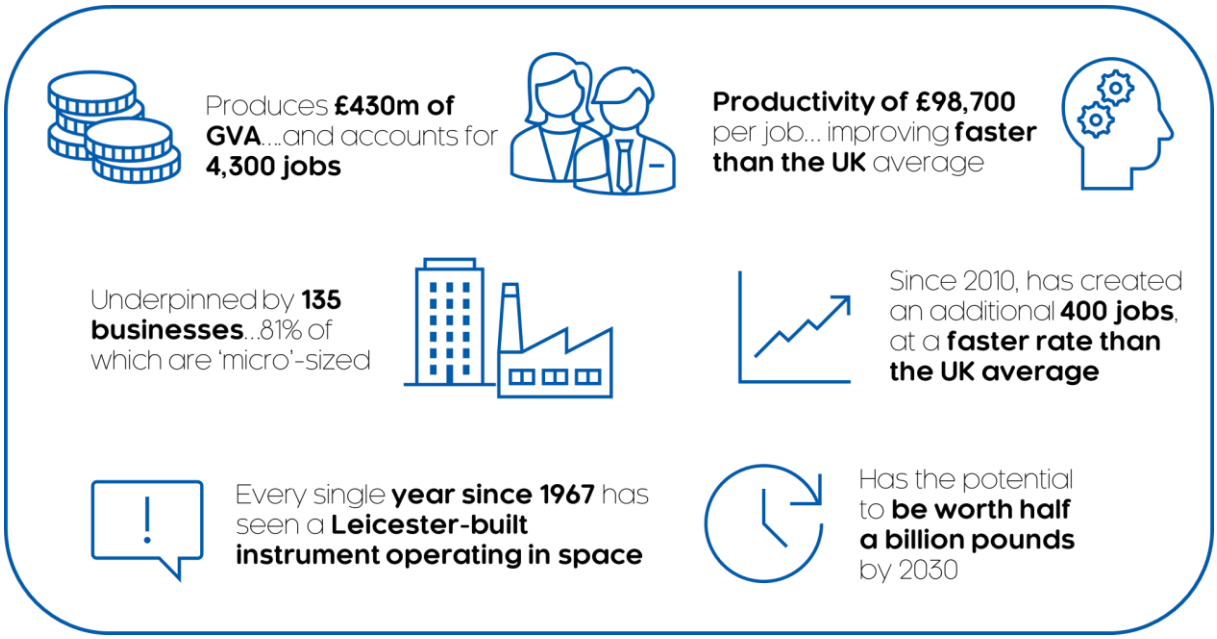
Sector profile: Aerospace and Satellite Technology in Leicester and Leicestershire



Source(s): See Economic and growth indicators.

Defining Aerospace and Satellite Technology

Aerospace and satellite technology is a diverse sector, with a multitude of commercial, industrial and military applications, and generally consists of the research, design, manufacture, operation and maintenance of aircraft and spacecraft (including satellites).

Given Leicester and Leicestershire is the UK's leading location for the space industry, this profile where possible attempts to focus on this subset of the sector. This cutting-edge activity currently employs approximately 42,000 people in the UK, generates £14.8 billion in GVA with productivity rates three times the national average, research shows.

Definitions of the 'space industry' used in HM Government publications is defined to include all organisations that are engaged in any space-related activity to some degree. It comprises both:

- Commercial organisations (i.e. businesses, companies, firms) that earn revenue from the manufacture, launch and operation of satellites/spacecraft, and from utilisation of the signals and data supplied by satellites/spacecraft to develop value-added applications; and
- Non-commercial organisations (e.g. universities, research institutes) that secure funding to contribute space-specific research and expertise throughout the industry supply chain, often in partnership with commercial organisations.

