineering and Technology
- The majority of universities have strong links to the aerospace sector and advanced manufacturing industry, and vast knowledge and capabilities in the fields
- The larger universities (Birmingham, Warwick, Coventry) have an extensive history of working on upstream space research and close connections with key institutes such as the ESA, UK Space Agency etc.

**Other examples of specific projects include:**

**Keele:**

- POLKA – hydrogen-fuelled combustion system (advanced simulation)

**Birmingham:**

- Lisa Pathfinder – first generation gravitational wave detector (phasemeter, optical bench)
- Photam – Equipment for 3D printing in space
- Impress – novel, higher-performance intermetallic alloys
- STE-QUEST – testing Einstein's equivalence principle using an atom interferometer and an atomic clock

- AMCASH – 2-day technical interventions for SMEs (microscopy and materials characterisation, polymer science, computational modelling)
- Science2Industry – SME interventions to overcome product, process, or R&D-based technical challenges

**Warwick:**

- ESA ESMO Satellite – Moon Orbiter (electrical power supply system)
- WUSAT-3 – ongoing 4<sup>th</sup> year MEng project to develop a CubeSat
- PLATO - search for small, rocky exoplanets in the in the habitable zone of stars

**Birmingham City:**

- Evolution of nanocrystallised, highly-reactive multi-layered metal structures

**Aston:**

- Various projects spanning fibre gratings, optoelectronics, nonlinear photonics, fibre lasers, material processing, UV and femtosecond lasers, THz technology, and nano-photonics.

**Coventry:**

- Kinetic turbulence in magnetised plasmas
- VExPro – Virtual Exhaust Prototyping System

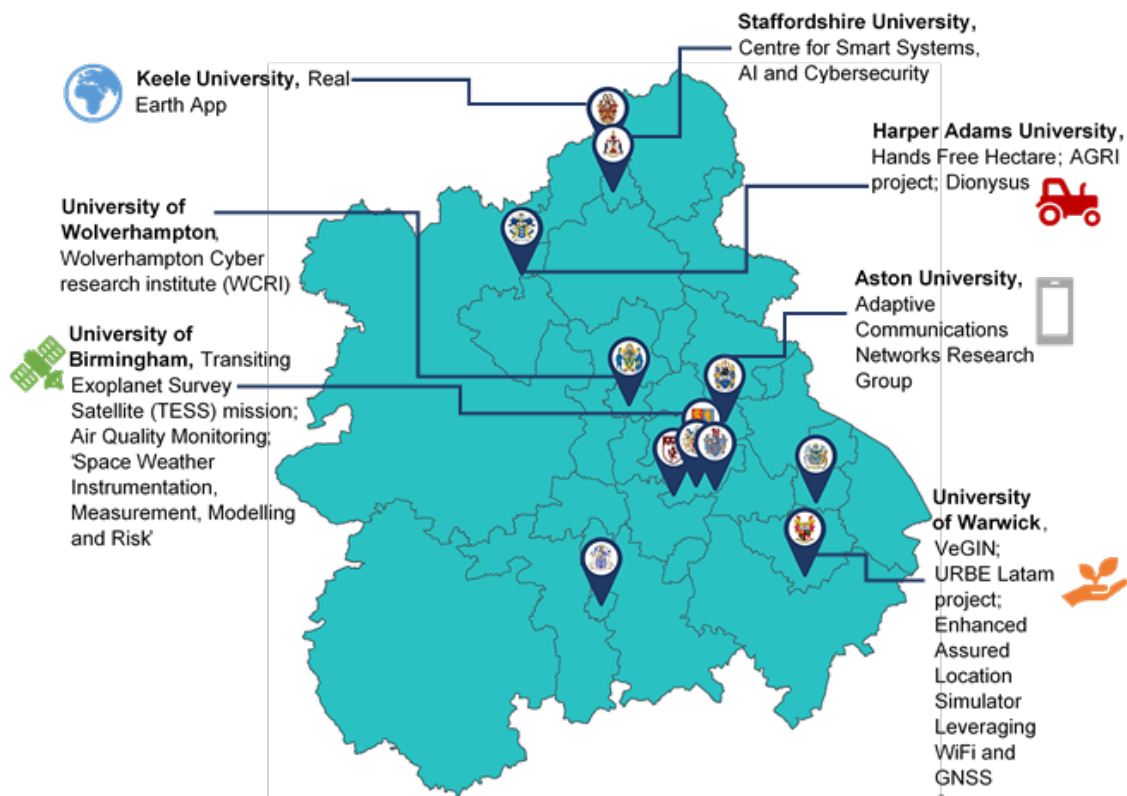
**Wolverhampton:**

- Various projects spanning advanced materials and composites, advanced manufacturing, structural mechanics, and vibro-acoustics

## Downstream Space Related Projects and Research

The **regional universities** demonstrate both existing and latent capabilities for downstream space applications. Key areas of strength relevant to space applications include

- Sensors and measurement (e.g. Quantum Sensors and Timing – Birmingham), machine learning and artificial intelligence (e.g. Centre for applied artificial intelligence)
- Warwick, Centre for Smart Systems, Artificial Intelligence and Cybersecurity – Staffordshire),
- Imagine analysis and visualisation, augmented and virtual reality, cloud computing (e.g. Centre for Data Science – Coventry),
- Big data and data analytics (e.g. Warwick Data Science Institute, Data Analytics and AI Group – Birmingham City),
- Cyber-security (e.g. Centre for Cyber Security – Wolverhampton),
- Internet of Things (Emerging Device Technology Group – Birmingham), 5G and wireless technologies (e.g. Adaptive Communications Networks Research Group - Aston), robotics and automation (Robotics – Birmingham), and blockchain.



**Figure 8:** Examples of Downstream-related projects in the West Midlands  
**Author:** Alice Pugh

**Other examples of specific projects include:**

**Keele University:**

- Real Earth App - uses satellite images to demonstrate the different ecosystems on Earth, and the environmental catastrophes faced globally.

**The University of Birmingham**

- Space Environment and Radio Engineering (SERENE) Group - AENeAS - an operational first-principles data assimilation model of the Earth’s ionosphere and thermosphere.
- Transiting Exoplanet Survey Satellite (TESS) mission
- SWIMMR (Space Weather Instrumentation, Measurement, Modelling and Risk)

**University of Warwick**

- Warwick Manufacturing Group - Robust GNSS for Intelligent Vehicles / Enhanced Assured Location Simulation Leveraging Wi-Fi and GNSS for Sensor Fusion
- The Vegetable Genetic Improvement Network

**Harper Adams University**

- Farming by Satellite Prize
- Hands Free Hectare Programme
- Dionysus - This is autonomous vineyard robot developed by Harper Adams.
- Synergy - Project Synergy will introduce innovative technologies to operate connected autonomous

**Aston University**

- Adaptive Communications Networks Research Group
- 4G/5G Mobile Cellular Systems and Technologies- Intensive research on the 5th generation (5G) cellular network architecture and technologies
- Internet of Things Systems and Technologies- the inter-working of physical devices (such as smart meters, buildings, vehicles).

**Staffordshire University**

- Smart systems- research on new models and architectures for various applications and addresses emerging challenges.
- Artificial Intelligence (AI)- the deployment of AI technologies into smart systems, for enhanced decision making.
- Cybersecurity research centre

**University of Wolverhampton**

- Wolverhampton Cyber research institute (WCRI)

**University of Worcester**

- River Science and Unmanned Aerial Vehicle surveys

## EXPERT COMMENTARY

### Hidden potential? The role of universities in the development of space-related innovation clusters

Professor Simon Collinson

#### **The Role of Universities**

A dynamic regional innovation ecosystem enables some regions to adapt faster or better than other regions. Universities, as both R&D producers and skills developers, are an integral part of this ecosystem, particularly when new technology or R&D-based opportunities appear. The alignment (or misalignment) between university R&D strengths and local firm-level innovation is a key component of this dynamism. A close match between the R&D and skills produced by local universities and demand by local firms and strong 'absorptive capacity' enables the region to exploit and benefit from new knowledge, expertise or technology for improved competitive advantage. The alternative, in less well-aligned ecosystems, is where graduates leave to work elsewhere and university R&D outputs are exploited by firms elsewhere, nationally or internationally.

The Birmingham city-region economy was an increasingly attractive place for both businesses and talented employees to invest, work and live in the pre-COVID period. We know this from data on inward investment and graduate retention. More students, from outside the region studying in local universities, stayed to work in this region after they graduated than in the recent past. This attractiveness was driving the economic and cultural renaissance of the city-region before the economic shock stalled the growth momentum.

In the case of new and emergent industries which are R&D-intensive, the role of universities is even more important. This is why it is helpful to map the R&D projects and education programmes across the group of local universities, against the demand for firm-level assets and expertise, in a new or emergent industry sector. By comparing this with similar combinations in other regions we can estimate the relative competitive advantage of one place against another. To some extent, this helps shape national and local R&D investment policies and other interventions which, under conditions of limited resources (i.e., always), need to accurately target particular growth policies towards places with particular kinds of comparative and competitive potential.

