# Emerging Tech Capabilities in the West Midlands

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London Economics

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## About glass.ai

*glass.ai* is a UK company that has developed AI technology that understands written language at scale, reading millions of business websites, news, social media, events, academic and official sources. The *glass.ai* system has already mapped a very large part of the UK economy based on its web presence. For example, it regularly reads the websites of 2 million+ UK businesses across sectors and geographies. As a result of this unique capability, organisations use the system to research emerging sectors and regional clusters of the UK economy and uncover hard to find evidence on businesses, skills and academic capabilities. *glass.ai* has worked with the Department for BEIS, the ONS, Northern Ireland Executive, various LEPs, HMRC, Innovate UK, DCMS, British Film Institute, Digital Catapult, Cabinet Office, Nesta, and many others.

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# Table of Contents

# Executive Summary

Innovation has been a fundamental driver of economic growth since the Industrial Revolution, but in today's advanced economies, emerging technologies are increasingly major influences on the creation of wealth and employment, driven by scientific and digital expertise and underpinned by data.

The UK has been hugely attractive to FDI decision-makers for decades, but all too often London has dominated discussions surrounding site selection due to the sheer scale of its emerging tech sector.

This report aims to provide a knowledge base for the economic development agencies of the West Midlands when implementing the region's growth and inward investment strategies over the next three years. Its purpose is to obtain an independent and quantitative understanding of the key attributes of the West Midlands' emerging tech ecosystem, its position within the UK and potential underlying innovation drivers.

The report was commissioned by the West Midlands Growth Company (WMGC) – the region's investment promotion agency and led by London Economics and glass.ai:

■ London Economics is one of Europe's leading specialist consultancies in economics and policy and has attracted an international client base by its use of analytical tools and strategic evaluation.

■ Glass.ai has developed innovative AI-based technology which understands written language at scale, capable of reading millions of corporate sites, news platforms, academic sources, government data and much more to build a comprehensive picture of company activity and industrial clusters.

Furthermore, the analysis provides a comparative assessment of overall breadth of emerging technology by benchmarking the West Midlands against the UK's other core city regions competing for innovation-based FDI, namely in the areas of tech & digital, data-driven healthcare, future mobility, advanced manufacturing, modern services and smart cities.

Supplementing this, the analysis draws on the relative depth of each region's Higher Education (HE) cluster regarding research and teaching across emerging tech specialisms.

Traditional business statistics and Standard Industrial Classification (SIC) codes have limitations and can be lagging indicators of sectoral change and potential, but this research uses a new methodology, based on mining of the latest data to capture economic activity in technology sectors across the UK's regions.

The core conclusions of the resulting 60-page 'Emerging Tech Capabilities in the West Midlands' analysis are below.

Data sourced and collated by glass.ai via its proprietary 'crawler software' revealed that emerging technologies were most strongly represented in four city regions outside of London: the West Midlands, Manchester, Leeds and Cambridge-Peterborough.

## DIVERSIFIED EMERGING TECH

Comparative analysis across the UK's core city regions outside London shows the West Midlands has established a leading overall position across the breadth of emerging tech, with the highest number of companies (2,946), followed by Manchester (2,020) and Leeds (1,594).

Unlike many of the other city regions, the West Midlands is not dominated by a single large tech company or sector. A deep dive into the UK's 'tech and creative' sector reveals the West Midlands is the most established region across 10 out of 13 niches within that sector.

It provides a classic example of the benefits of agglomeration economies in relation to tech and creative – the largest of the West Midlands' emerging tech industries.

- In addition to being highly concentrated, the area's technology industry is highly diverse, principally spanning digital transformation, gaming, immersive tech, process automation and software development.
- Software development is the largest niche, with 468 companies, followed by 329 in telecoms, 192 in cloud computing, 88 in process automation and 78 in cyber-security.
- The West Midlands has 212 companies operating in modern services technologies (fintech, professional services-tech and proptech) and 237 in the smart cities' sector, with proptech the most prominent in the former and construction tech in the latter.
- Excluding London, the West Midlands is responsible for 27.8% of the UK's telecoms roles and 23.8% of software development roles.

The smallest emerging tech sector in the analysis of the West Midlands is data-driven healthcare, which falls below other comparative regions. Cambridge-Peterborough has the most significant data-driven health sector, with the highest share of companies in all four related sub-sectors.

The dominance of the West Midlands in emerging tech outside London and the South East is further underlined by the latest employment data, with 77,804 working in the sector as compared to just 46,401 in the second-placed location, Manchester.

## INNOVATION LEVERS

The region's critical mass is partly attributed to its supportive infrastructure. The report reveals the number of accelerators in Greater Birmingham and Solihull per 10,000 businesses (1.43) is higher than anywhere else in the UK, including London (1.32), highlighting the area's long-term prioritisation of entrepreneurship.

The region's emerging tech ecosystem also benefits from a well-developed system of R&D support. Analysis of its collective research and teaching activities (as measured by web content and published data) shows it leading all other regions in five out of our six target sectors. This leading academic position is mainly driven by the region's two Russell Group universities, University of Warwick and University of Birmingham, which are both significant players across all emerging tech sectors analysed in this study.

Competition for talent within emerging tech sectors, and between core city regions, is fierce and upskilling is the most powerful catalyst for higher productivity, so the power of the West Midlands in Higher Education will be crucial in attracting future investment.

Equally, the study's science and innovation audit demonstrates that this region is successfully engaging in complex cross-sector networking and collaboration between its public and private sectors, and in particular between universities and research and technology organisations.

The report concludes that:

"In 2019, the West Midlands region invested approximately £2.4 billion in R&D which accounts for 9.1% of the UK total. The number of full-time equivalent employees in the West Midlands engaged in R&D increased in the past years to 26,000 employees in 2019. This corresponds to almost 10% of the UK total".

## ESTABLISHED CLUSTERS

When potential FDI locations are being assessed, corporates, institutional funds, venture capital and private equity houses always look to identify areas offering established and successful clusters in the same sector. The West Midlands has built upon the success of its large industrial clusters, interlinked with strong technology communities in related fields.

The research highlights that the West Midlands Advanced Manufacturing Cluster was the largest and most active in the UK and supported 14% of the country's advanced engineering workforce, and that the Coventry-based Midlands Aerospace Alliance was Europe's largest aerospace cluster.

Within the future mobility sector, the West Midlands is particularly strong in the areas of autonomous vehicles, battery tech, electric engines, and rail tech. Those four specialisms are currently much in demand from investors (along with electronics, industrial automation, and e-commerce). The report concludes:

- For each of these seven themes, the West Midlands has an absolute, as well as a relative advantage, over other areas in the UK.
- Despite the size of London's emerging tech sector, the West Midlands has a greater number of firms in advanced manufacturing and future mobility, and more people are employed in those sectors in the region than in London.
- The region also has a very high concentration of roles in construction tech, with almost 28% of the UK's total.
- The West Midlands, Manchester and Leeds are the city regions which dominate the smart cities' sector, with the West Midlands dominant for clean tech, space tech and construction tech.

The West Midlands contains the largest cluster of tech and digital firms outside London. While the region also benefits from the largest advanced manufacturing sector in the UK, the sector is dwarfed by the scale of its tech and digital base, which employs three and a half times more people than the advanced manufacturing sector.

The West Midlands emerging tech ecosystem is characterised by a strong research sector; these institutions are key R&D performers in the West Midlands in cooperation with industry and play a key role in the internationalisation of research and innovation in the region.

As global efforts intensify to reverse the impact of climate change, widen the adoption of sustainable technologies and deliver zero-carbon strategies, investors are targeting regions capable of fostering innovation. The report concludes that:

"There is a strong policy focus on fostering innovation in the West Midlands, and its Local Industrial Strategy aims to create a regulatory framework which supports innovation.

"The region is home to a well-developed infrastructure network fostering innovation and technological advances."

## CONCLUSION

The independent analysis undertaken by London Economics and glass.ai provides data-led evidence that the West Midlands is well-placed to build on its existing appeal to FDI decision-makers, and has the potential to sustain a competitive advantage when targeting entrepreneurs and investors in high-growth, emerging tech sectors.

The comparative assessment of the West Midlands' technology landscape corroborates the region as the UK's largest emerging tech cluster outside of London, outpacing all other core city regions on relative scale of emerging tech capabilities.

The findings reflect the scale of local institutional capacity required to retain, scale-up and attract new emerging technology investment into the West Midlands, as well as the need for coordination across the region to maximise the economic potential of the region's innovation ecosystem.

Although the purpose of this research is to provide a supportive knowledge base for investment promotion activity, rather than make policy recommendations, the analysis is relevant to a wide range of stakeholders in the West Midlands, including local authorities, universities and thinktanks.

Based on the findings of this study and in the light of its wider strategic objectives, the West Midlands Growth Company comments:

"The findings of this analysis support a conclusion that the West Midlands is home to the largest cluster for emerging technology businesses of any core city region in the UK, outside of London. The scale of its technology clusters across smart mobility, advanced manufacturing, tech and creative, smart cities and data driven healthcare suggest a significant level of agglomeration, both in terms of supply chain and specialist skills. Both are highly favourable attributes that will prove attractive to prospective FDI decision-makers, seeking to identify investment locations that can bestow a lasting competitive advantage and should be highlighted extensively in the region's future investment narrative.