A 'space-related activity' is defined to be any one (or more) of the following activities:

- Space Manufacturing: Design and/or manufacture of space equipment and subsystems
- Space Operations: Launch and/or operation of satellites and/or spacecraft
- Space Applications: Applications of satellite signals and data
- Ancillary Services: Specialised support services

A wide range of non-space activities (including consumer, industrial, and public sector) are supported by satellite services – termed 'users'. 'Space' is therefore designated as a critical element of the UK's national infrastructure. Many commercial users would experience severe disruption if satellites were to be de-activated.

Another definition in use is to split Space activities into the Upstream Space Subsector (comprising the design and/or manufacture of space equipment and subsystems, and operations) and the Downstream Space Subsector (space infrastructure operations and "down-to-earth" products and services that directly relay satellite data and signals to operate and function).

Market and economic outlook

Global market

According to Deloitte, as funding continues to increase and costs decline, the space industry is likely to experience increased opportunities, primarily in satellite broadband internet access. In 2020, space investments remained strong at $25.6 billion, and Space launch services are expected to record strong growth in 2021, with the market forecast to grow more than 15.7 % year-on-year. More than 60% of space-related economic activity comes from commercial goods and services.

Over the long term, costs will likely continue to decline, with companies in the space ecosystem focused on reaching critical mass. For example, there are over 1,000 Starlink satellites launched into orbit by SpaceX, and the company aims to deploy 4,425 satellites in orbit by 2024 as its launch costs decline, driven by reusable rockets and mass production of satellites. Launch costs for a satellite have already declined from $200 million in the past decade to nearly $60 million currently and have the potential to fall further to as low as $5 million.

Satellite technology enabling Earth observation and imaging services constitutes a small, but very important part of the global space economy, providing a wide spectrum of applications in different fields; the largest revenue growth occurred in defence, intelligence and in the sectors of energy and natural resources.

UK market

The UK has enjoyed globally acknowledged leadership in small spacecraft and instrumentation (payloads) for decades. Recent years have also seen an expansion of activities in downstream applications recognising that this is the largest part of the broader space economy.

The income of the UK Space Industry was estimated at £14.8 billion in 2018. Income has been measured, rather than sales, because the industry includes universities and research institutions.

The upstream (manufacturing and sending objects into space) grew strongly to £2.4 billion, though the downstream (use of data and telecommunications and use of technology and data) dominates at £12.4 billion. Space Applications is the largest segment with 69% of income, of which 48% is Direct-to-Home (DTH) broadcasting (Satellite TV) This is followed by Space Operations (15%), Space Manufacturing (13%) and Ancillary Services (3%).

Across all activities, Broadcasting dominates (51% of total income) followed by Communications (19%), Position, Navigation and Timing (12%), Defence (which has grown to 8%), and Earth Observation (3%)

Space Manufacturing was the engine for growth (27% growth per annum), contributing three quarters of the overall change in total income. This was followed by Ancillary Services (7% p.a.) and Space Operations (2% p.a.). The Space Applications segment saw no growth (0% p.a.) in aggregate, with a decrease in DTH broadcasting income concealing growth of Other (non-DTH) space applications (3% p.a.): satellite data (e.g. EO) processors (35% p.a.), satellite applications (32% p.a.), mobile satellite communications (27% p.a.) and location-based signal services (20% p.a.)

Research shows the UK Space Sector has built, over the past 20 years, one of the most innovative, highly skilled sectors in the UK economy. UKspace (the industry trade association) has estimated that they UK Space Sector could increase its global market share to £30 billion by 2030.

Business impacts of Covid-19 and Brexit

Covid-19 has impacted the UK Space Industry. From data gathered by HM Government, it is clear that the Space Industry has weathered the worst of the pandemic, but demand for UK Space exports and Foreign Direct Investment has fallen over the past 12 months. Findings from the Monthly Space Sector Covid-19 survey demonstrated that almost half (47%) of companies have seen a reduction or significant reduction in international demand for their products or services. More than half (52%) of companies have postponed or abandoned plans to expand overseas or seek international investors. 44% of companies reported operating below one-hundred percent capacity for significant periods during 2020.