In our research on the regional space sector, mapping local university R&D and educational programmes and understanding how much these involved collaboration and the co-production of knowledge and expertise with and/or relevant to local firms, proved to be a very good place to start. Our 'university asset mapping' shows that R&D programmes, closely related to new opportunities in the space sector, exist in the West Midlands region. For example, the UKRI-funded SWIMMR (Space Weather Instrumentation, Measurement, Modelling and Risk) project, which will deliver improved monitoring capability to the UK's Met Office, involves a national consortium led by the University of Birmingham. The 'Enhanced Assured Location Simulator Leveraging WiFi and GNSS Sensor Fusion' (ELWAG) project is the focus of an Innovate UK project led by Spirent Communications and WMG at the University of Warwick. It aims to help intelligent vehicles and smart devices to gain more accurate location awareness by integrating Global Navigation Satellite Systems (GNSS) and WiFi signals.

Similarly, an analysis of teaching programmes in regional universities, focused on subjects like engineering, technology, physics, ICT and computer sciences, but including more specialist modules such as telecommunications, data analytics, navigation, GIS, or earth observation gave an estimate of the local skills 'supply-side'. This revealed, for example, that Coventry University is a significant source of the right kinds of skills for this industry.

The downstream space sector, particularly space applications and data services businesses, employs the majority of space sector workers (79%) and has grown at an average rate of 5% per annum in the last 5 years. Demand is likely to increase. So, regions that have a ready supply of talent are likely to attract investment from firms that are expanding

or moving into the space sector. The West Midlands has the second-largest cohort of students outside of London studying in these subject areas. This makes it attractive for investors in this emerging industry.

But a number of challenging questions still remain. First, how much of the R&D in local universities is transferred, or spills-over, potentially via graduates, to benefit firms in the local space innovation ecosystem? Second, is this revealed alignment, between universities and business, any greater than in other comparable regions? Do the university contributions give support particular patents, technologies, processes, capabilities or knowledge that provide sustainable competitive advantages, again compared to combinations elsewhere?

It is worth trying to resolve some of these questions, if only to get a slightly clearer vision of what the future might bring for regions that needs investment and jobs, now more than ever.



## 4. REGIONAL SPACE STRATEGY

### 4.1 Where do we want to be? A vision of the future for the West Midlands?

Our vision is a future where the West Midlands plays a pivotal role in the UK space industry:

- closely engaged with upstream space primes and subsystem system manufacturers, downstream space application markets, and broader national and international stakeholders.
- providing connected and globally leading supply-chain capabilities:
  - mobilised around well-defined areas of competency (mirroring those found within the regional aerospace sector),
  - leveraging our significant manufacturing base (aerospace, automotive, and rail) with high latent space manufacturing potential,
  - and competencies in advanced manufacturing and industry 4.0,
  - supporting the upstream manufacture of satellites, spacecraft, and launch vehicles,
  - and representing ~10% of UK space manufacturing market by 2030 (£323m GDP by 2030),
- realising a thriving downstream space applications sector:
  - comprising a balance of disruptive start-up business, and businesses that have either pivoted into, or have adopted, the use of space data and services,
  - leveraging our significant regional competencies in data and computer sciences,
  - to realise internationally competitive and disruptive space application products and services,
  - addressing important industrial, commercial, and societal challenges,
  - within important end-user sectors of strength to the region (transport, modern professional services, health and life sciences, and agriculture),
  - and representing ~10% of the UK space applications market by 2030 (£1.32bn GDP by 2030),
- achieving international recognition for our capabilities with strong exports markets (>12.5% GDP) for both upstream space manufacture and downstream space application services,
- attracting new business to the region and significant inward investment (£300m by 2030),
- investing >£300m in research and innovation by 2030,
- supporting growth in regional:
  - GDP, targeting ~£1.64bn direct growth by 2030, with a further £40bn+ of GDP reliant upon satellite services, and
  - Employment, targeting 3,000+ new jobs by 2030,
- providing high-quality training to support the regional (and UK) space industry (3,000+ additional skilled people by 2030),

### 4.2 Implementation

Co-ownership of our regional space strategy is important and it is imperative that there is continued collaboration across our different stakeholder groups (building on our Space Leadership Group activities). The key stakeholders include businesses, universities, investors, local government bodies/agencies, and entrepreneurs/potential start-ups.

The 'UKSA Local Space Sector Cluster and Supply Chain Development Funding Call' for the region has been a partnership between the University of Birmingham, the West Midlands Combined Authority, GBSLEP, the Black Country LEP and Coventry and Warwickshire LEP. The local government partners will be invited to adopt the strategy going forward.

It is envisaged that the Space Cluster will be initially launched and operated in collaboration with the Midlands Aerospace Alliance (MAA). The MMA is a regional association that:

- already mobilises many key regional and national stakeholders associated with upstream space manufacture,
- draws many parallels with the space sector, with direct experience in:
  - the clustering and coordination of sector specific activities and initiatives,
  - supporting businesses that operate with a heavily regulated and global sector,
- has an existing ‘cross sector pivot programme’ financed by the West Midlands Combined Authority, and ERDF funding, to facilitate and support aerospace companies to enter new markets (such as space)
- encompasses the required profile to draw the attention and engagement of key regional and national stakeholders.
- has an established management and operational structure that may be leveraged to efficiently support a new space cluster,

It is envisaged that the Space Cluster will (Figure 9):

- mobilise a non-executive advisory board, drawing key opinion leaders across our target regional value chains and selected national space sector bodies,
- recruit a chief executive officer who will establish the cluster foundations and lead its continued development and growth,
- recruit one or more thematic leaders who will lead specific priority areas within the cluster strategy,
- leverage professional functional support resources from the MAA,



Figure 9. Space cluster operational structure

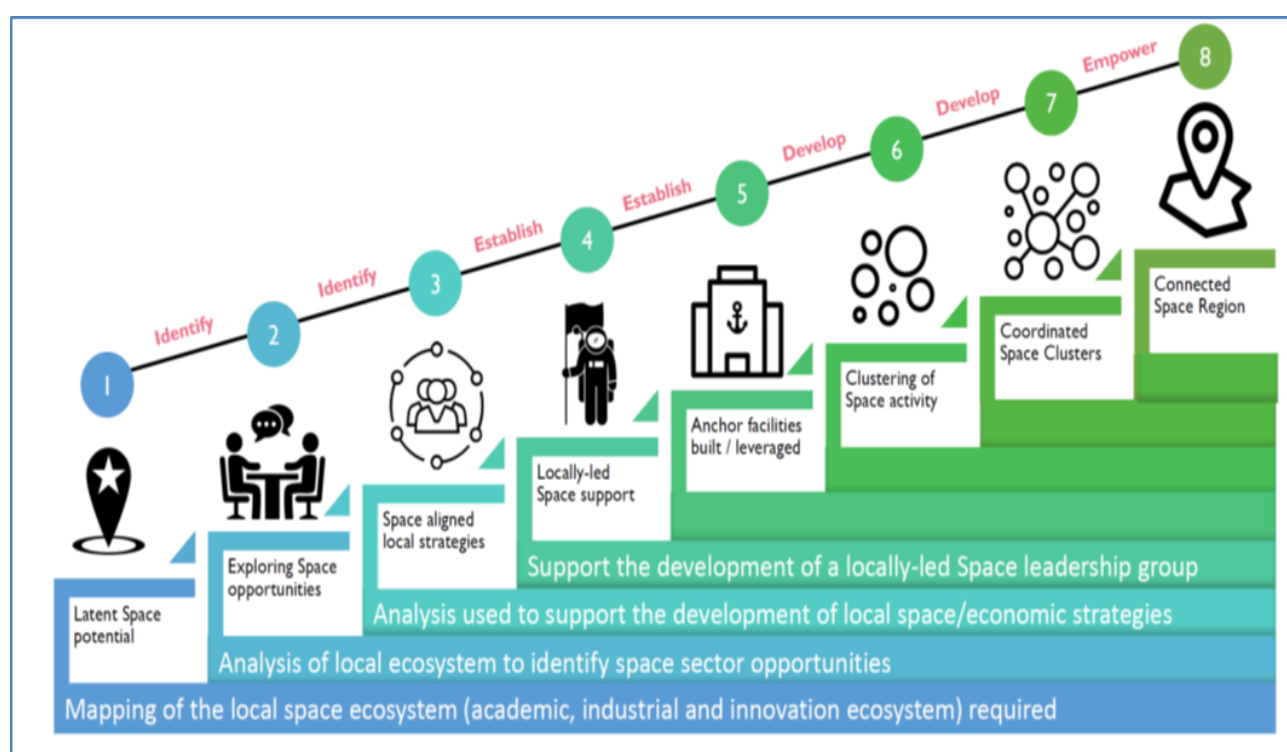
Wherever possible we will seek to leverage existing facilities and initiatives from within the region, thereby maximising efficiency and ensuring resources are focused on those activities that add the greatest value.

We will also seek to establish strategic collaborations with other regional and national clusters/initiatives, and in particular the Leicester Space Park.