As the region's investment promotion agency, the West Midlands Growth Company should proactively target inward investment in the niche sectors in which the region is, in accordance with this analysis, a national leader and globally competitive. These include: Electronics, Industrial Automation, Autonomous Vehicles, Battery Technology, Electric Engines, Rail Tech, Professional Services Tech, Property Tech, Construction Tech, Gaming, Software Development and Telecoms.

Reflecting the significant efforts expended by the region towards developing a diversified and critical mass of innovation-based industries, the West Midlands has much to gain from continual prioritisation of its tech-integrated sectors, particularly those which are assigned key importance in the West Midlands Local Industrial Strategy.

The depth of academic strength within the analysed emerging technology fields indicates that the region boasts the institutional capacity required to retain, scale-up and attract new emerging technology investment into the West Midlands, and serves as a reminder of the need to ensure

cohesion and coordination between public, private and academia across the region, in order to maximise the economic potential of the West Midlands.

# 1      Introduction

**Box 1          Summary of introductory section**

- Innovation is a fundamental driver of economic growth in advanced economies.

- Technology clusters play a key role in fostering innovation and have a large impact on the productivity of regional economies.

- Technology clusters are drivers of economic development.

- This report uses a new methodology to capture economic activity in the technology sector across the regions of the UK.

### 1.1.1      The relationship between technology, innovation & growth

**Innovation is a key lever for economic development through its spill over effects on overall economic growth.** Through the creation of new or improved products and services, innovation is linked to economic growth (aggregate increase in productivity). Innovation can be encouraged through investment in R&D (foreign and domestic), support for clusters, including links between business and academia, and other knowledge sharing initiatives. Determinants of innovation include 'positive' driving forces, such as returns to innovation and market demand as well as 'negative' factors such as declining profit from aging products or technical inefficiencies in existing processes.[2]

The importance of innovation in the UK is highlighted by the UK Industrial Strategy. Published in late 2017, **the Industrial Strategy identifies 'ideas' as a foundation for future productivity gains and growth**. The strategy aims for the UK to become the most innovative country in the world and committed to increasing the proportion of GDP invested in R&D to 2.4% by 2027, eventually rising to 3%.[3] This increase included commitments to investing £725 million through UKRI's Industrial Strategy Challenge Fund and to developing what is now the UKRI's Strategic Priorities Fund.[4] In 2020, the UK Government published a 'UK Research and Development Roadmap'[5] reaffirming the importance of research and innovation in government policy.

The **UK has long been at the forefront of scientific discovery and innovation** and continues to achieve high positions in global rankings of university quality and scientific research excellence.[6] The positive link between public investment in research and innovation, and economic growth is well-established in the literature. A 2019 paper from the UCL Institute for Innovation and Public Purpose (IIPP) found that government expenditure on non-military R&D had a GDP multiplier of 7.76 (using

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[1] Jones, B. F., & Summers, L. H. (2020). A Calculation of the Social Returns to Innovation (No. w27863). National Bureau of Economic Research.

[2] Taalbi, J. (2017). *What drives innovation? Evidence from economic history*. Research Policy, 46(8), 1437–1453. https://doi.org/10.1016/j.respol.2017.06.007

[3] UK Government (2017), *Industrial Strategy: Building a Britain fit for the future*.

[4] Ibid.

[5] UK government (2020), *UK Research and Development Roadmap*.

[6] See e.g. Dutta et al. (2019), *The Global Innovation Index 2019*.

US data).[7] There is substantial evidence that public investment in research and innovation does not 'crowd out' but rather stimulates complementary private investment in R&D.[8]

### 1.1.2 The role of clusters in the economy

Clusters are geographic concentrations of related industries and firms. Clusters comprise a variety of private and public sector organisations, often at different levels of the value chain (from basic research to support services).[9] Clusters are usually defined by the following characteristics:

- A geographical concentration of firms connected through industry, supply chain, common resource or market, similar philosophy, similar opportunities and challenges or by collaboration with the same research institution;[10]
- A critical mass of actors and resources which can sustain interaction within the cluster, and be sufficiently large enough to attract new members;[11]
- Existing interaction *and* cooperation of firms.[12]

The benefits of clustering include increased productivity (through increased access to information and access to public goods), more rapid innovation (through cooperative research and competition), and new business formation (filling in niches).[13] **Clustering of economic activity in particular cities or regions can also lead to higher economic growth**.[14] Firms located within clusters benefit from increased networking and access to talent and growth – especially due to proximity to suppliers and major universities.[15]

**Clusters are a significant contributor to the UK economy**. In 2014, the UK's 31 biggest clusters (which contained 8% of the UK's businesses) contributed 20% of the nation's GVA – employing four million people. The top 10 clusters contribute roughly £200 billion in GVA to the UK economy per year. UK clusters cover a range of industries; some examples include: financial services in London, electronics and Internet-of-Things in the South East, Oil and Gas in Aberdeen and the Golden Research Triangle.[16]

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[7] Deledi et al. (2019), *The macroeconomic impact of government innovation policies: A quantitative assessment*, UCL Institute for Innovation and Public Purpose, Policy Report WP 2019-06.

[8] Ibid.; see also Diamond Jr., A.M. (1999), *Does Federal Funding "Crowd In" Private Funding Of Science?*, Contemporary Economic Policy Vol.17 No.4, October 1999, 423-431 and Coccia, M. (2010), *Public and private R&D investments as complementary inputs for productivity growth*, International Journal of Technology Policy and Management Vol.10 No.1, June 2010.

[9] Slaper & Ortuzar (2015), *Industry Clusters and Economic Development*, Indiana Business Review, retrieved from: https://www.ibrc.indiana.edu/ibr/2015/spring/article2.html#:~:text=Developing%20industry%20clusters%20has%20become,presentin g%20opportunities%20for%20entrepreneurial%20activity.

[10] Porter, M. E. (1998): Clusters and the new economics of competition. In: Harvard Business Review, 76, pp. 77-90.; referenced from: https://cor.europa.eu/en/engage/studies/Documents/Clusters-and-Clustering-policy.pdf

[11] Andersson, T; Schwaag Serger, S.; Sörvik, J.; Wise Hansson, E. (2004): The Cluster Policies Whitebook. IKED - International Organisation for Knowledge; Economy and Enterprise Development, Malmö, Sweden.. referenced from: https://cor.europa.eu/en/engage/studies/Documents/Clusters-and-Clustering-policy.pdf

[12] European Commission (2008): The concept of clusters and cluster policies and their role for competitiveness and innovation - Main statistical results and lessons learned. Brussels: Commission Staff Working Document, SEC (2008) 2637.; referenced from: https://cor.europa.eu/en/engage/studies/Documents/Clusters-and-Clustering-policy.pdf

[13] Reference for Business, *Clusters*, Available at:https://www.referenceforbusiness.com/small/Bo-Co/Clusters.html#:~:text=Clustering%20helps%20cities%20and%20counties,refocus%20efforts%20on%20existing%20industries.

[14] Glaeser E L (2010) 'Agglomeration Economics: Introduction', chapter 1, Agglomeration Economics, The University of Chicago Press

[15] Opus Energy (2018), *Business clusters – what are they and how can they help small businesses?* Available at: https://www.opusenergy.com/brighter-business/what-are-business-clusters/

[16] Centre for cities (2014), *Industrial revolutions: capturing the growth potential.* Available at:https://www.centreforcities.org/wp-content/uploads/2014/07/FINAL_Centre-for-cities-report2014.pdf