However, launches have not been curtailed by Covid-19. According to Deloitte, despite the ongoing pandemic, space launches for the first half of 2020 were mostly at par with previous years; the 41 successful launches were only slightly below the five-year average of successful launches.

As a result of the impacts of Covid-19, HM Government has established a Space Sector COVID Support Plan with five core objectives: 1) local growth initiatives, 2) a space sector-specific Export Academy, 3) promotional collateral for FDI attraction, 4) more effective structures across government to represent and coordinate UK interests in the space sector, and 5) Consult on policy and regulation.

A specific deliverable for the HM Government Space Sector COVID Support Plan is to relaunch the Leicester Space Park HPO (High Potential Opportunity), building on existing progress and success in attracting inward investment.

The implications of Brexit are becoming clearer. The UK's space industry has trebled in size since 2000, but during this period it has had close ties with the European Space Agency and Europe-wide initiatives such as Galileo, the global navigation satellite system that went live in 2016. The United Kingdom will no longer participate in the European Galileo or Egnos programs but can continue, in principle, with Copernicus and remain member of the European Space Agency (ESA). Brexit threatens to limit the supply and movement of highly-skilled workers between the UK and EU. There is also uncertainty concerning EU design-approval for components designed and manufactured in the UK.

Activities and key organisations in Leicester and Leicestershire

University and R&D expertise

For the past 60 years, the University of Leicester has played a leading role in pioneering space research and missions from across the world. The first Leicester-built instrument in space was launched aboard a Skylark rocket; a simple pinhole camera designed to record X-rays from the Sun on photographic film in 1961. There has been at least one piece of Leicester-built equipment operating in space every year since 1967, including equipment aboard BepColombo, which is on its way to Mercury, arriving in 2025. Leicester and Leicestershire has 200 academics, 29,000 employees and 20,000 students in space-related fields.

The University of Leicester's Space Research Centre has a team of 80 academic and technical staff engaged in the research, design, engineering, build and testing of advanced sensors and instrumentation, and a number of well-equipped laboratories and workshops. The SRC annual research and development budget is valued at £4.5m and Leicester built devices are currently operating on six space missions and the Centre is involved in building sensor devices for a further six missions. The team combines specialist research expertise, technical engineering skills, and project management.

The SRC houses state of the art clean rooms, laboratories and workshops for testing and qualifying flight instrumentation, and a laboratory for the development of planetary exploration instrumentation. The room is currently being used for the ESA ExoMars mission. A CCD laboratory enables the group to qualify and test detector assemblies; the SRC has implemented the detectors for the GERB (Geostationary Earth Radiation Budget) instrument on board several generations of Europe's METEOSAT weather satellites.

The Rolls-Royce University Technology Centre (UTC) at Loughborough University represents a strategic partnership between academia and industry set-up to investigate combustion and aerothermal processes. The Loughborough UTC is a world-leading research centre and focusses on the complex aerodynamic processes occurring within gas turbine combustion systems and other related engine components. It provides enhanced knowledge of the fundamental physics, the development of new and innovative methodologies and is supported by state-of-the-art computational and experimental facilities.

Over 12 test facilities provide researchers with the opportunity to operate test rigs of various sizes and over a range of temperatures and pressures. In total the group has supervised in excess of 50 successful PhD candidates and the research activities have led to almost 200 journal publications, over 260 conference papers and the award of numerous worldwide patents.

The East Midlands is typically referred to as a cluster of space activity. This is underpinned by broad expertise in diverse parts of the space economy at the universities of Leicester, Nottingham, and Cranfield. The University of Leicester enjoys worldwide recognition for its international research in space science, planetary exploration and earth observation science. The University of Nottingham is a world leader in space-based applications of PNT (position, navigation and timing), and hosts the UK national centre of excellence for GNSS.