### 4.3 West Midlands Space Cluster Approach

Our approach follows the 8 phases of the cluster roadmap (below). Our initial work as part of the UKSA project has enabled us to initiate the first four phases. So far, we have:

- 1) Identified our core areas of strength in terms of latent space potential,
- 2) Identified key upstream and downstream opportunities to apply and develop this potential,
- 3) Developed a top-level regional space strategy, and
- 4) Established a locally-led Space Leadership Group, mobilising stakeholders from government, industry, and research/academia.



The next phases of activity are to:

- 5) Establish anchor facilities at the heart of our cluster, leveraging key existing regional assets, and exploring the need for need dedicated facilities,
- 6) Establish clusters of space activity around our regional strengths and opportunities,
- 7) Coordinate cluster activities towards defined strategic goals, and
- 8) Integrate and empower our clusters within a connected space region.

It is important to note that these activities are not sequential, but rather run concurrently to continuously build and develop the cluster.

#### 4.3.1 Establishment of anchor facilities

Will mobilise the physical infrastructure to support the cluster. These anchor facilities will not only play a central role in supporting the cluster and providing focal points for activity, but will also raise the profile of the region, attracting interest and inward investment. We foresee three phases of development:

- Mobilisation of existing regional assets – to provide the foundations from which we may build the cluster infrastructure,
- Establishment of specialist support facilities – providing essential design, prototyping, and testing services aligned to our specific regional needs and interests, and
- Establishment of public-private funded applied research and innovation centre – supporting longer-term development goals that enhanced regional offerings and capabilities.

Existing regional assets include:

- Technology parks, business incubators and accelerator facilities - provide flexible property and value-added business support services to new start-up firms. they are predominantly physical workspaces providing facilities, lab space, and technical equipment. Examples in the West Midlands region, include: the UKSA Local Space Sector Cluster and Supply Chain Development Funding Cal, Innovation Birmingham Campus, (Ignite Incubators) Warwick Science Park, The Staffordshire Advanced Materials, Incubator & Accelerator Centre
- 12 regional Universities– to provide centres of excellence for science and technology, and essential research and innovation support services.
  - The first thing that stood out from our study is the sheer number of universities and the projects that are coming through academia in the West Midlands - we've got an incredibly strong solid base here e.g. "UoB has around 8 programmes of activity including access to key facilities such as radiation testing" (Space Leadership Group Meeting 3)
  - Access to University facilities is important given we have a wealth of start-ups and tech companies who won't have access to facilities.
- The Manufacturing Technology Centre is located in the region a representative for the wider 'Higher Value Manufacturing Catapult' on all space sector activities providing a single point of entry for the sector. The MTC has developed relevant capability and worked in the space sector over many years, and has recently (September 2020) accelerated its Space sector effort identifying opportunities for development, application and commercialisation of technologies (particularly robotics) to support the advancement of the space sector.

Examples of potential specialist support facilities include:

- A 'data centre' for downstream space application businesses – a collaborative space for companies to network and access data.
- Access to specialist support on standards / accreditation in the space sector.
  - Space sector primes might ask for suppliers to be certified to ISO 9001 or the aerospace sector-specific AS9100.
  - In the downstream space sector, primes might be interested in compliance to ISO27001 Information Security. Defence customers companies often ask for 'Cyber Essentials or Cyber Essential plus' which are more about the company IT systems being resilient to cyber-attack.
  - A slightly different sort of standard are the ECSS (European Cooperation for Space Standardization) <https://ecss.nl/> This is a huge list of specific design requirements for all aspects of spacecraft design. So when a prime is specifying their requirements they will typically reference the relevant ECSS standards in their statement of work. Then this helps them to decide the level of design, analysis and testing required to meet the standard.
  - Some of the debate about 'new space' is that the 'new space' companies (SSTL for example) do not follow all the ECSS standards and take a more pragmatic approach to risk – understanding the nuances here is important.

### 4.3.2 Clustering of space activities

We will mobilise and cluster space and related activities. Focus will be given to activities that are relevant to our strengths and identified opportunities. Key activities include:

**Stakeholders** – across the space value chain including upstream and downstream customers, supply-chain companies, providers of enabling technologies, academia and research organisations, government/regional agencies and partners, professional services, investors, etc.

**Networking/Connectivity** – linking the upstream sector with the downstream sector in the region, helping to grow the cluster as a whole.

- Just because you have both upstream and downstream – it does not mean they will talk to each other: “It was quite a difficult thing to make that connection between the upstream and the downstream when it comes to actual customers... the upstream sell to huge companies or governments... and the downstream sells to a myriad of commercial customers”.
- We have an opportunity to create a shared/collaborative culture, where like-minded businesses can come together, allowing mutually beneficial relationship creation.
- “Companies follow companies... It is about raising awareness to identify companies that are doing something exciting and all that is about facilitating local active networking”
- Early engagement of suppliers with OEMs/primes is key: - Early engagement at the innovation/R&D level, when technologies are being developed, enables trust to be built, which in-turn facilitates entry to supply chains. i.e. route in through R&D projects, recognising that it will take years to become an eventual supplier (new business)

**Leverage aerospace capabilities** – Need to ensure that we align our existing capabilities (within the West Midlands) with the space opportunities, and in particular the aerospace sector that is so adjacent to the space sector. This has to form one of the bedrock of what we do in the region and leverage into the space sector. Engagement here will help us to understand/learn about the next evolution of what is required by the space industry and primes.

- We need to “look at their supply chains, look at good companies in those supply chains and build out”.
- Could develop diversification voucher that supports everyday innovation; helping companies identify the right consultant. Could be relatively small - £5K - similar to an innovation voucher that gets companies to think through opportunities.
- R&D – different kinds of investments are needed at different stages. More difficult for start-ups in the upstream sector than the downstream.
- Need support for companies that have the capabilities and opportunities to pivot into Space. The majority of companies would not have an awareness of the supply chain, digital solutions relevant to space, etc. The majority of companies in the West Midlands would not profile themselves as space industry companies at all. Awareness-raising is needed around supply chains / digital solutions.
- Need to understand what is the level of risk involved in moving into the Space sector at different points in time? Is it better to move early? Or is it better to get involved in a smaller way over the longer-term?

**Facilitating networking across our regional academic partners** for joint ESA and UK Space Agency bids – “there is a lot of building blocks that if we can start to stack them up at a technical level, we can start to look”

- The “academic expertise is really diverse, we've got some fantastic specialisms. And actually, we could use this to start to tease out some of that very diverse expertise that we have here”.
- Public awareness is crucial if we want this to develop. Universities have an important role to play in this. Warwick is building a three-unit CubeSat, designed to go to the International Space Station to be in low Earth orbit.
- Connecting with other Universities – how can key research groups join together for the common good of the WM Space Cluster aspirations. Warwick University has strengths in future materials and manufacturing and

already closely work with Leicester. They are part of the Midlands Innovation Group, which also includes Birmingham. So there is the opportunity to strengthen that activity.

- The Universities could act as a safe space/forum where people are free to discuss the problems they are facing and shared objectives. - They could host an annual conference, which facilitates confidential meetings between firms and potential investors. This could include student competitions.
- However, we need to work hard to address specific challenges within University Institutions, such as:
  - Within universities, there are people next door to each other, who are not quite sure what each other is doing. We need to try to shine a lens on this and uncover where all these fantastic opportunities could be and what people are doing in terms of the research. There are going to be masses of ECRs, across all the universities in the region. But unless we can shine a light and uncover what they're doing, then those opportunities will not be commercially viable.
  - How can we ensure there is greater tech-transfer/spinouts from these universities? Need to put in place an applied funding stream to encourage near-to-market innovations within universities with the ambition that they will be measured, not by publications but being measured by the number of spinouts.
  - We have to avoid being 'ivory towers', and make sure that what we develop is fit for purpose for the local space industry. Role of universities important, but universities tend to be to blue skies. So there needs to be a national reorientation of certain University activities, so it becomes more of practical.
  - We are not matching research and industry together. So we are kind of doing it with other sectors like automotive, but we are not doing it with space. We need to widen our matching between employers and the graduates, which would help with that graduate retention piece.
- **Partnerships and collaboration** – collaborations with other clusters or organisations (inside and outside the region) for the exchange of information, networking, access to facilities, and collaborative activities, including:
  - Space-related: Space Park Leicester, Satellite Applications Catapult, UK Space Agency, Harwell and Westcott Space Clusters, Space Growth Partnership, etc., and
  - Non-space related: Midlands Aerospace Alliance, etc.

We foresee a close collaboration with Space Park Leicester, seeking to build synergistic capabilities that deliver value for stakeholders across the Midlands.

For **space manufacture**, we will seek to engage strongly with existing and future upstream customers. This is essential for ensuring supply chain capabilities and development focus are aligned with (and have access to) genuine upstream customer needs and demand (mirroring those found in the aerospace sector). Whilst there are several sub-system manufacturers located within the (West) Midlands, we will also seek to forge engagement with others (and space primes) outside the region.

For **space applications**, the focus will be given to engagement with downstream customers within our sectors of strength (stimulated and ensuring focus on genuine areas of demand) and enabling technology partners (such as data and computer sciences), ensuring the region has the necessary capabilities to respond to opportunities and demand.