**Figure 1      Map of UK Tech and Innovation Clusters**
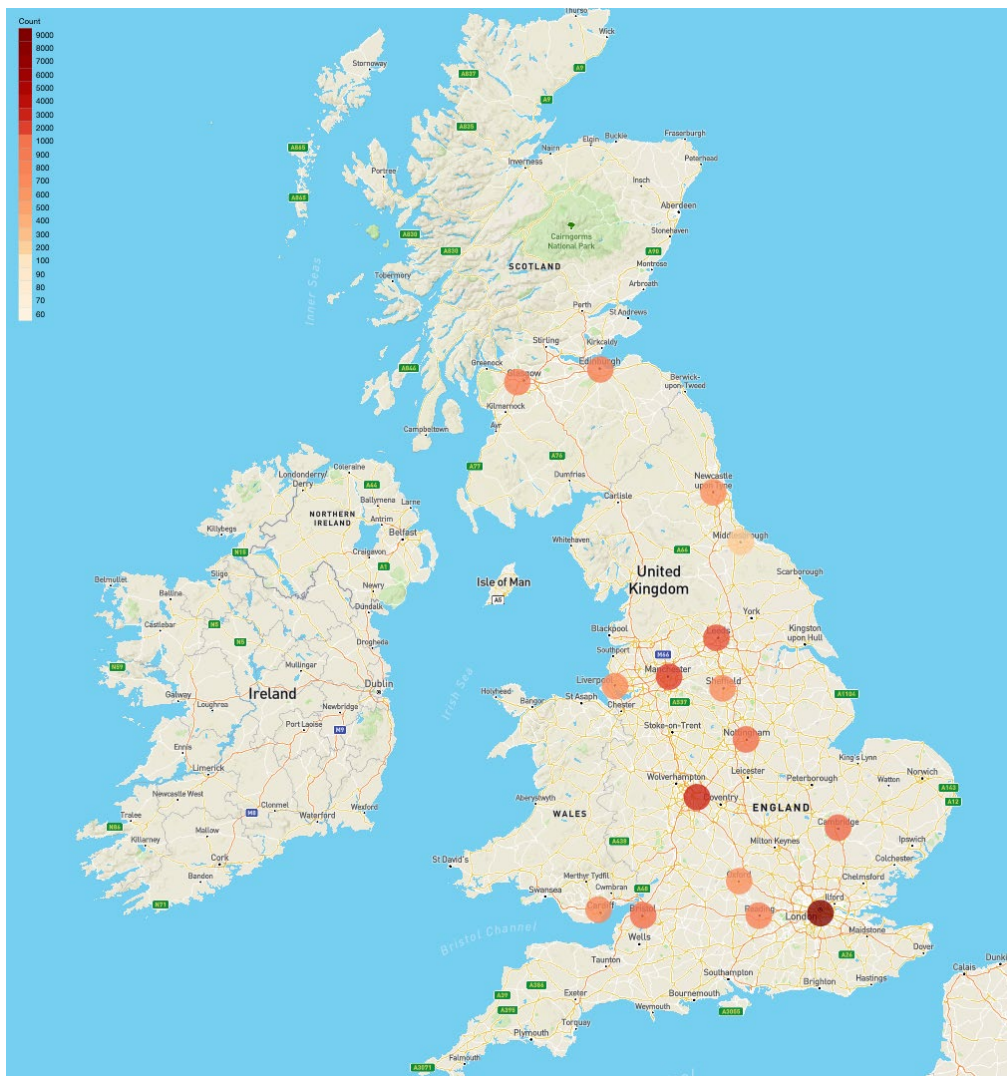


*Source: glass.ai*

### 1.1.3      The role of clusters in the West Midlands

The West Midlands shares its borders with the North West, East Midlands, South East, South West regions and Wales. Given its central location in England, **the West Midlands region is one of the most accessible regions in the country**. The West Midlands has a **fast growing economy**, as well as a **large higher education cluster** with multiple universities, including research-intensive institutions such as the University of Warwick and the University of Birmingham.

The West Midlands is home to a number of emerging tech clusters:

- **West Midlands Automotive Cluster**: producers include Jaguar Land Rover, Aston Martin, BMW & Peugeot. These producers enjoy close links with nearby universities such as the University of Warwick, Coventry University and Aston University as well as the Warwick

Manufacturing Group. This cluster added £10.9 billion GVA to the UK economy in 2014,[17] with 40% of all cars exported from the UK being manufactured in the region today.[18]

- **West Midlands Advanced Manufacturing Cluster**: This cluster is the UK's most active advanced engineering and manufacturing cluster, working with transport technologies, energy storage, food tech, Industry 4.0 and advanced materials. This cluster supports 14% of the country's advanced engineering workforce.[19]

- **The Midlands Aerospace Alliance**: Based in Coventry, the Midlands Aerospace Alliance represents the largest aerospace cluster in Europe, with more than 300 members; 25% of the UK aerospace sector can be found within the wider Midlands region.[20]

- **West Midlands tech and digital Cluster**: The West Midlands contain the largest cluster of tech and digital firms outside of London. For the West Midlands Combined Authority, this cluster is one of several priority sectors identified within its investment strategy for the 2021/21 financial year.[21]

## 1.2    Methodology

This report uses a new methodology to capture economic activity in the technology sector across the regions of the UK.

The core of this report is a mapping of businesses that develop or apply certain advanced technologies that either already have a significant presence in the regions of the UK or have been identified as important drivers of growth in the economy. Throughout the report, these companies are collectively referred to as the emerging technology sector. The methodology underlying the report is an automated process to map the UK business population into broad but well-defined technology areas according to a taxonomy that has been used in previous work by different government departments and agencies and was developed from the sector classification used by the professional social network LinkedIn.

By using current data mined from the Open Web (organisations' websites, online news sources, etc.) and applying a granular taxonomy of technology areas, the methodology can overcome some of the limitation of traditional business statistics to provide an up-to-date picture of the technology sector.

Details of the methodology are provided in Annex 1 (p. 39).

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[17] Batmunkh, U., Barnes, R., Barbosa, E., Kaya, Z. D., & Samuda, C. (2017). *The Future of the UK Midlands Automotive Cluster*. 27. Available at: https://www.isc.hbs.edu/Documents/resources/courses/moc-course-at-harvard/pdf/student-projects/UK_Automobiles_2017.pdf

[18] Hub for Advanced Manufacturing Industries. (n.d.). *Invest in the West Midlands*. Available at: https://investwm.co.uk/sectors/advanced-manufacturing/

[19] Ibid.

[20] Hub for Advanced Manufacturing Industries. (n.d.). *Invest in the West Midlands*. Available at: https://investwm.co.uk/sectors/advanced-manufacturing/

[21] West Midlands retains position for FDI. (2020, July 15). *Invest in the West Midlands*. https://investwm.co.uk/2020/07/15/west-midlands-retains-fdi/

# 2 The national context

## 2.1 UK tech strengths

**Box 2        Key take-aways about tech strengths in the UK**

- The UK is home to a world-leading research and innovation ecosystem, including impressive strengths in R&D, funding and institutional support.

- The emerging tech sector significantly strengthens the UK economy by employing 2.9 million people and contributing £149 billion in GVA in 2018.

The **UK offers an excellent ecosystem for new technologies** based on a distinguished research base, strong financial backing, effective acceleration and incubation initiatives, as well as targeted Government support[22] - making the UK one of Europe's best start-up nations.[23]

The **UK is home to a world-leading research and innovation ecosystem** with the most productive science base in the G7.[24,25] The UK is successful at translating knowledge into real-world benefits - every £1 invested in public R&D delivers an estimated net economic benefit of £7 to the UK.[26]

Compared with other European countries, the **UK has a very strong funding environment**. In 2019, £10.1 billion was invested in UK technologies, which corresponded to a 44% increase compared with the previous year - an all-time high. The UK ranks third in the world for tech investment, behind the US and China (see Figure 2). In 2019, UK investments were larger than those in Germany and France combined.[27] When comparing these countries on a per capita basis, the UK ranks even before China, and behind only the US (see Figure 2).

Over 80% of UK tech investment was made into high-growth, high-productivity potential scaleup firms (defined as having at least 10 employees and growing at a rate of over 20% per year).[28] Venture Capital investment data from 2018 to 2019 show that investment increased for all growth stages[29]. This **highlights the very active and stable funding environment for the UK tech ecosystem.**

In 2020 the UK is also home to eighty tech unicorns (companies valued over $1bn (~£720m)) and 136 'future unicorns' (companies valued between $250m (~£180m) and $800m (~£573m). Notably, 41% of these high-value firms are not based in London, which underlines that successful tech ecosystems also exist outside of London.[30]

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[22] London Economics (2020): AI for Services, AI-for-Services-full-report-2020_KTN-green_Final.pdf (ktn-uk.org)

[23] NimbleFins (2020): Best Countries in Europe for Startups 2020: https://www.nimblefins.co.uk/business-insurance/best-countries-europe-startups-2020

[24] Based on field-weighted citations impacts and research papers produced per unit of R&D expenditure

[25] Department for Business, Energy & Industrial Strategy (2019): International comparison of the UK Research Base 2019, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/815400/International_comparison_of_the_UK_research_base__2019._Accompanying_note.pdf

[26] UK Research and Innovation: The UK's research and innovation infrastructure: Landscape Analysis, https://www.ukri.org/wp-content/uploads/2020/10/UKRI-201020-LandscapeAnalysis-FINAL.pdf

[27] Tech Nation (2020): UK Tech for a changing world – Tech Nation report 2020, https://technation.io/wp-content/uploads/2020/03/Tech-Nation-Report-2020-UK-Tech-For-A-Changing-World-v1_0.pdf

[28] Tech Nation (2020): UK Tech for a changing world – Tech Nation report 2020, https://technation.io/report2020

[29] Pre-seed & Seed: +6%, Bridge rounds: +23%, Series A & B: +28%, Series C+: +71%, Growth Equity: +51%

[30] Tech Nation and Dealroom (2020): UK Tech Ecosystem update, https://dealroom.co/uploaded/2020/12/End-of-year-2020-Tech-Nation-Dealroom.pdf

**Figure 2    VC tech investment (in £bn) and VC tech investment per capita in 2019 by country**
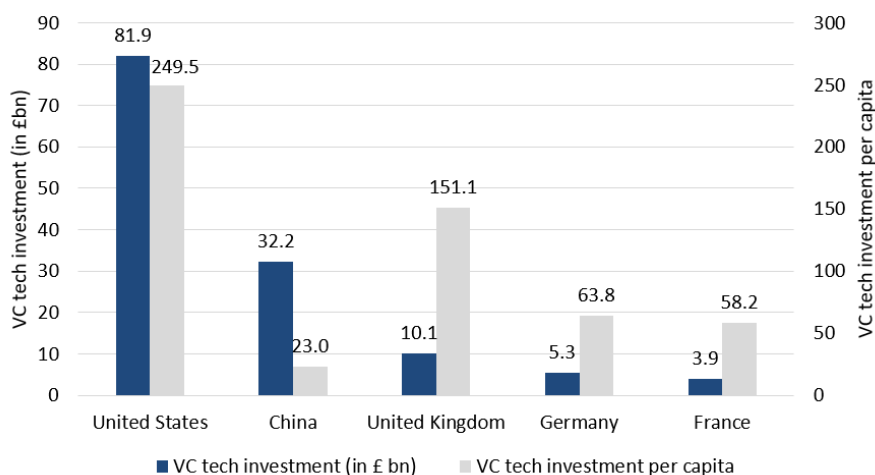


*Source: London Economics based on Tech Nation 2020[31] and the World Bank 2019[32]*