The National Space Centre is a £60M science visitor centre attracting over 200,000 visitors annually, with over 10,000 students and their science teachers participating in the National Space Academy programmes and other space education initiatives (some of which are globally exported). Much of the recent emphasis for the East Midlands and Leicester has been on the Upstream Space Subsector.

The Space Industries Accelerator is based at the Leicester Innovation Hub, is funded by the UK Space Agency and forms part of the Leicester Start-up Accelerator.

The University of Leicester recently secured £14 million in funding for its new Manufacturing, Engineering, Technology and Earth Observation Research Centre (METEOR) through Round 6 of Research England's flagship capital investment scheme, the UK Research Partnership Investment Fund (UKRPIF). This funding will leverage a further £33 million of investments in space and Earth observation (EO) research in Leicester. Partners include Airbus, Lockheed Martin, and Thales Alenia Space. A number of firms partner the METEOR project, including 2Excel Geo, Airbus, Amazon Web Services (AWS), ATM Automation, Bluesky, CGI, Deimos Space, Earthsense, European Thermodynamics, Geospatial Insight, Hewlett Packard, Hybrid Geospatial, Lockheed Martin, MTC, Planet Labs, Point 4, Spherea Test and Services, Telesazio, and Thales Alenia Space.

Leicester's Hospitals and the University of Leicester was recently awarded £2 million by the UK Space Agency to develop a new mobile application providing disease-specific exercise advice. The funding was awarded by the UK Space Agency in partnership with NHS England and the European Space Agency (ESA) for the NHS' 70th birthday - which will help to address a key NHS 70th Anniversary Challenge – managing long term conditions (LTC). One of only four successful projects to receive the funding, the new mobile application – Personalised Space Technology Exercise Platform (P-STEP) – will provide guidance based on space data combined with artificial intelligence to deliver personalised, disease specific exercise advice with pollution warnings at a staggering 10-metre resolution.

Long-term exposure to air pollution is linked to decline in lung function, type 2 diabetes, problems with brain development and cognition, cardiovascular diseases and cancer. There is a need for effective monitoring and reporting of air quality, to protect the health of people at risk. P-STEP will combine real-time high-resolution air quality data with expert-designed disease-specific individualised exercise advice. Exercise is widely recognised as a 'miracle pill', however it can be challenging for many people with these long-term conditions, which is why the development of this app is so important.

The University of Leicester is part of SPRINT – the Space Research and Innovation Network for Technology, which provides unprecedented access to the expertise and facilities at top UK space universities to help businesses accelerate the development of their products and services through the commercial exploitation of space data and technologies. Leicester and Leicestershire firms supported include: Artec Vida Ltd (Project: Earth observation of night-time city lights in developing countries with The University of Leicester); Bloc Digital Ltd (Project: Virtual Lab Builder for the Rapid Creation of Collaborative Digital Twins for Space Applications with The University of Leicester); Bluesky (Project Title: Feature classification in the built environment with The University of Leicester); Deep Planet Ltd (Project: Machine learning applications in remote sensing with The University of Leicester); Fishbone Solutions (Project: Readiness and Verification & Validation Tool for Large Infrastructure Projects with The University of Leicester); Geospatial Insight Ltd (Projects: Detecting methane emissions through Earth Observation, and Methane Watch with The University of Leicester); Photek Ltd (Four projects with the University of Leicester: Photocathode Efficiency Improvement using DFT Simulations, Resolution enhancement of pixelated detectors, Development of electron gain devices, and Performance optimisation and calibration of space instrumentation).

Other SPRINT projects with the University of Leicester have been conducted by the companies European Thermodynamics Ltd, Point4Geo, Previsico Ltd, Raymetrics Ltd, Recycle2Trade Ltd, Redshift Associates Ltd, Routemasters, Serac Imaging Systems, Stevenson Astrosat Ltd, Sylvera Ltd, TrailMed Ltd, Treewise (Lincs) Ltd, Visual Management Systems, and XCAM.