### 4.3.3 Coordination of cluster

Will undertake activities to structure and coordinate progression towards our strategic goals. These will include:

#### **Awareness raising and networking:**

Awareness raising, knowledge exchange, and networking activities lie at the heart of the cluster activities. This is particularly important for many of the cluster members who are unfamiliar with the space market, and for driving engagement with the upstream space prime/subsystem manufacturers who are largely unfamiliar with our capabilities and unique service offerings, and downstream end-user customers who are often unfamiliar with space capabilities and uses. For example, many companies using space data do not think of themselves as ‘space’ companies - “we sell ourselves as basically providing information”. There are also needs to be awareness-raising amongst investors and local government stakeholders, since “when you use the word space, most people think of NASA and the big, shiny, multi-million pound opportunities that go on”. There is ‘knowledge brokering’, which needs to happen across the whole business community, as well as, the university community. We need to engage with stakeholders and almost go back to basics. Awareness raising is important because “industry frequently needing to start from square one when entering into stakeholder discussions...t would help greatly if stakeholder already had an understanding about space”.

We will seek to raise awareness concerning:

- the emerging Space 2.0 market, how it operates, and who the are stakeholders are,
- the existing and anticipated future programmes/missions, opportunities, and challenges,
- how companies can get involved and manage the regulatory, compliance, and (international) trading requirements,
- the capabilities/facilities, specialisms, and IP/technology of regional academic, RTO, and enabling technology partners,
- available business support services and finance opportunities, and
- the profile, capabilities, and unique product/service offerings of regional manufacturers (suppliers) to upstream primes/OEM and sub-system manufacturers

A broad range of **awareness raising** activities will be considered, including articles, reports, supplier catalogues and profiles, presentations, videos, and seminars. These will be stored/available via the cluster website and will be promoted across a broad range of dissemination/communication channels. For example, the UK Space Agency runs ‘space 101 training. There are also numerous awareness-raising courses ran by the Satellite Applications Catapult.

We will leverage our partnerships and collaborations to ensure transparency across value-chains and to ensure that our members have access to the most up-to-date information.

**As part of the awareness raising, we need to very clearly define what we mean by the ‘West Midlands’ Space Cluster:**

- We need to develop guidance on which companies are included – “one of the big challenges is actually getting companies who are technically using space data and white space, but don't realise that they're space companies” – we need to talk about ‘space enabled’ companies rather than space companies per se.
- Definition of downstream sector: “Research or operations are substantially or critically dependent on the capabilities or information supplied by satellites and related technologies”.
- From a LEP perspective we need to identify the opportunities for businesses to market and promote within the region – we need a compelling story to tell our business bases – a joined-up narrative developed and shared by all key actors.

What ‘awareness raising activities’ have worked well in other space clusters?

- Space advocates in different areas can go out and champion the cause.
- Space advocacy / advisory groups involved space champions from different fields (academia, industry, etc.) so that when they're going out to their networks or thinking about their strategies and organisation, they can have space in their minds and can push that to the forefront.
- From experience, those that have strong industrial/business engagement have worked very well
- Collaborating with those that have done it gain insights and lessons learned from them; but also recognising that things may work differently in different areas.

Many of the awareness raising activities will be undertaken in combination with **networking events**. These events are essential for:

- engaging with regional members to understand their needs and interests, and offer, or sign-post to, appropriate support
- forging engagement and early collaboration between:
  - regional manufacturing companies and upstream customers, and in particular upstream technical teams that are at the design stage, enabling regional supplier capabilities to be designed into emerging systems (thereby securing later procurement contracts)
  - regional space application companies and downstream end-use customers, ensure innovation and business growth are aligned closely with real customer needs and demand
- open access to and collaboration with clusters and organisations beyond our membership, and in particular Space Park Leicester, the Harwell and Westcott Space Clusters, the Satellite Applications Catapult (and associated regional centres of excellence), and the UK Space Agency.

Networking events will combine both real and virtual events, overcoming barriers associated non-physical co-location.

An example of a 'raising awareness' event would be 'TechSevern' on Innovative Healthcare:

- Brought together people from health (and a whole variety of other sectors) to look at new technological applications/ developments.
- It brought people together doing sensing and with people who might be dealing in care (and so could see who sensors might help people stay in their own homes for longer, or set up alerts if they did not get up to put the kettle on)
- <http://techsevern.com/news/tech-severn-hailed-as-huge-success/>.

### **Working Groups (WGs):**

WGs represent an important vehicle for: 1) exploring specific subject areas and foresight mapping, 2) identifying and proposing solutions to key sector challenges, 3) strategizing and informing policy, 4) mobilising advocates, and 5) lobbying decision makers.

WGs will mobilise diverse groups of experts to address defined goals/challenges, typically meeting monthly and led by a WG Leader who will be responsible for managing the group and driving the agenda, chairing meetings, and reporting.

For example, one WG would focus on the opportunities for the Business and Professional Service Sector:

- We need to build on the strength of BFPS in the region – including making them aware of the market opportunities in terms of services they can provide the space sector. This is not just downstream applications, but also 'ancillary services' such as regulatory advice and access to finance.
- However, the Business and Professional Service sector will have their own push back – "because of their own innovation pains, and reticence and lack of burning platform"



- We need to identify the products and services that are risk from disruptive innovation linked to space; there are a whole series of activities that are currently non-space aware that will be destroyed by space solutions, some of those solutions we have just seen. We need to have sight of these so that we can be prepared for any push back.

### **Demonstrator Projects:**

Specific projects or companies will be selected to showcase:

- how west midlands companies can pivot into and/or grow within the space manufacturing sector
- the (latent) space capabilities of the west midlands region

These projects will reinforce awareness-raising activities, provide practical examples of achievements and progress made, and attract further interest and investment into the region.

Another example would be Agritech

- Farmers in the agri market are “quite hard to sell to. Because they are quite resistant to change. And they don't necessarily believe everything they're told. So when we're trying to go in with new tech, it's quite hard to make sure that you're talking the right talk and have some evidence. So actually having support so we can build evidence. So for us maybe prototypes using a satellite and space data and showing people that it's worth it”.

### **Business Support Framework**

Will provide a broad framework of business support services. Wherever possible, we will seek to leverage existing infrastructure, programmes, and expertise. The business support framework will include:

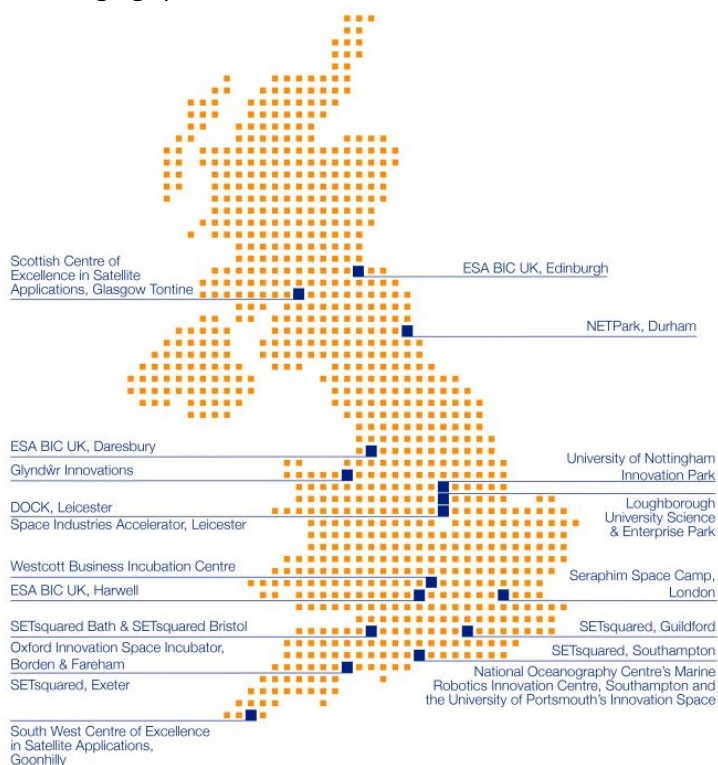
- Business Engagement – will provide a central contact points for engagement. The team will engage with existing and/or potential members to raise awareness, understand the businesses needs and interests, and signpost to opportunities and support both within and outside the cluster.
- Business Incubation Space – we will seek to provide access to business incubation space near to key assets, leveraging existing regional science and business parks. These will provide hubs through which businesses may network and access facilities and support.
- Accelerator programmes – in the short-term we will seek to leverage the wealth of accelerator programmes that are already available across the region. However, in the longer-term, we would like to developed accelerator programmes tailored to the specific needs of the region, and in particular 1) supply-chain manufacture for space, and 2) space applications for future transport, modern professional services, health, and agriculture.
- Workshops and consultancy – will provide workshops and expert consultancy services to help members to advance their innovation or business growth projects. Whilst the cluster will seek to develop key competencies within our areas of strategic interest, it is envisaged that these services will initially be provided using external experts. It is anticipated that consultancy services will be financed by individual members.
- Coaching and facilitation – will provide 1-2-1 support for companies wishing to pivot into, or seek new growth opportunities within, the emerging space market. Coaching programmes will consider both peer-to-peer based support, through to more intensive programmes of support delivered by external expert coaches.
  - Relating to specific challenges such as UK development of space accreditations is needed to bring more definable standards to the space sector.