Alongside rising levels of investment in the UK technology industry, **the contribution of the sector to Gross Value Added (GVA) has been growing six times faster than the wider UK economy**. More specifically, the digital tech industry contributed £149 billion in GVA in 2018 (7.7% of the nation's total GVA) compared to £104.2 billion in 2010. This corresponds to an increase of 43% over the period.[33]

The growing UK tech sector also provides significant employment opportunities. **Between 2017 and 2019, UK tech employment increased by 40% to 2.9 million**. This increase is driven by a rising demand for jobs in the digital tech industry, which has been rising at three times the rate as in the financial services sector.[34]

The UK tech sector further benefits from being a focus of policy makers. **The UK Government has the ambition to make the UK a global leader in science and technology**.[35] In the March 2020 Budget, the UK Government committed to increasing its yearly R&D spending to £22 billion until 2024/2025. This will be distributed across universities as well as governmental bodies such as UK Research and Innovation (UKRI) and Innovate UK which play a vital role in supporting the country's R&D activities.[36]

The March 2021 budget, which included initiatives such as the Future Fund Breakthrough and the Help to Grow scheme, was also well received by the industry.[37] The Future Fund Breakthrough scheme will offer grants to firms that invest heavily in R&D with public investment being matched

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[31] Tech Nation (2020): UK Tech for a changing world – Tech Nation report 2020, https://technation.io/report2020

[32] World Bank (2019): Population 2019, available at: https://data.worldbank.org/indicator/SP.POP.TOTL?most_recent_year_desc=true

[33] Tech Nation (2020): UK Tech for a changing world – Tech Nation report 2020, https://technation.io/report2020

[34] Tech Nation (2020): UK Tech for a changing world – Tech Nation report 2020, https://technation.io/report2020/#11-global-investment-trends

[35] HM Government (2020): UK Research and Development Roadmap, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/896799/UK_Research_and_Development_Roadmap.pdf

[36] TechUK (2021): Putting the D's back into UK R&D, https://www.techuk.org/resource/putting-the-d-s-back-into-uk-r-d-why-we-mustn-t-forget-the-other-d.html

[37] Chen, M. (2021) March 2021 Budget – A significant budget for the UK's digital economy. Tech UK news and views. Available at: https://www.techuk.org/resource/march-2021-budget-a-significant-budget-for-the-uk-s-digital-economy.html

by private sector investment.[38] The Help to Grow scheme focuses on providing SMEs with training to adopt digital tech, boost innovation and thereby encourage future growth.

## 2.2 Emerging tech in London compared to the West Midlands

**Box 3**      **Key take-aways about emerging tech in London compared to the West Midlands**

- London has the highest number of emerging tech companies in the UK, most of which are in the tech & creative sector.

- Despite the size of London's emerging tech sector, the West Midlands has a greater number of firms in advanced manufacturing and future mobility, and there are more people employed in these areas in the West Midlands than in London.

Emerging tech companies are categorised into the following six sectors: advanced manufacturing, data driven health, future mobility, modern services, smart cities, and tech & creative. London has by far the largest emerging tech industry in the UK. The Greater London area is home to over 36% of all emerging tech companies with websites in the UK (Figure 3).

**Figure 3**      **Number of emerging tech companies per region**
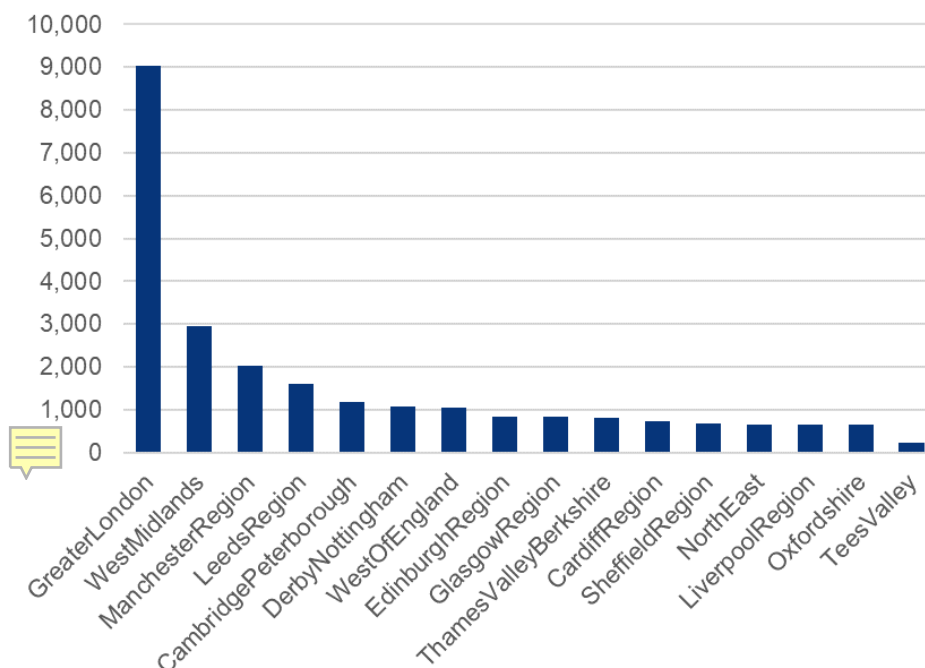


However, while London is predominant in absolute terms, this often obscures the considerable strengths of other regions. Although London has a higher absolute number of emerging tech companies than the West Midlands (9,023 vs 2,946), in both regions the proportion of emerging tech companies relative to other types of companies is around 6%. Figure 4 provides a breakdown

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[38] Warrington, J. (2021) Budget 2021: UK tech sector 'delighted' with spending plans. City A.M. Available at; https://www.cityam.com/budget-2021-uk-tech-sector-delighted-with-spending-plans/

of the size of the emerging tech industry by sector for each region. The West Midlands has a higher number of advanced manufacturing companies, and a greater proportion of advanced manufacturing companies relative to other types of companies with websites compared to London.

**Figure 4    Emerging tech companies per region (number of companies and % of total companies with a website)**
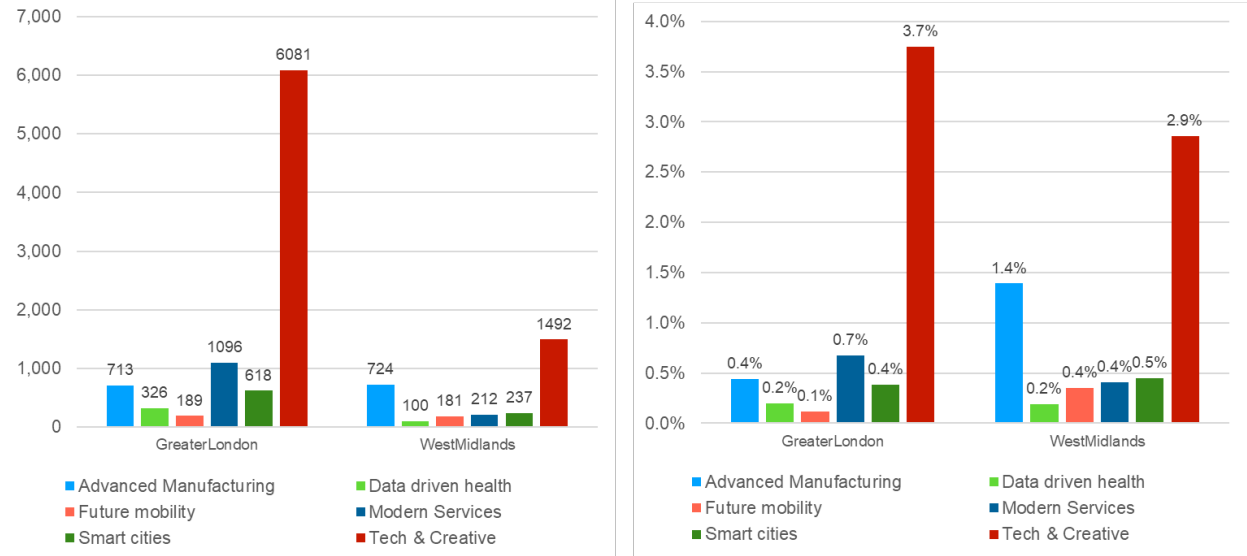


*Source: London Economics based on glass.ai*

Although the emerging tech sector is significantly bigger in London than in the West Midlands in most sectors, there are more people employed in advanced manufacturing (18,555 vs 13,097) and in future mobility (5,757 vs 4760) in the West Midlands than in London (see Figure 5).

**Figure 5    Number of people employed in the emerging tech sector**
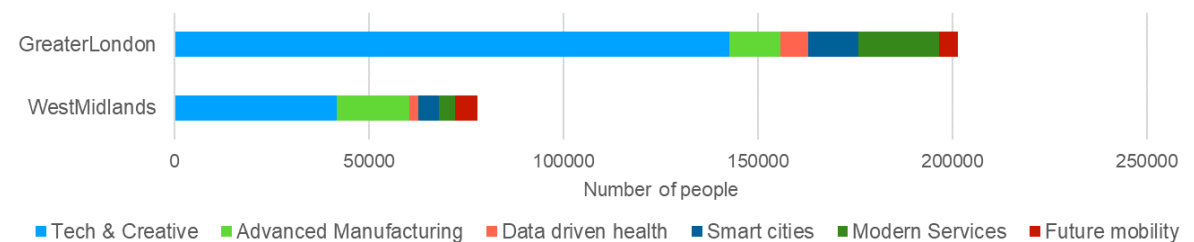


Note: The employment numbers correspond to the number of people employed by companies located in the region

*Source: London Economics based on glass.ai*

Despite the slight advantage that the West Midlands enjoys over London with regards to advanced manufacturing and future mobility, London is still considered a special case due to its size and is therefore excluded from regional comparisons. The following sections will draw comparisons between the West Midlands and other regions in the UK.