Key sites and facilities

SpacePark Leicester is £100 million research, innovation and teaching hub for space-related high-tech companies and researchers. Developed by the University of Leicester in collaboration with local, national and international partners, including Leicester and Leicestershire Enterprise Partnership, the project will deliver a 10,000 m2 facility comprising offices, shared laboratories, teaching facilities and co-working spaces, focussing primarily on research, development and applications of space.

Phase 1 was complete in April 2021, delivering 4,800 m2 of premises and facilities, with Phase 2 due for completion at the end of 2021. Planning permission for the second phase of the SpacePark was granted earlier in January, which will focus on research into Artificial Intelligence and robot-assisted satellite production, in addition to research into novel solutions for downstream space data challenges. The ambition for phase three is for a Low-Cost Access to Space (LoCAS) satellite manufacturing facility for the manufacture of mid-range satellites.

The National Space Centre in Leicester is a museum and educational resource covering the fields of space science and astronomy, along with a space research programme in partnership with the University of Leicester. The £52 million centre was funded by a partnership between the University of Leicester's Space Research Centre, Leicester City Council, Local Enterprise Partnership and private sector sponsors. The National Space Centre currently has post-doctoral science researchers based at the University of Leicester's Space Research Centre (SRC) and the University of Nottingham's Institute of Engineering Surveying and Space Geodesy (IESSG).

Economic and growth indicators

Table 1: Summary of key economic and growth indicators for the Aerospace and Satellite Technology sector in Leicester and Leicestershire

	Value, 2019	% of economy total	*% of economy total (UK average)*
GVA (£m)	427	1.7%	*2.4%*
Jobs	4,300	0.8%	*1.4%*
Businesses	135	0.3%	*0.4%*
Productivity (£)	98,700	221.7%	*173.7%*
	Value, 2010-19	**% change p.a.**	***% change p.a. (UK average)***
Real GVA growth (£m)	21	0.6%	*-1.3%*
Jobs created	400	1.2%	*-1.4%*
New businesses	-5	-3.6%	*10.4%*
Productivity growth	-	-0.6%	*0.2%*

Source: ONS, Cambridge Econometrics.

Worth £430m and accounting for 4,300 high-value jobs (according to official statistics, which include the broader aerospace sector - see Table 1 above), Leicester and Leicestershire hosts the **fifth fastest growing aerospace and satellite technology cluster in the country** (ranked out of 38 LEP areas).

Recent growth has been strong, and has outpaced the UK sector average, with 400 additional jobs created since 2010. Accompanying productivity growth however has been subdued, contracting by 0.6% p.a., pulling down headline GVA growth (only +£21m).

Productivity in the sector is very high, almost 2.5 times the economy average, **and the highest of all sectors** in Leicester and Leicestershire. Highlighting the strength of the sector locally, productivity performance exceeds the UK sector average by more than 10%**.**

The sector comprises some 135 local businesses, the majority of which (some 81%) are 'micro'-sized (employing <9 people).