Whilst the business support services will be open to all types of company, we will have a particular focus those companies with greatest growth potential, including: 1) businesses with the potential to pivot and prosper within

space markets; 2) innovation driven enterprises that are actively, or open to, exploring space opportunities; and 3) start-up and scale-up firms that are experiencing growth episodes.

**Space Incubator Network** <https://www.setsquared.co.uk/uk-space-incubator-network/>

The UK Space Incubator Network is comprised of a growing number of incubators dedicated to identifying and accelerating the growth of start-up and scale-ups that are leveraging space technology as a critical asset in their businesses. The network aims to share best practice and engage in collective action where it is more effective than operating individually. Centres provide a mixture of office space, business support, networking and events, and access to specialist facilities and funding. Figure 2 provides a map of existing network members. There are currently no members located within the West Midlands, creating an important gap within the regional business support landscape for emerging space industries.



**Figure 2. UK Space Incubator Network members**

**Skills**

Will ensure that the west midlands space sector has access to, and is able to retain, the necessary people and skills to meeting existing and future demand. We will seek to:

- Facilitate graduate engagement with regional space employers, driving understanding and enthusiasm for the sector
- Assess the existing and anticipated future regional skill requirements and resources to identify key gaps
- Engage with higher-education providers and regional skills/training programmes to develop appropriate training solutions to fill these gaps (considering graduate, apprenticeship, and targeted professional development courses).

In developing the skills programme we will not only consider how to achieve the skill requirements, but also how to retain these skills within the west midlands (through improvement in opportunity, the workplace environment, and pay).

## Finance

We will work to mobilise a range of **grant, equity, and loan finance options** for research, innovation, and business growth. Whilst this will primarily include signposting to existing finance options already available (or due to be released soon), we will work closely with equity finance ventures, investment banks/schemes, and regional/national agencies to source or influence new finance options.

### Access to finance/funding

- The biggest problem is actually investment – their needs to somehow be access to ‘a pot of money’ or a way to “get shareholders really interested in order to grow that area”.
- The ‘elephant in the room’ is of course funding. It is very difficult to get funding for collaboration or the development of new space projects from the academic side. “The Space Agency only funds things, which are already existing and proven, sort of the late stages. So when it is at the earlier stages in the pipeline, which academia is involved with, I haven't seen any funding streams for that yet”
- Support needed with investing in R&D – including product services and everyday innovation.
- Need for venture start-up money - coming out at the end of March, the business bank is producing a new strategy for the region on access to early stage finance - there is money in the region, it's just making it easier to access.
- There may be a route to linking space with other policy initiatives, such as, decarbonisation and sustainability for food production systems.

### Satellite Finance Network <http://satellitefinancenetwork.org/>

The Satellite Finance Network represents individuals and organisations from the finance, legal, insurance, government and space technology and applications communities, from start-ups and small companies to industry leaders, with a common interest in delivering satellite and space-enabled projects to domestic and export markets around the world. Services of the network include:

- Facilitating and attracting investment (Connecting industry players (particularly SMEs) with the financial community; Matching industry players with the right investors),
- Identifying regulatory barriers and other impediments to growth (Working to create a “space friendly” and competitive regulatory environment for the UK; Offering solutions, where they exist, to industry players; Encouraging and supporting exporters in areas of finance and regulation),
- Promoting business opportunities between companies.

We will engage with the Satellite Finance Network to help mobilise (access to) finance to support regional activities.

### 4.3.4 Integration and empowerment of clusters

We will collaborate with other Centres of Excellence, such as Harwell and Leicester Space Park, building on their existing strengths and sharing our own. The West Midlands’ central location will help build these cross-cluster networks.

We will undertake a range of activities to both integrate and empower our cluster and drive long-term competitive growth for the region. These include:

## Strategic Programmes:

Will seek to deliver structured programmes with the necessary critical mass of activity to effect change and realise strategic policy goals.

Through the strategic programmes we will seek to achieve breakthrough / step-change advancements in technology, capability, and competitiveness within our target specialisms and market niches, leading to international recognition and leadership, and driving the necessary (positive inflection in) growth to achieve our ambitious targets.

Programmes will typically mobilise a range of targeted activities, from research and innovation projects, through to skills/training, business support, and access to finance.

Programme goals, activities, and resources will be defined by the thematic working groups and approved by the leadership team. Whenever possible we will seek to leverage existing assets and resources. Where necessary, additional resources/finance will be sought.

## 4.5 Next Steps: Roadmap Of Activities (and options)

**Do Nothing:** Moving forward, one potential option is to ‘do nothing’. Under this scenario, it is highly unlikely that the West Midlands share of the space market would increase beyond its existing position (~1% share of the UK market) and is in fact more likely to decrease as other regions rise to the opportunity. If we do not act quickly enough, it is also likely that we will lose any competitive advantage gained through our regional strengths and will move into a position of playing ‘catch-up’.

**Action:** A far better strategy is to take action and to gain competitive advantage and leadership through our strengths. We have identified both ‘core-’ and ‘optional-’ activities towards the development of a West Midlands Space Cluster.

**Core activities** provide the basis upon which the cluster will be built and include:

- Option 1 – Implementation Strategy and Business Case.
- Option 2 – Cluster CEO.
- Option 3 – Thematic Leaders.

**Option 1 – Implementation Strategy and Business Case.** Within the scope of our initial UKSA project we mobilised key regional (and national) stakeholders; identified our regional strengths with latent space potential; understood how these align with opportunities presented by the emerging space industry; explored the challenges and barriers to addressing these opportunities; defined a vision for the future West Midlands space industry; and identified key actions to the realisation of this vision. These activities have resulted in a top-level strategy and business case that enable the opportunity in the West Midlands to be understood.

We believe the next step in our journey is to undertake a more robust assessment of the opportunity, working with key regional stakeholders, to define a detailed strategy and business case for implementation. Activities will include a detailed assessment of the identified upstream and downstream opportunities (including a West Midlands Space Directory), target outcomes and policy objectives, cluster approach, plan for implementation, management and operational structure, options and costings, business case etc. This will ensure that the cluster adopts an optimum focus and approach and will be used to secure investment (from both public and private sector organisations) for implementation of our ‘short-term’ strategy (see below).

**Option 2 – Cluster CEO.** We will recruit a cluster CEO to establish the foundational components of the cluster and lead its continued development and growth. This will include establishment of the operational and management structures

and procedures (fig.9), identification and leverage of regional assets, anchor institutions and facilities, clustering of key stakeholders and space activities, definition of the cluster policy objectives and strategy, establishment of working groups around key policy objectives/thematic areas, and implementation of networking and awareness raising events, including signposting to existing opportunities and support.

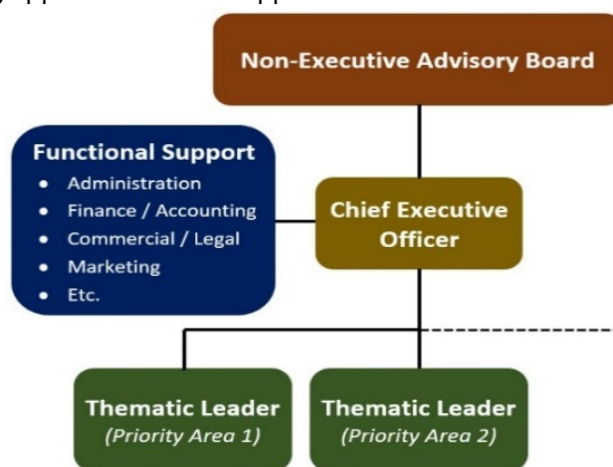


Figure 9. Space cluster operational structure

**Option 3 – Thematic Leaders.** Will recruit one or more thematic leaders who will act as cluster champions for specific priority areas and will proactively drive progress towards achievement of key policy objectives. We envisage 3 thematic leaders, one who will lead the upstream space manufacturing priority area, and two who will lead the downstream space application priority areas. The thematic leaders will report into the cluster CEO. Thematic leaders will be responsible for mobilising key stakeholders and activities, leading thematic working groups, driving the strategy and agenda, leveraging available resources and support, and defining structured programmes of support around specific policy objectives.