## 2.3 Emerging tech across the UK

**Box 4        Key take-aways about emerging tech across the UK**

- **13,426 emerging tech companies were identified in the UK,** corresponding to 5.4% of all companies with a web presence.

- The **West Midlands has the highest number of emerging tech companies (2,946)**, followed by Manchester (2,020) and Leeds (1,594).

- The West Midlands is **home to the most companies in all emerging tech sectors**, including tech & creative, advanced manufacturing, smart cities, modern services, future mobility and data driven health.

- **The West Midlands employs more people in emerging tech (77,804)** than any other region outside of London.

- For advanced manufacturing, data-driven health, future mobility, smart cities and tech & creative sectors, the largest share of the academic evidence of publications, experts, and academic programs related to emerging technology themes **was identified in the West Midlands region.**

This section compares the emerging tech sector in the West Midlands with other city regions that are known to have demonstrable strength in one or more of these sectors. These regions are Cambridge-Peterborough, Cardiff region, Derby-Nottingham, Edinburgh region, Glasgow region, Leeds region, Liverpool region, Manchester region, the North East, Oxfordshire, Sheffield region, Tees Valley, Thames Valley Berkshire, and the West of England.

The largest share of companies outside of London that are active in the field of tech & creative are located in the West Midlands, followed by Manchester region, and Leeds region. Figure 6 shows a regional breakdown of the emerging tech areas. The inner circle represents the relative size of the sectors in the UK, for example the tech & creative sector (coloured in orange) is the largest across the six sectors included in the analysis. The outer circle depicts the distribution of companies in the specific sector across regions, for example following the West Midlands, the largest share of companies active in the field of tech & creative are in the Manchester and Leeds regions. More granular data can be found in Table 2 in Annex 4.

**Figure 6    Regional breakdown of emerging tech sectors**



*Source: glass.ai*

## 2.3.1    Size of the emerging tech sectors

Based on a crawl of company websites by glass.ai, **13,426 emerging tech companies were identified in the UK.** This corresponds to 5.4% of total companies with a web presence. Overall, **the emerging tech sector employs around 307,519 people in the UK** which accounts for 7.7% of people employed by firms with a website.

The region with the highest number of emerging tech companies, excluding London, is the West Midlands with 2,946 identified companies. With a significant gap to the West Midlands, Manchester region (2,020) and Leeds region (1,594) have the second and third highest number of companies. These are also the three largest regions in terms of the total number of firms with a web presence. The Cambridge-Peterborough region (8.3%), the West of England (5.9%), and Thames Valley Berkshire (5.8%) have the highest shares of emerging tech companies out of all companies with a web presence, followed by the West Midlands (5.7%), Manchester (5.6%) and Edinburgh (5.2%) regions (see Figure 7).

**Figure 7    Emerging tech companies per region (number of companies and % of total companies with a website)**
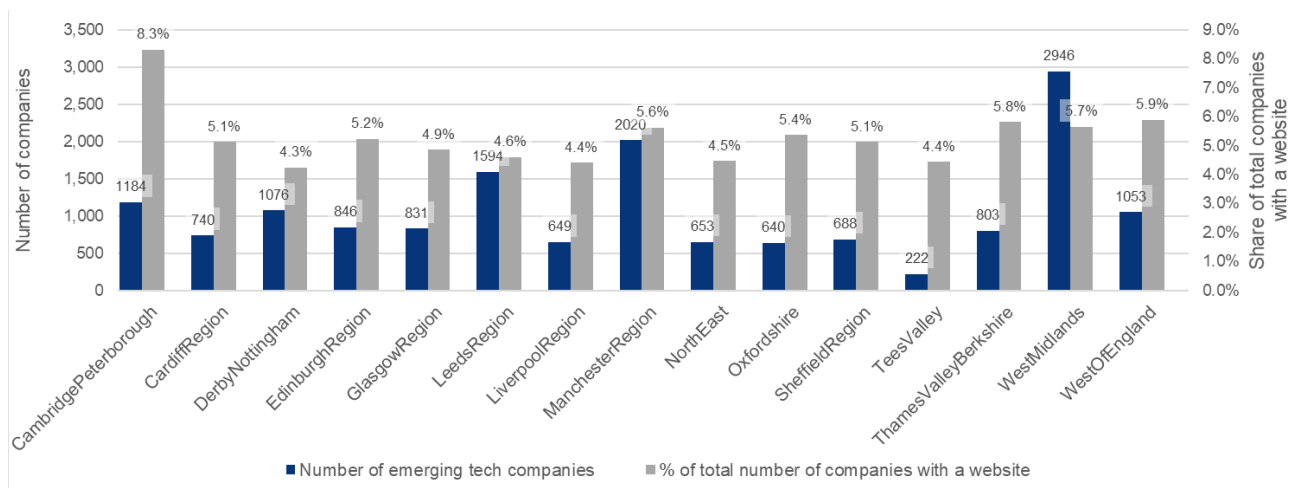


*Source: London Economics based on glass.ai*

## 2.3.2    Tech capabilities by sector

The largest sector is tech & creative with 8,577 identified companies across the country, with the West Midlands having the largest share. **A further break down reveals that the West Midlands has a leading position in 10 out of 13 areas within that sector, particularly in digital transformation, gaming, immersive tech, process automation, and software development.** The Manchester region has a leading position in cloud computing as well as cybersecurity, while Cambridge-Peterborough is home to the most 5G companies. Cambridge-Peterborough has a leading position in the tech & creative sector across most areas in terms of the proportion of tech companies within the overall business population.

**The second largest sector, advanced manufacturing, is considerably smaller than the tech & creative sector with 3,226 identified companies.** Just under a quarter of those companies are in the West Midlands, corresponding to 1.4% of all companies with a website in the region. Only Cambridge-Peterborough has a higher share (1.8%) of companies active in advanced manufacturing. Within the sector, the West Midlands is particularly strong in electronics and industrial automation while Cambridge-Peterborough is comparatively strong in advanced materials.

**In the smart cities sector, 1,403 companies were identified across the selected regions.** The regions with the largest representation of smart cities companies are the West Midlands, Manchester, and Leeds. The West Midlands region is home to most companies in clean tech, construction tech, and space tech, while Manchester has most companies in smart grids.

**The West Midlands also has a leading position is the modern services sector (with 212 identified companies)** and across all its areas (fin tech, professional services tech, and prop Tech). However, when accounting for the total number of companies with a website in the region, the Cardiff region and the West of England stand out as having a higher proportional share. More specifically, the West of England is relatively strong in ProfTech compared to the West Midlands while Cardiff has a strength in FinTech and PropTech.

**The future mobility sector is relatively small compared to the other sectors with only 823 identified companies in the country.** The sector is again dominated by the West Midlands in terms

of absolute number of firms. Within future mobility, the region has a particular strength in autonomous vehicles, battery tech, electric engines, and rail tech. The only area in this sector that is not represented in the West Midlands is urban air, however, only nine companies across the whole country were identified to be active in this field. Cardiff also scores highly in the future mobility sector when accounting for the size of the region, with a particular strength in the areas autonomous vehicles and battery tech.

**Lastly, the smallest sector is data-driven health with 753 identified companies. Most are in the West Midlands, showcasing** the region's leading position in MedTech specifically. The other areas in the sector have a higher concentration in the Manchester region (telehealth) and Cambridge-Peterborough (health analytics and precision med). Accounting for the size of the regions, Cambridge-Peterborough is a clear leader in the data driven health sector, with the highest share of companies in all four related sub-sectors.

**Based on the total number of firms present, the West Midlands, followed by the Manchester and Leeds, are leading across all sectors we examined.** This is not surprising given their overall size. Taking into account the relative size of the tech sector compared to the overall business population (approximated by number of companies with a website in the region), the Cambridge-Peterborough region is the clear leader in advanced manufacturing, data driven health, smart cities, and tech & creative, while its lead in the smart city sector is shared with Edinburgh. Cardiff and the West of England have the highest shares in the sectors future mobility and modern services, respectively.

Figure 8 compares, for each region, the absolute (number of firms in the sector, on the vertical axis) and relative size (number of firms in the sector as a proportion of all firms with a web presence in the region, on the horizontal axis) of the segments identified. Regions in the top right quadrant have larger than average sector in both absolute and relative terms. In other words, a region that is higher up on the vertical axis has a larger than average sector size in absolute terms (i.e. more than average firms present in the region). Similarly, a region further to the right on the horizontal axis has a larger than average sector size in relative terms (i.e. a higher than average proportion of firms in the segment).

The West Midlands has more companies in emerging tech than the average UK region in all segments identified. In the areas of advanced manufacturing and future mobility a greater proportion of companies with a website are devoted to emerging tech than in the average UK region.