Additional evidence and research

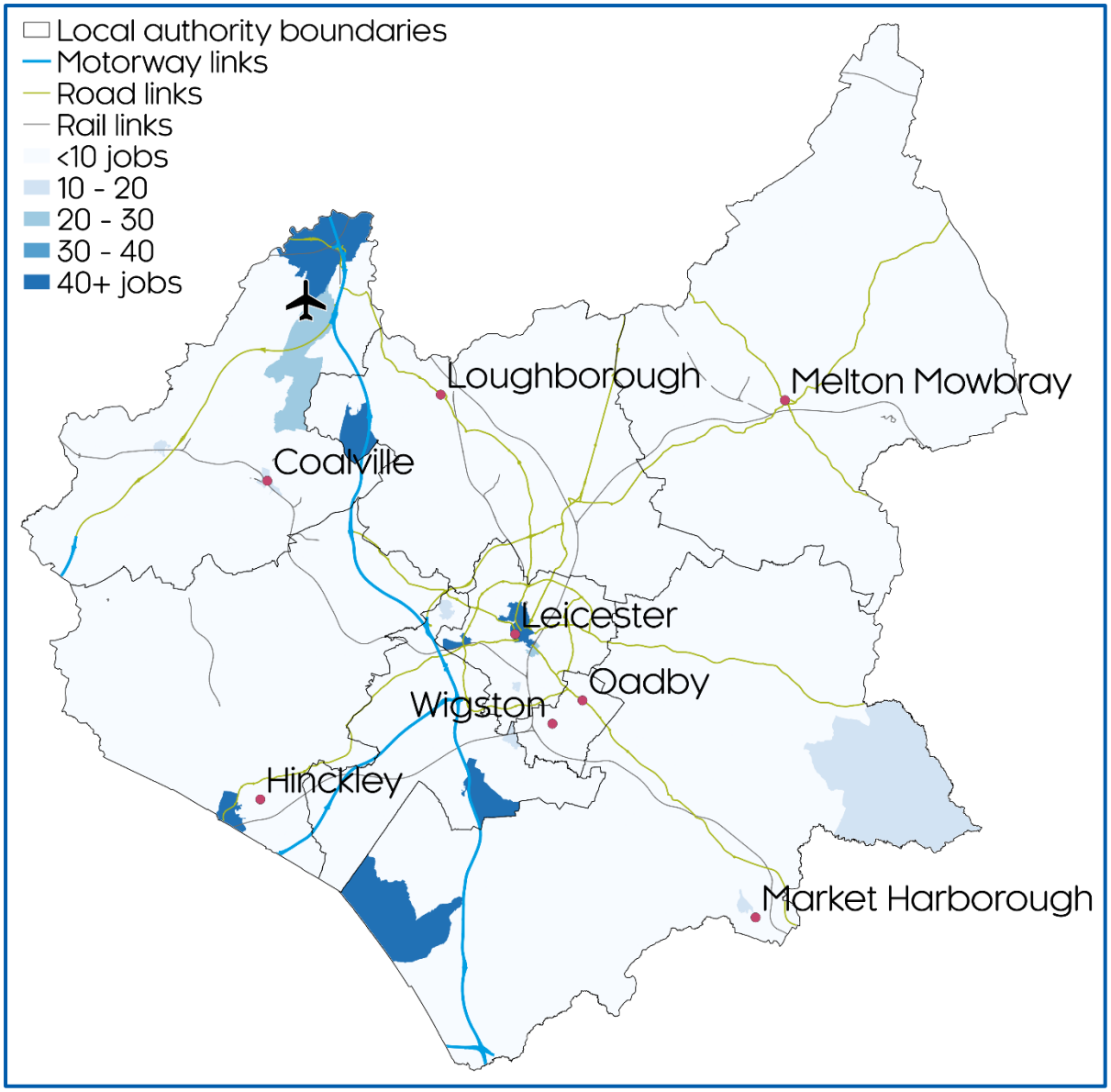
Additional indicators and research on the sector in Leicester and Leicestershire show:

- Research shows that Leicester and Leicestershire hosts some 200 academics, 29,000 employees and 20,000 students in space-related fields.
- The same research also found every single year since 1967 has seen a Leicester-built instrument operating in space.

Spatial structure and clusters

The sector is highly concentrated in Leicestershire, and largely focused on the city of Leicester, as Figure 1 below shows. The city hosts some of the UK's most notable space and

Figure 1: Aerospace and Satellite Technology clusters in Leicester and Leicestershire



Source: ONS, Cambridge Econometrics.

satellite assets, such as SpacePark Leicester – a £100 million research, innovation and teaching hub for space-related high-tech companies and researchers – and the Space Industries Accelerator at the Leicester Innovation Hub.

Despite the concentration of activity in the city, there is also clustering elsewhere in Leicestershire, particularly relating to aerospace and defence activities. This is most notable to the west of the county around the M1 and M69 corridors, in close proximity to East Midlands Airport - the UK's largest pure cargo airport.