We have also identified a range of ‘**optional activities**’ that will facilitate, reinforce, and accelerate realisation of our policy objectives and maximise impact, that will be investigated further under option 1. These include:

- **Option 4 – Dedicated Innovation Consultancy Vouchers:** that provide direct funding to companies to help them explore space-related opportunities and address specific challenges or barriers to progressing their business idea. They are aimed at businesses that traditionally focus on other (non-space) advanced manufacturing sectors, such as aerospace, automotive and energy. Working with the Manufacturing Technology Centre and Midlands Aerospace Alliance, we have been able to identify that these businesses have a ‘high-potential’ to pivot/diversify into the space sector. The purpose of the vouchers is to help business owners develop a clearer understanding of the potential of a business idea or innovation and to produce an action plan that recipients can use with potential investors (or make the case internally for investment where a business is considering pivoting towards the sector). This will allow them to unlock further R&I and/or business development investment either through internal funding and or external private and public funding (e.g. UK Space Agency, ESA, Innovate UK, Horizon Europe etc.) ultimately leading to business growth.
- **Option 5 – Skills and Training:** providing dedicated space related skills and training meeting specific identified needs not currently addressed by existing initiatives. This might include:
  - the development of internships within local companies for undergraduates and postgraduates to improve retention of STEM graduates within the region as well as improve the employability and entry into work of graduates from the region’s universities. There are existing models for delivering these kinds of internships that could be adapted with support of sector champions,
  - Technical and degree apprenticeships,
  - Outreach activities to schools and colleges in the region building existing schemes such as Aim Higher that also provide opportunities for disadvantaged and underrepresented groups,

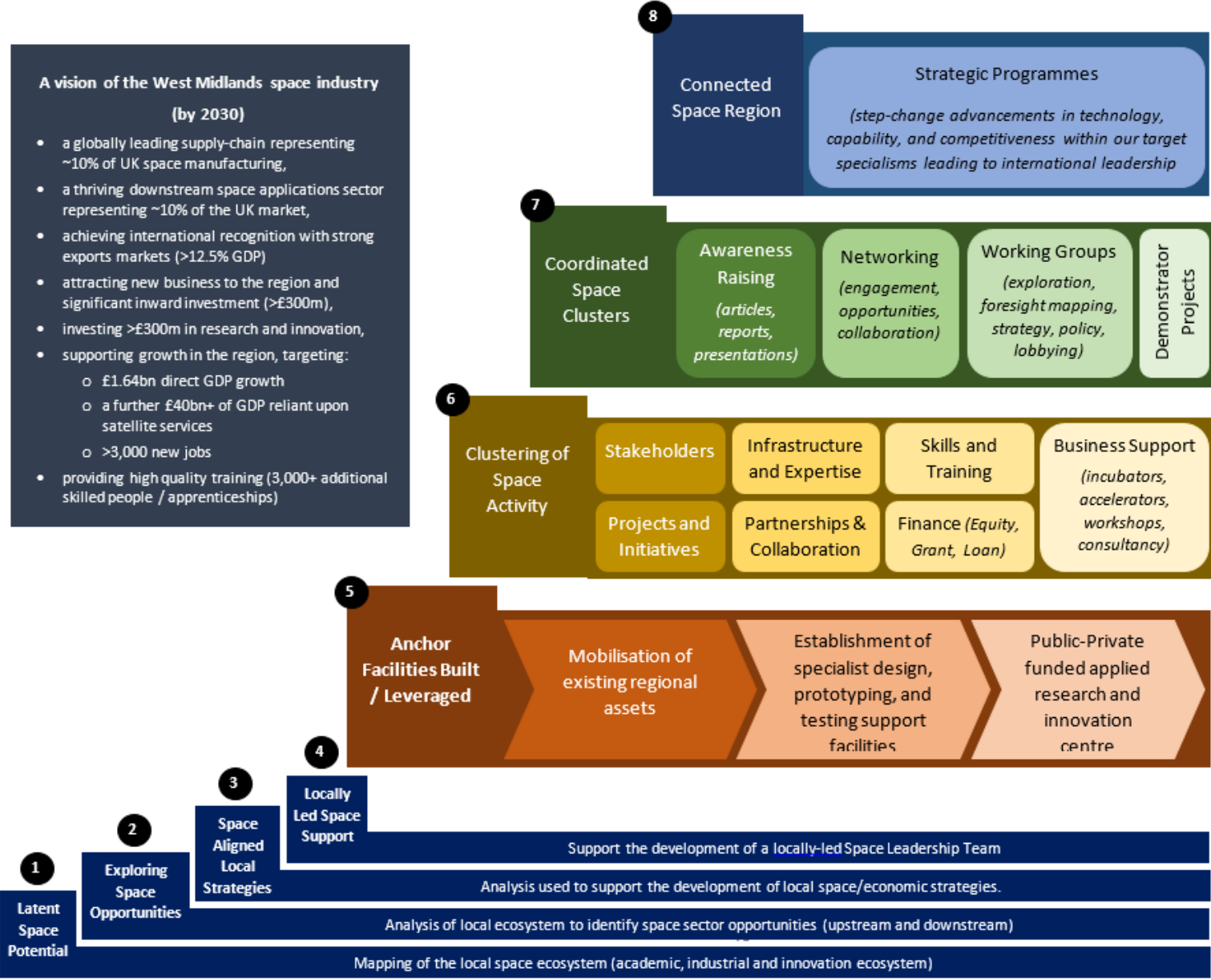
- Apprenticeships for older workers displaced by economic shocks in the region that have potential transferable skills,
  - Working with university and colleges to develop modules around the opportunities in the sector, and
  - Identification and provision of training in advanced level skills.
- **Option 6 – Space Incubator / Accelerator:** access to dedicated incubator space and/or accelerator programmes to increase the number and growth of space start-ups and/or pivots.
  - **Option 7 – Cluster Facilities:** investment in dedicated cluster facilities and equipment needed to address regional research and innovation weaknesses/needs and to drive international recognition and leadership within our target niches. In the short-term we envisage a centre providing dedicated design, prototyping, and testing support for upstream manufacture, and downstream and end-user applications. In the medium- to long-term we envisage a public-private applied research and innovation centre.
  - **Option 8 – Structured Programmes:** investment in structured programmes of activity targeting realisation of strategic policy objectives (typically defined by the thematic leaders and their working groups).

A summary of the cluster options and their associated teams, goals, outcomes, and ROM costs are shown in '**Business Case Executive Report**'.

## West Midlands Space Cluster (Overview)

**A vision of the West Midlands space industry (by 2030)**

- a globally leading supply-chain representing ~10% of UK space manufacturing,
- a thriving downstream space applications sector representing ~10% of the UK market,
- achieving international recognition with strong exports markets (>12.5% GDP)
- attracting new business to the region and significant inward investment (>£300m),
- investing >£300m in research and innovation,
- supporting growth in the region, targeting:
  - £1.64bn direct GDP growth
  - a further £40bn+ of GDP reliant upon satellite services
  - >3,000 new jobs
- providing high quality training (3,000+ additional skilled people / apprenticeships)



### 'Must-Win' Battles (Outcomes)

**Upstream – Space Manufacture**

- 1) early engagement and collaboration with space primes/OEMs and sub-system manufacturers,
- 2) recognition, mobilisation, and alignment of regional supply-chain capabilities for space manufacture, and
- 3) step-change enhancement of regional manufacturing offerings and capabilities, meeting existing and future unmet supply-chain needs.

**Downstream – Space Applications**

- 1) engagement with key end-users to raise awareness, explore potential applications, and demonstrate the use and benefits of space enabled systems and services,
- 2) growth of space application start-up's (and pivots), and
- 3) step-change enhancement of regional offerings and capabilities within our end-user market niches.

Automotive	Rail
Modern Professional Services	Health and Life Sciences
Agriculture	

## 5. CONCLUSION

The outcomes from this work is a route to increasing the maturity of the West Midlands space cluster. Our research has revealed the latent competitive advantages of what a future West Midlands space cluster could build on, through identifying the available assets, technologies, skills, knowledge and expertise that are present in the West Midlands region. We now have a deeper understanding of our foundations for attracting further investment and talent to develop a West Midlands space cluster, as part of a wider regional economic growth plan.

Within the West Midlands we have identified latent space potential within:

- the upstream sector for space manufacture (materials, components, and assemblies), leveraging our nationally leading aerospace (automotive and rail) supply-chains,
- downstream space application sectors, leveraging our specialisms in computer and data sciences, and
- end-user sectors for future mobility (automotive, and rail), modern services (business, professional, and financial service sectors), data driven health and life sciences, and agriculture.

### Upstream sector strengths

A unique strength of the West-Midlands is our manufacturing sector (aerospace, automotive, and rail). Within the region we have strong supply-chains mobilised around key capabilities (such as engines, electromechanical systems etc.). These industries (and in-particular aerospace) share close similarities with space and thus demonstrate strong latent space potential. The aerospace sector draws many parallels with the space industry, working to strict and often bespoke specifications, requiring upfront investment with long lead times to a return, requiring extensive quality management testing and documentation, and operating within a complex regulatory and international trading environment. These capabilities and strengths provide a strong basis's through which the (West) Midlands can capture share of the national and global space manufacturing market, and in particular the materials and components (and sub-system) segment(s). These strengths/capabilities are not currently being leveraged resulting in lost opportunities.

However, the growth of the upstream space sector in the West Midlands is currently limited by:

- Lack of big company(s) or regional space assets within the West Midlands for supply chains and companies to cluster around and take a lead (as they do for the aerospace sector).
- Limited available skilled resource trained for space manufacture, and in particular 'Shopfloor' technicians/engineers for manufacture and assembly (driven in part by competition with other industries, such as automotive, aerospace etc.).
- Lack of training programmes that specifically address this skill gap for space manufacture (or able to meet anticipated future demand).
- Many companies have limited awareness and understanding of what the space sector is, how it operates, who the key stakeholders are, how to get involved etc. The relevance of their products and services to space.
- Value chains are 'closed' to those already involved and difficult to enter (due in part to the time, cost, and risk of on-boarding new suppliers) - suppliers find it difficult to raise their profile and 'get a foot in the door'.
- Poor awareness of academic specialisms, capabilities/facilities, and IP/technology leading to poor academic and industrial collaboration.