**Figure 8      Regional specialism across sectors**



● CambridgePeterborough  ● CardiffRegion  ● DerbyNottingham  ● EdinburghRegion  ● GlasgowRegion  ● GreaterLondon  ● LeedsRegion
● LiverpoolRegion  ● ManchesterRegion  ● NorthEast  ● Oxfordshire  ● SheffieldRegion  ● TeesValley  ● ThamesValleyBerkshire  ● WestMidlands
● WestOfEngland
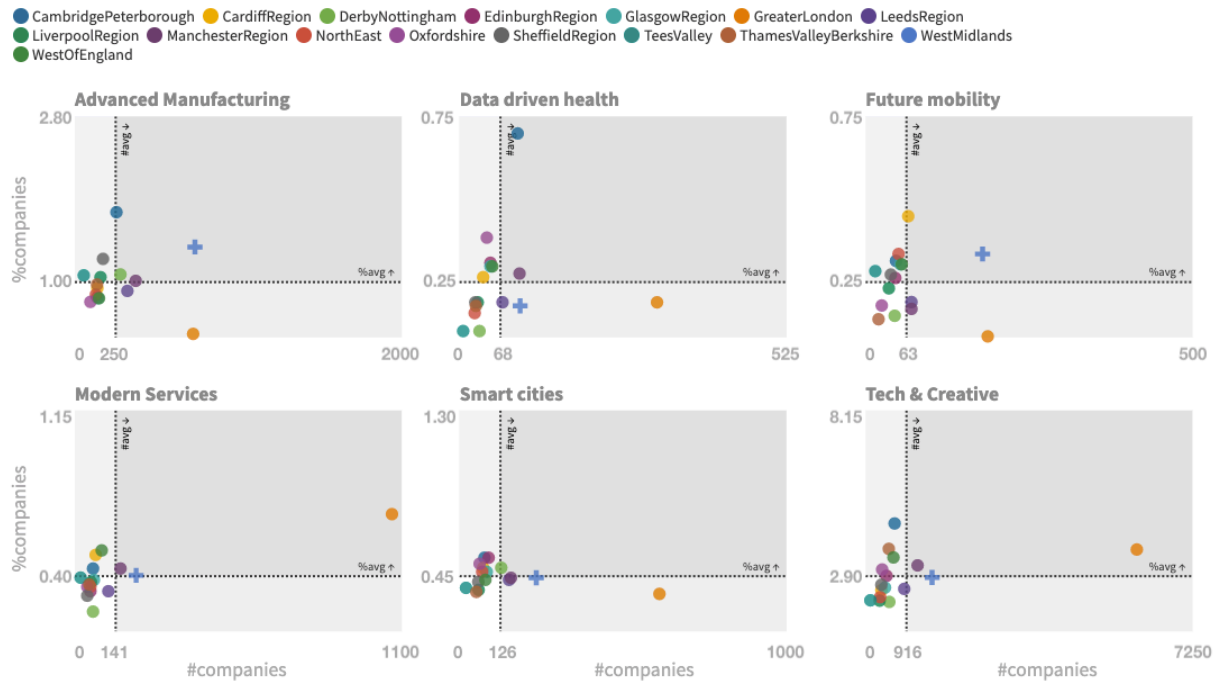
*Source: glass.ai*

## 2.3.3      Employment in emerging tech

In line with the size of the emerging tech sector across regions, emerging tech companies located in **the West Midlands employs the most people in emerging tech (77,804) with over 30,000 more people employed than in the Manchester region (46,401).**[39] Leeds and Cambridge-Peterborough also have relatively large numbers of people employed by companies in the emerging tech sector (see Table 3 in Annex 4 for more granular data).

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[39] The matching was only able to match employees to firms at the total company level. Therefore where companies in a region also have a presence in another region, the matching was unable to distinguish between the number of persons employed within the region and those elsewhere in the UK. As such the matching can only compare the UK-wide employment levels of firms located in the region, but not the exact employment in the region itself.

**Figure 9**     **Number of people employed in the emerging tech sector**
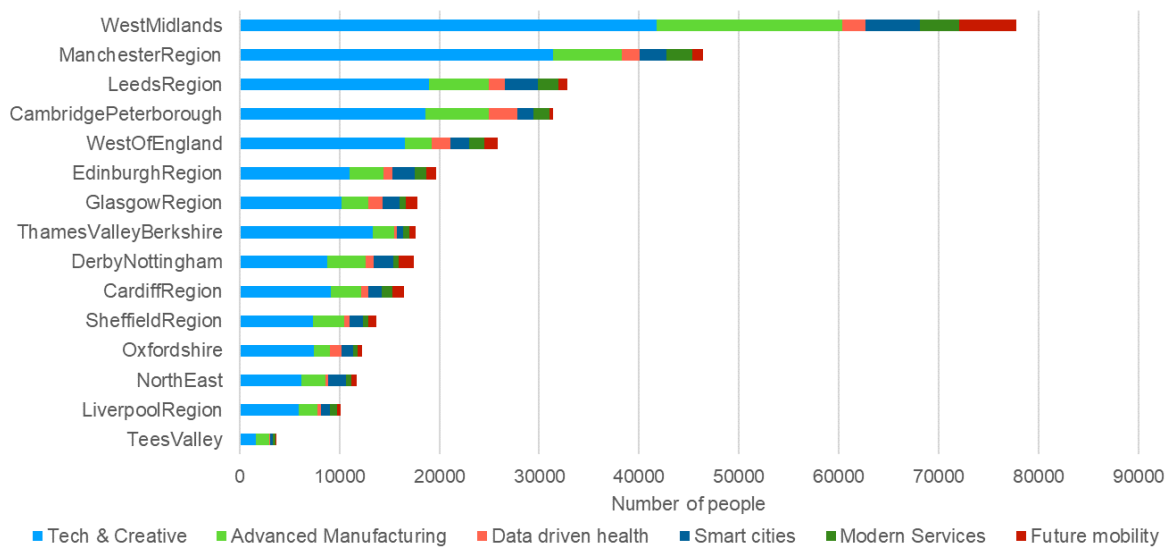


Note: The employment numbers correspond to the number of people employed by companies located in the region

*Source: London Economics based on glass.ai*

### 2.3.4      Roles in emerging tech

Glass.ai identified the top job roles[40] performed in the emerging tech sector by reading LinkedIn profiles of a sample of employees working for companies in the sector. These roles were then used to collect data on employees listed on the identified company websites across regions.

Overall, **most of the identified roles belong to the tech & creative sector** (40,398 roles), which was identified as the largest emerging tech sector in the country based on the number of companies (see section 2.3.1). **In line with the preceding analysis, the West Midlands is the region with the highest number of jobs in advanced manufacturing, future mobility, modern services, smart cities and tech & creative**. In the data-driven health sector, Cambridge-Peterborough is leading in total number of roles identified (1,224). Compared with the other regions, the West of England also seems to have a relatively high number of roles in data-driven health (1,030) (see Table 4 in Annex 4).

To account for the size of the regions, Figure 11 shows the number of roles per 100,000 people employed at companies with a website across regions and sectors (see Table 5 in Annex 4 for more granular data). **In five out of six sectors, the Cambridge-Peterborough region has the highest number of roles relative to total people employed in the region**, namely in advanced manufacturing, data-driven health, future mobility, modern services, and tech & creative. The North East region stands out by leading in smart cities.

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[40] See Annex 1.