Industry structure and specialisms

The wider aerospace and satellite technology sector in Leicester and Leicestershire is represented by some internationally-recognised and growing specialisms, according to official statistics. Activities represented locally include:

- **Manufacture of air, spacecraft and satellites** – 1,600 jobs, £120m GVA; the most specialised activity, and also the fastest growing
- **Satellite telecommunications** – 2,000 jobs, £270m GVA; the next most specialised activity, and also the largest in the sector
- **Repair and maintenance of air, spacecraft and satellites** - 250 jobs
- **Defence activities** – 500 jobs; with the defence sector the largest practitioner of aerospace applications
- **Space transport and travel** – a nascent sector but with high growth potential

Sector prospects in Leicester and Leicestershire

Economic impact and recovery from Covid-19 and Brexit

The Covid-19 pandemic and the end of the EU transition present significant challenges for the wider aerospace and satellite technology sector. During a difficult 2020, GVA losses could total £30m locally, driven largely by reduced demand and uncertainty within the aviation sector. As

Table 2 below shows, the contraction (6%) could be marginally less severe in Leicestershire compared to the UK average (7%).

Table 2: Covid-19 impacts and recovery prospects for the Aerospace and Satellite Technology sector in Leicester and Leicestershire

Forecasted Covid-19 impact (2020)			
	Value, 2020	% change	*% change (UK average)*
GVA impact (£m)	-26	-6.0%	*-7.0%*
Jobs impact	-200	-3.9%	*1.4%*
Productivity impact	-	-2.3%	*-8.3%*
Forecasted Covid-19 recovery (2021-30)			
	Value, 2021-30	% change p.a.	*% change p.a. (UK average)*
Real GVA growth (£m)	82	1.9%	*2.1%*
Jobs created	200	0.5%	*0.4%*
Productivity growth	-	1.4%	*1.8%*

Source: Cambridge Econometrics Spring 2021 Forecasts.

From 2021 onwards, there is the potential for a robust recovery, with post-Covid rates of growth expected to be 3 times faster than the previous decade, driven by stronger productivity growth and higher research intensity, with a renewed focus on the importance of the UK space sector. The £80m of potential growth by 2030 will more than offset the losses of 2020.

Aerospace job opportunities in Leicester and Leicestershire are expected to increase faster than the UK average to 2030, with 200 additional roles expected in the sector by 2030. By this time, the sector could be directly worth half a billion pounds to the Leicester and Leicestershire economy.

Skills needs and challenges

The UK space sector has an exceptionally skilled workforce, emphasising the technical and demanding skills needs in the sector. Research indicates 75% of roles in the sector are currently filled by those with at least a bachelor's degree, almost twice the average for the UK labour market as a whole, and higher than any other sector studied.

With the sector retaining strong links to local universities – with almost a third (27%) of local graduates staying in Leicestershire for work – the research also notes the positive uptake and impact of vocational learning and training in the sector, which currently accounts for 13% of roles in the sector.

Given skills needs in the sector are fast-moving, characterised by continuous technological change and development, and a globally competitive talent pool, skills shortages and gaps can emerge; the same research found more than half (52%) of large space sector employers are particularly worried about access to skills.

Appendix A: Sector definition and sources

Data has primarily been sourced from Cambridge Econometrics LEFM. For a full and detailed overview of definitions, sources and forecasting methodology, please refer to the Technical Summary report accompanying this profile.

The sector has been defined using 5-digit Standard Industrial Classifications (SICs), detailed as follows. These have been informed by government and/or industry recommended definitions, and aim to capture as much of the sectors value chain as possible:

30300: Manufacture of air and spacecraft and related machinery

33160: Repair and maintenance of aircraft and spacecraft

51220: Space transport

61300: Satellite telecommunications activities

61900: Other telecommunications activities

84220: Defence activities