**To facilitate entry and growth of our manufacturing supply-chains within existing and future space value chains we have identified 3 key 'must-win' battles:**

- 1) early engagement and collaboration with space primes/OEMs and sub-system manufacturers – to *unlock supply-chain opportunities*,**



**2) recognition, mobilisation, and alignment of regional supply-chain capabilities for space manufacture – *to mobilise and structure regional capabilities, and***

**step-change enhancement of regional manufacturing offerings and capabilities, meeting existing and future unmet supply-chain needs – *to achieve international recognition and leadership in our target specialisms, facilitating customer engagement and take-up, and thereby driving penetration and growth within global markets***

### **Downstream sector strengths**

Whilst the West Midlands is home to only a handful of downstream space application businesses, the region combines latent space application capabilities with important end-user sectors for space data/services, creating a powerful value-chain ecosystem for innovation, business growth, and end-user benefit. Our latent space application capabilities including, data analytics, image analysis, artificial intelligence, machine learning, and gaming technologies. Combining ubiquitous connectivity, remote sensing, and precision navigation and time, space enabled systems and services have the potential to transform end-user sectors, addressing major industrial and societal challenges and driving innovation, competitiveness, and growth. The West Midlands holds particular strengths in key user sectors that have the potential to benefit significantly from space enabled data and services, including future transport (connected and autonomous vehicles, digital rail etc.), modern services, health and life sciences (connected data driven services), and agriculture 4.0 (precision agriculture and autonomous farming systems). There is a real opportunity to build on the existing digital infrastructure in the region to further the growth of the downstream application sector.

However, the growth of the upstream space sector in the West Midlands is currently limited by:

- Limited existing regional industry for space applications.
- End-user awareness and understanding of space capabilities, applications, and benefits (art of the possible), creating barriers to user engagement and adoption.
- Access to and cost of space data and services, compounded by the lack of sovereign space capabilities.
- Concerns surrounding the privacy and (cyber) security of space data and services.
- Existing markets are small and niche, creating barriers to investment and growth. This is compounded by inferior public and private finance for space applications compared to competitors in Europe and the US.
- Whilst the region produces employees and graduates with the required skills for downstream space applications, these are increasingly being poached by companies outside the region (such as London) that can offer higher salaries (combined with remote working practices), creating a skills gap.

**To facilitate growth of downstream space application and user sectors we have identified 3 key ‘must win’ battles:**

- 1) engagement with key end-users to raise awareness, explore potential applications, and demonstrate the use and benefits of space enabled systems and services – *to stimulate market demand and enables to benefits of space to be realised,***
- 2) growth of space application start-up’s (and pivots) – *to generate a regional capability to meet this demand and capture market share, and***
- 3) step-change enhancement of regional offerings and capabilities within our end-user market niches – *to achieve international recognition and leadership in our target specialisms, facilitating growth within global markets.***

**Stimulation of end-user markets will be key to driving growth of the region's downstream capabilities and services.**

### **Regional Space Strategy**

Our approach has followed the 8 phases of the cluster roadmap. Our initial work as part of the UKSA project has enabled us to initiate the first four phases. So far, we have:

- 1) Identified our core areas of strength in terms of latent space potential,
- 2) Identified key upstream and downstream opportunities to apply and develop this potential,
- 3) Developed a top-level regional space strategy, and
- 4) Established a locally-led Space Leadership Group, mobilising stakeholders from government, industry, and research/academia.

The next phases of activity are to:

- 5) Establish anchor facilities at the heart of our cluster, leveraging key existing regional assets, and exploring the need for need dedicated facilities,
- 6) Establish clusters of space activity around our regional strengths and opportunities,
- 7) Coordinate cluster activities towards defined strategic goals, and
- 8) Integrate and empower our clusters within a connected space region.

It is important to note that these activities are not sequential, but rather run concurrently to continuously build and develop the cluster. The West Midlands Space Cluster seeks to address the challenges and achieve sector growth by:

- Mobilising regional stakeholders, assets, and expertise that have relevance to the space industry
- Forging partnerships and collaboration with key stakeholders, assets, and expertise that lie beyond our region (including national/regional space clusters, centres of excellence, universities etc.)
- Raising awareness of the space industry and the capabilities of our region
- Facilitating networking between the cluster members and across national and international value chains
- Forming working groups to lead application areas of importance to the region, driving foresight and strategy, informing decision making and policy, and supporting lobbying activities.
- Providing business services that support companies to enter and flourish within the national and international space market
- Facilitating engagement of the workforce with the space industry and access to training programmes for retraining and upskilling of the workforce in areas of need (and to meet future demand)
- Facilitating access to grant, equity, and loan finance for research, innovation, and business growth
- Implementing structured programmes of activity to realise strategic policy objectives

A summary of the cluster options and their associated teams, goals, outcomes, and ROM costs are shown in 'Business Case Executive Report'.

### **Our Vision**

Our vision is a future where the West Midlands plays a pivotal role in the UK space industry:

- closely engaged with upstream space primes and subsystem system manufacturers, downstream space application markets, and broader national and international stakeholders.

- providing connected and globally leading supply-chain capabilities:
  - mobilised around well-defined areas of competency (mirroring those found within the regional aerospace sector),
  - leveraging our significant manufacturing base (aerospace, automotive, and rail) with high latent space manufacturing potential,
  - and competencies in advanced manufacturing and industry 4.0,
  - supporting the upstream manufacture of satellites, spacecraft, and launch vehicles,
  - and representing ~10% of UK space manufacturing market by 2030 (£323m GDP by 2030),
- realising a thriving downstream space applications sector:
  - comprising a balance of disruptive start-up business, and businesses that have either pivoted into, or have adopted, the use of space data and services,
  - leveraging our significant regional competencies in data and computer sciences,
  - to realise internationally competitive and disruptive space application products and services,
  - addressing important industrial, commercial, and societal challenges,
  - within important end-user sectors of strength to the region (transport, modern professional services, health and life sciences, and agriculture),
  - and representing ~10% of the UK space applications market by 2030 (£1.32bn GDP by 2030),
- achieving international recognition for our capabilities with strong exports markets (>12.5% GDP) for both upstream space manufacture and downstream space application services,
- attracting new business to the region and significant inward investment (£300m by 2030),
- investing >£300m in research and innovation by 2030,
- supporting growth in regional:
  - GDP, targeting ~£1.64bn direct growth by 2030, with a further £40bn+ of GDP reliant upon satellite services, and
  - Employment, targeting 3,000+ new jobs by 2030,
- providing high-quality training to support the regional (and UK) space industry (3,000+ additional skilled people by 2030),

## 5.1 Next Steps and Research Gaps

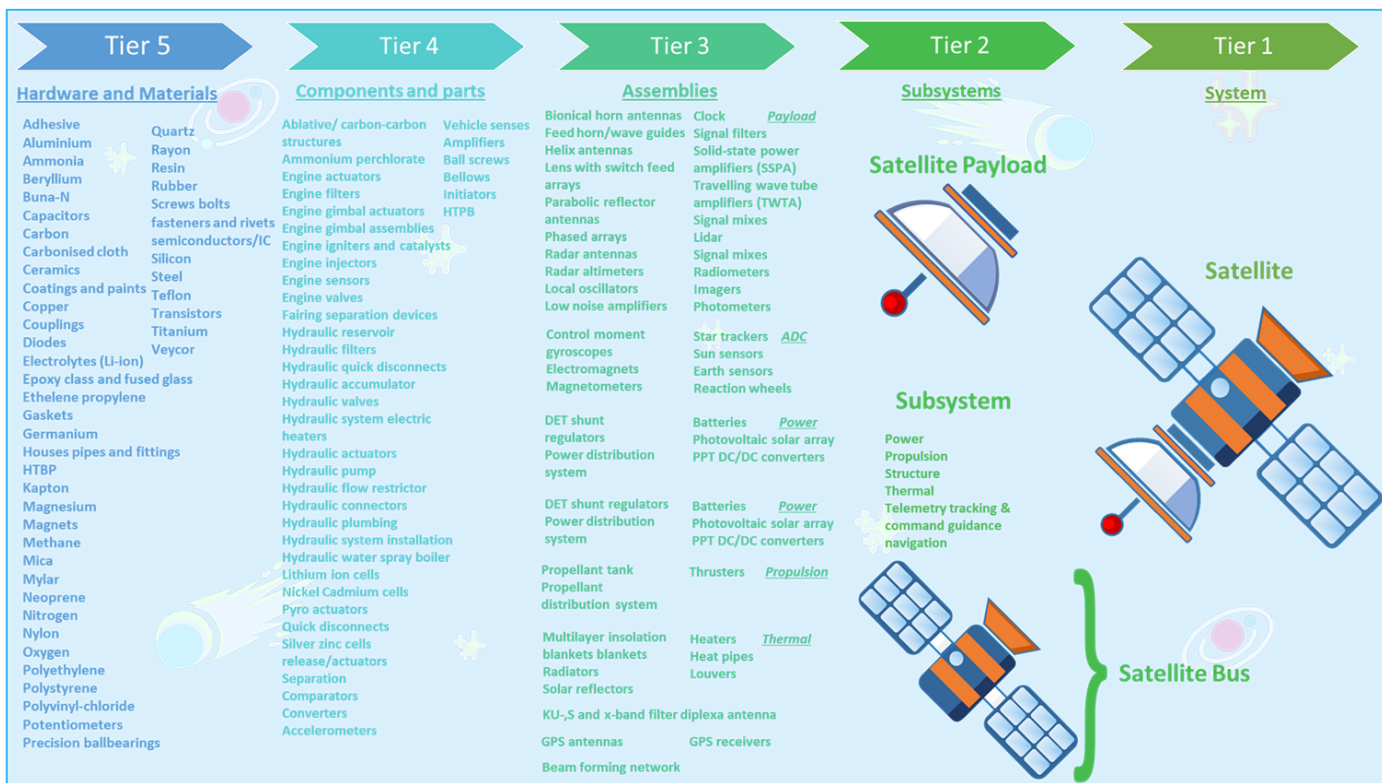
The next steps for this project will be to disseminate the findings amongst all of our local stakeholders via our Space Leadership Group. This will be done through the distribution of this summary document and our other executive reports via email and our social media channels. We will also be hosting an online 'launch' event to help promote our key findings and the publishing of our reports in an accessible format on our website.