**Figure 10      Number of roles across regions and sectors**
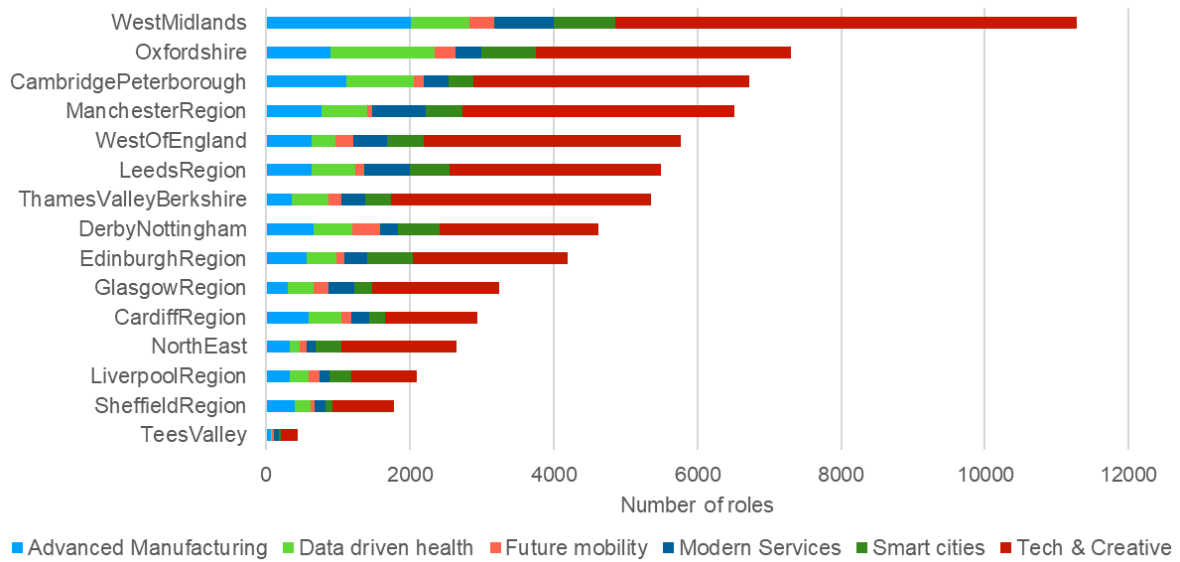


*Source: London Economics based on glass.ai*

**Figure 11      Number of roles per 100,000 people employed at companies with a website**
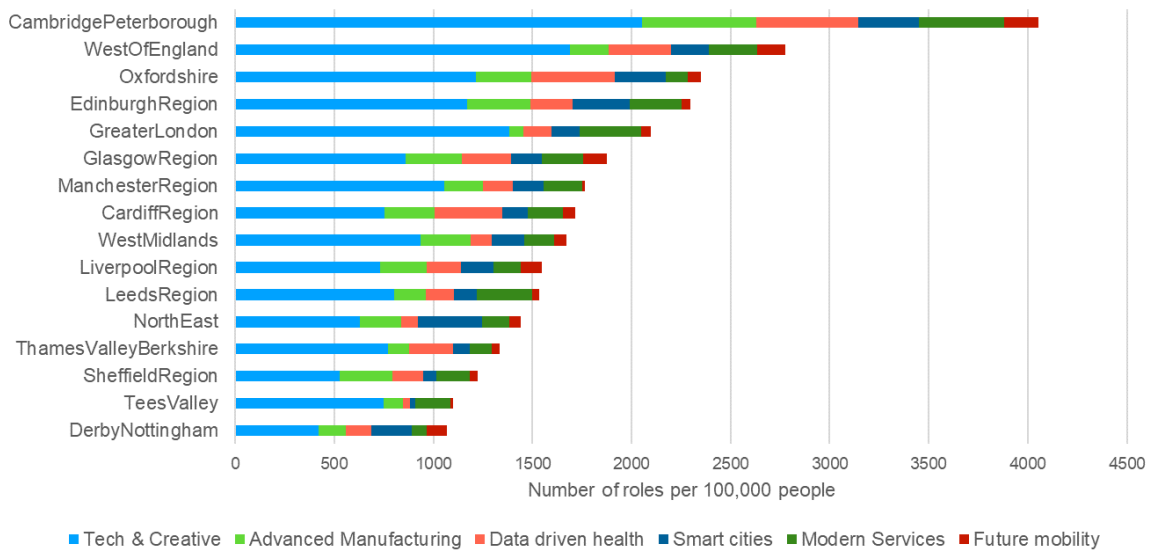


*Source: London Economics based on glass.ai*

### 2.3.5      Academic strengths

glass.ai collected evidence on research activities related to emerging tech across universities and regions by running deep crawls of universities' websites and other sources to count the occurrences of topics that have been matched to the emerging technology themes. This provided evidence about academic publications, experts, and academic programs related to emerging technology themes. **For the sectors advanced manufacturing, data-driven health, future mobility, smart cities and tech & creative, the largest share of evidence was identified in the West Midlands region**. For the modern services sector, most evidence was identified in the Oxfordshire region (see Figure 12).

**Figure 12     Sum of academic evidence across regions and sectors**
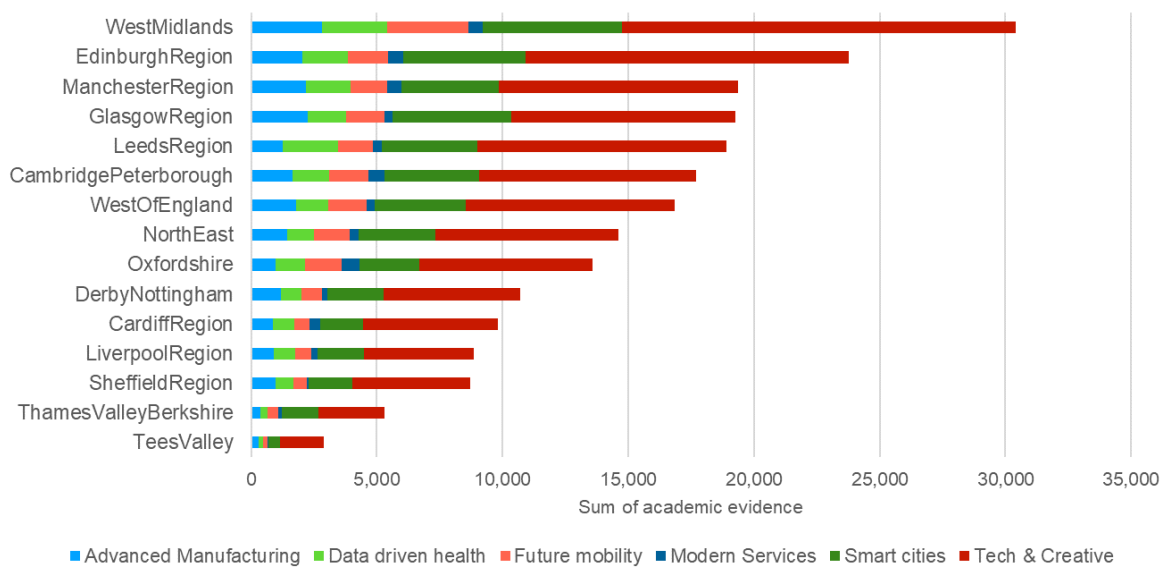


Source: London Economics based on glass.ai

Given that the amount of academic evidence within a region is driven partly by the size of its universities, it is worth exploring the university landscape in more detail. Figure 13 shows a ranking of the top 20 universities in the country, excluding London, measured by the sum of evidence related to emerging tech that was identified. **The University of Cambridge is not only leading in the emerging tech sector overall but also ranks first in all sectors aside from modern services, in which the University of Oxford takes the lead**. Notably, the University of Edinburgh ranks second in three sectors (data-driven health, modern services, and tech & creative), and the University of Strathclyde ranks second in two sectors (advanced manufacturing and smart cities). The University of Warwick ranks second in future mobility.

In terms of academic institutions in the West Midlands, the University of Warwick, the University of Birmingham and Coventry University rank among the top universities in each subsector (coloured in grey in Figure 13). **The University of Warwick and the University of Birmingham are in the top universities in every sector**, while Aston University ranks in the top universities for advanced manufacturing, data-driven health and future mobility, and Coventry University ranks in the top universities in advance manufacturing, future mobility and tech & creative.

Figure 13 excludes universities in London; the rankings do not change significantly when those universities are included. The University of Warwick remains in sixth place and the University of Birmingham moves down a place to fourteenth, and Coventry University does not make it to the top 20.

**Figure 13    Sum of evidence in the emerging tech sector for the top 20 universities in the nation**
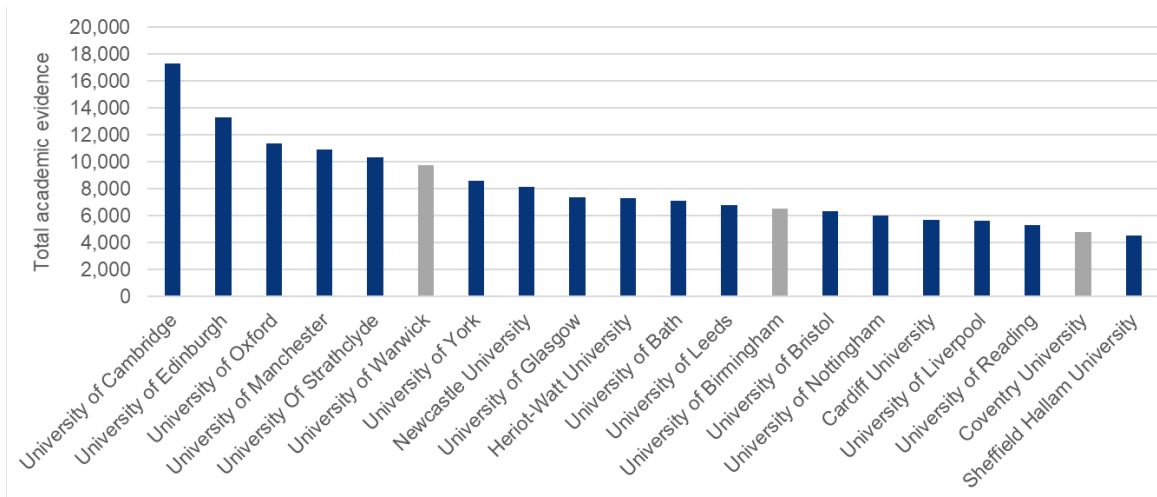


*Source: London Economics based on glass.ai*

# 3 The West Midlands: An overview of emerging tech strengths

**Box 5          Key take-aways from the deep-dive into the West Midlands**

- The West Midlands region is well connected to other regions of the UK through major rail and road networks, **making it one of the most accessible regions in the country**.

- The West Midlands **economy grew faster than any other region outside of London between 2012 and 2018.**

- The growth rate of active enterprises also increased at a faster rate than the national average from 2017 to 2018.