Within the scope of our initial UKSA project we mobilised key regional (and national) stakeholders; identified our regional strengths with latent space potential; understood how these align with opportunities presented by the emerging space industry; explored the challenges and barriers to addressing these opportunities; defined a vision for the future West Midlands space industry; and identified key actions to the realisation of this vision. These activities have resulted in a top-level strategy and business case that enable the opportunity in the West Midlands to be understood. We invite the West Midlands Combined Authority and local LEP leads to review these options and consider a feasible level of investment to help us realise the potential growth opportunities of the West Midlands Space Cluster. We recommend a series of 'core' and 'optional' activities to support the maturity of the West Midlands Space Cluster.

The first core activity will fund the development of a detailed cluster strategy and supporting business case. We have already funded Rob Bevan (Framework Innovation) to develop an initial top-level business case, however, a more detailed assessment of the policy objectives, strategy, operational structure, costings, management structure, and

business case for developing the space cluster is now needed. The detailed business case will be used to secure investment for the development of the cluster. Secondly, we recommend the recruitment of a cluster CEO to establish the foundational components of the cluster and lead its continued development and growth. This will include the establishment of the operational and management structures and procedures, identification and leverage of regional assets, the definition of the cluster policy objectives and strategy, establishment of working groups around key policy objectives/thematic areas, and implementation of networking and awareness raising events. Finally, we recommend the recruitment of one or more thematic leaders who will act as cluster champions for specific priority areas and will proactively drive progress towards the achievement of key policy objectives. We envisage 3 thematic leaders, one who will lead the upstream space manufacturing priority area, and two who will lead the downstream space application priority areas. These roles (CEO and thematic leaders) may be part of a separate entity or hosted by existing regional organisation, such as, local universities, the MTC and Midlands Aerospace Alliance. We have also identified a range of ‘optional activities’ that facilitate, reinforce, and accelerate realisation of our policy objectives and maximise impact. These include: Dedicated Innovation Consultancy Vouchers; Skills and Training; Space Incubator / Accelerator; Cluster Facilities; and Structured Programmes.

There are additional questions about adaptability, or the ease or difficulty of recombining and reorienting these ingredients towards new kinds of technologies, products and services. We need to do further research to understand how easy or difficult it is to recombine and reorient (pivot) these ‘ingredients’ (factor endowments) towards new kinds of technologies, products and services. For example, if the step-change from one set of technologies, products or services to a new set is too big, a cluster of firms will be unable adapt to compete in the new industry. In the context of the West Midlands, we need to unpack whether a step-change from supplying other advanced manufacturing sectors to the upstream space sector is too big. We have partnered with the Manufacturing Technology Centre (MTC) on a follow-on piece of research to provide a detailed readiness assessment of 10 non-Space sector companies for possible pivoting into the sector against repurposing module. The findings from this research will help to address these questions. To complement these readiness assessments, further funding could support a ‘deep-dive’ into the specific capabilities of another West Midlands sector (such as, automotive), to explore to what degree there is an overlap between the hardware, materials and component parts used in space manufacturing (as in Figure 2) and other sectors.



**Figure 2:** List of 'hardware and materials', 'component and parts', 'assemblies', 'sub-systems' and 'systems' for the manufacturing of satellites.

**Author:** Alice Pugh, adapted diagram from Bryce Space.

This research would help us to test our estimations of population of businesses that have the potential to diversify (pivot) into the space sector in the West Midlands. To identify firms that are able to pivot, we utilised the hierarchical structure of the Standard Industrial Classification (SIC-07) information for the 85 companies we already have confirmed as being part of the space supply chain. To identify what firms may pivot, we assume that companies within the same 3-digit code to the 85 above form a population of companies with the highest potential to pivot. Our analysis suggests that up to 25% of businesses in the West Midlands (64,580 businesses) are in similar industries to the 85 companies we have identified highlighting the significant potential for the development of a space cluster in the region. However, further research is needed to understand whether it is feasible for them to reorient (pivot) their skills and capabilities towards new space-related technologies, products and services.

This research has mapped the 'upstream' and 'downstream' R&D projects and education programmes across the group of local universities (see Executive Report for further detail). As part of this analysis, we have gone some way to understanding how much these involved collaboration and the co-production of knowledge and expertise with and/or relevant to local firms. At a 'high-level', our 'university asset mapping' shows that R&D programmes, closely related to new opportunities in the space sector that exist in the West Midlands region. However, further research is needed to fully understand the alignment / or misalignment between the R&D projects and education programmes of local universities and the priorities of local firms. This is important to help shape national and local R&D investment policies and other interventions which, under conditions of limited resources (i.e., always), need to accurately target particular growth policies towards places with particular kinds of comparative and competitive potential. To help address this gap, we have funded the MTC to do a follow-on piece of work to compare and contrast the UoB and University of Warwick space specialisms against existing West Midland business capabilities. Further funding could support a follow-on-piece of research to replicate this across the other local universities.

## Appendix 1 - Employment and establishment numbers and Location Quotients (LQ) in 2010 and 2019

Local Authority	Employment numbers		Employment LQs		Establishment numbers		Establishment LQs	
	2010	2019	2010	2019	2010	2019	2010	2019
Birmingham	1850	750	1.12	0.41	5	15	0.36	0.39
Bromsgrove	10	0	0.08	0.00	0	0	0.00	0.00
Cannock Chase	5	10	0.04	0.07	0	5	0.00	1.39
Coventry	600	630	1.20	1.11	0	10	0.00	0.94
Dudley	125	250	0.30	0.62	0	0	0.00	0.00
East Staffordshire	30	30	0.15	0.14	0	5	0.00	0.99
Herefordshire, County of	5	200	0.02	0.65	0	0	0.00	0.00
Lichfield	75	40	0.52	0.23	0	0	0.00	0.00
Malvern Hills	140	100	1.41	0.89	0	5	0.00	1.19
Newcastle-under-Lyme	0	0	0.00	0.00	0	5	0.00	1.32
North Warwickshire	0	100	0.00	0.59	0	0	0.00	0.00
Nuneaton and Bedworth	125	255	0.88	1.51	0	10	0.00	2.38
Redditch	125	0	0.96	0.00	0	0	0.00	0.00
Rugby	250	105	1.61	0.60	0	5	0.00	0.97
Sandwell	30	0	0.07	0.00	0	0	0.00	0.00
Shropshire	435	450	0.97	0.95	5	10	0.71	0.63
Solihull	25	65	0.07	0.13	0	10	0.00	1.13
South Staffordshire	500	400	4.50	2.93	0	0	0.00	0.00
Stafford	0	0	0.00	0.00	0	0	0.00	0.00
Staffordshire Moorlands	0	0	0.00	0.00	0	0	0.00	0.00
Stoke-on-Trent	0	20	0.00	0.05	0	0	0.00	0.00
Stratford-on-Avon	100	100	0.46	0.38	0	0	0.00	0.00

Tamworth	0	0	0.00	0.00	0	0	0.00	0.00
Telford and Wrekin	5	0	0.02	0.00	0	0	0.00	0.00
Walsall	0	0	0.00	0.00	0	0	0.00	0.00
Warwick	185	100	0.63	0.33	0	10	0.00	1.26
Wolverhampton	1255	1000	3.14	2.75	0	0	0.00	0.00
Worcester	0	150	0.00	0.81	0	0	0.00	0.00
Wychavon	700	500	3.90	2.54	0	0	0.00	0.00
Wyre Forest	0	0	0.00	0.00	0	0	0.00	0.00

Source: NOMIS-ONS BRES and UK Business counts.