The West Midlands is the only landlocked region in the UK, sharing its borders with the North West, East Midlands, South East, South West regions and Wales. The region consists of three Local Enterprise Partnerships (LEPs): the Black Country, Coventry and Warwickshire, and Greater Birmingham and Solihull. The large conurbation Birmingham is the largest urban area in England after London.[41]

Given its central location in England, **the West Midlands region is well connected to other regions of the UK making it one of the most accessible regions in the country**. Being connected to major rail and road networks, the region is linked to the south, east, and west of England and it is home to Birmingham International Airport, the second largest Airport in England outside of the London area.[42]

The **West Midlands region has around 4 million inhabitants** (as of 2020).[43] Greater Birmingham/Solihull and the Black Country have the highest populations with 2.05 million and 1.19 million residents respectively. According to the 2011 census published by the Office for National Statistics[44], the West Midlands region is the second most ethnically diverse region in the country and has the largest non-White population outside of London.[45]

### 3.1.1 The West Midlands economy

**Output & employment**

The West Midlands region has historically been known for its **manufacturing sector,** including metal manufacturing, mechanical and electrical engineering, and car production, making the region one of the most prosperous in the country until the late 1970s. After a period of modest economic growth, the West Midlands has seen a substantial resurgence in the past years. The West Midlands

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[41] West Midlands Regional Economic Development Institute Partnership (2020): State if the Region 2020 Full Report, https://www.wmca.org.uk/what-we-do/office-for-data-analytics/

[42] Medland, A. – Office for National Statistics (2011)

[43] Statista (2020): Population of England in 2019, by region, https://www.statista.com/statistics/294681/population-england-united-kingdom-uk-regional/

[44] The ONS data is based on the wider West Midlands region

[45] Office for National Statistics (2011), https://www.ethnicity-facts-figures.service.gov.uk/uk-population-by-ethnicity/national-and-regional-populations/regional-ethnic-diversity/latest

**economy grew faster than any other region outside of London between 2012 and 2018,** according to the Office for National Statistics.[46]

The region's **total GVA in 2018 was £105.1 billion,** growing at a rate of 4%, a higher rate than the UK average (3.4%) between 2017 and 2018. Birmingham has the highest GVA contribution with £29 billion followed by Black Country with £21.2 billion. The GVA per head (£25,183 as of 2018), grew at rate of 3.3% compared to a national average of 2.7%. The region employs 1.8 million people, which corresponds to an employment rate of 72.4% (compared to a national average of 75.6%).[47] The unemployment rate decreased significantly in the past years to 5.5%.[48] This compares to a national average of 4.0% and an EU average of 6.9%.[49]

The West Midlands is the **youngest region outside of London,** with nearly one in three people being under the age of 25. The number of people with higher level skills has increased at a faster rate than the national average since 2013. Simultaneously, the number of people with no qualifications is falling faster than the national average.[50]

Nevertheless, in line with the UK overall, the West Midlands region faces a skill shortage,[51] which may inhibit its ability to capitalise on potential innovation and growth, as few people possess the high-level qualifications needed fully utilise these emerging tech capabilities. To tackle these issues, the West Midlands Industrial Strategy lays out several measures such as creating a West Midlands Career Hub, extending the Mayor's Mentor programme (an initiative aiming to help young people to acquire life skills and career advice), and as delivering the Apprenticeship Promise to provide apprenticeship or training opportunities to young people in the region.[52]

**Technology sector employment**

The sectors with an above-average proportion of jobs compared to the national average are advanced manufacturing and engineering, retail, logistics and transport technologies, public sector and education, life sciences, and healthcare.[53] The Midlands Engineering Science & Innovation audit identified significant future market opportunities in the sectors of advanced transport technologies, medical technology, future food processing, energy and low carbon systems, advanced manufacturing and engineering, digital technologies as well as system integration.[54]

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[46] WMCA (2019): West Midlands economy has grown faster than anywhere outside London since 2012, https://www.wmca.org.uk/news/west-midlands-economy-has-grown-faster-than-anywhere-outside-london-since-2012/

[47] These are pre-COVID19 numbers, as post-COVID19 employment statistics are not yet available.

[48] West Midlands Regional Economic Development Institute Partnership (2020): State if the Region 2020 Full Report, https://www.wmca.org.uk/what-we-do/office-for-data-analytics/

[49] European Commission: West Midlands - Economy, https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/base-profile/west-midlands

[50] HM Government (2019): West Midlands Local Industrial Strategy, https://www.wmca.org.uk/media/3094/west-midlands-local-industrial-strategy-single-page.pdf

[51] West Midlands Combined Authority (2018): West Midlands Industrial Strategy, https://www.wmca.org.uk/media/2627/west-midlands-industrial-strategy.pdf

[52] ibid

[53] West Midlands Regional Economic Development Institute Partnership (2020): State if the Region 2020 Full Report, https://www.wmca.org.uk/what-we-do/office-for-data-analytics/

[54] SQW (2017): A Science & Innovation audit for the West Midlands, https://www.sqw.co.uk/insights-and-publications/west-midlands-science-and-innvation-audit/

**Innovation performance & business formation**

According to the Regional Innovation Scoreboard 2019, the wider West Midlands region[55] is ranked as "strong + innovator". The corresponding score has increased by 22.5% since 2011 which shows that the **innovation performance of the region has increased meaningfully over time**. Its strong research base is rooted in the region's universities, private institutions, and commercial R&D and research facilities. The West Midlands' Gross Expenditure on Research and Development (GERD) as a share of GDP was 1.96% in 2016, which exceeds the UK average of 1.68%.[56]

The growth rate of active enterprises also increased at a faster rate than the national average from 2017 to 2018 resulting in an active enterprise base of 170,475 active businesses[57] – growing at a rate of 3.3% compared to the UK average of 0.5%. This is related to a **higher enterprise birth rate in the West Midlands** (1.7%) when compared to the UK average which shows a decline (-0.3%). Accordingly, the number of enterprise births per 10,000 inhabitants is 59 - above the UK average of 58.[58]

## 3.2    Emerging tech in the West Midlands

**Box 6        Key take-aways from emerging tech in the West Midlands**

- Of the **2,946 emerging tech companies were identified in the West Midlands,** half are active in the tech & creative sector.

- **The West Midlands has the most companies in the areas of autonomous vehicles, battery tech, electric engines and rail tech.**

- The proportion of skilled people in the West Midlands has been increasing at a faster rate than the national average since 2013.

- Over a third of all roles in the country that relate to construction tech can be found in the West Midlands.

- The West Midlands region is the **largest higher education cluster outside of London** with multiple universities, including research-intensive institutions such as the University of Warwick, the University of Birmingham.

Based on a crawl of company websites by glass.ai, **2,946 emerging tech companies were identified in the West Midlands**. The total number of companies with a web presence in the region was 51,756. Thus, 5.7% of identified companies with a website in the West Midlands belong to the emerging tech sector. Emerging tech companies identified to be operating in the West Midlands employed around 77,804 people across the UK.[59]

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[55] The Regional Innovation Scoreboard refers to the wider West Midlands region

[56] European Commission: West Midlands - Regional Innovation Scoreboard results, https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/base-profile/west-midlands

[57] Note this compares to the total number of companies with a web presence in the region of 51,756. While data collected for this report is not directly comparable to official data (e.g. due to differences in regional boundaries), it is likely that large parts of this difference are due to very small companies such as one-man band construction businesses which are unlikely to have a web presence.

[58] West Midlands Regional Economic Development Institute Partnership (2020): State if the Region 2020 Full Report, https://www.wmca.org.uk/what-we-do/office-for-data-analytics/

[59] The matching was only able to match employees to firm at the total company level. Therefore where companies in a region also have a presence in another region, the matching was unable to distinguish between the number of persons employed within the region and

Figure 14 shows the distribution of companies among the different sectors (advanced manufacturing, data-driven health, future mobility, modern services, smart cities, and tech & creative) in the West Midlands region.

**Figure 14     West Midland's emerging tech sector (number of companies and % of total companies with a website)**
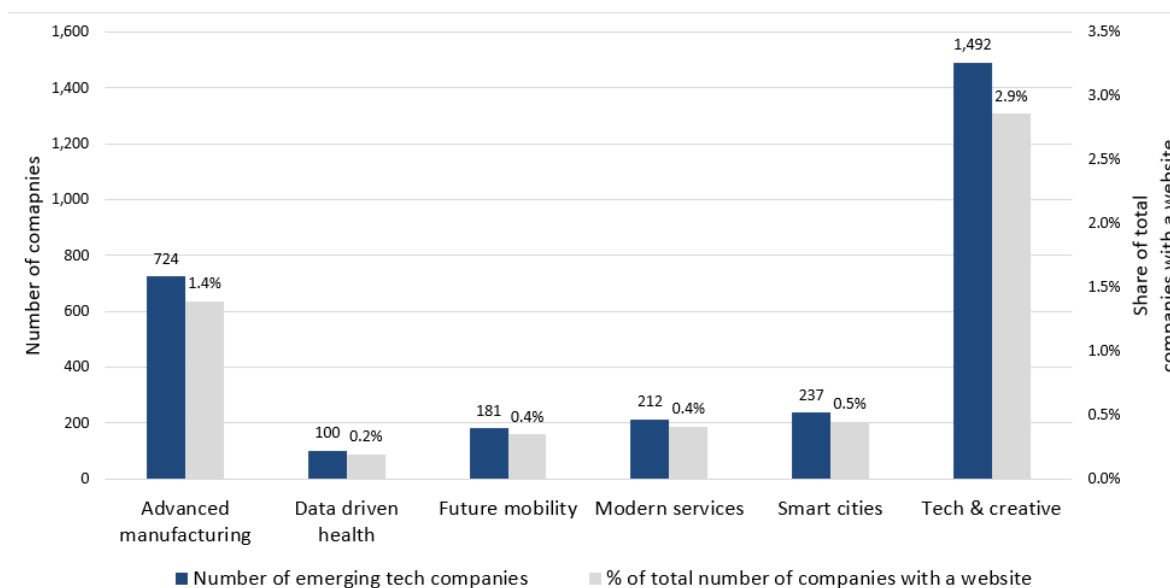


*Source: London Economics based on glass.ai*

**Around 50% of identified companies in the emerging tech industry are active in the tech & creative sector, which makes this sector the largest emerging tech sector in the West Midlands.** This corresponds to 1,492 companies representing 2.9% of all companies in the West Midlands that have a web presence (see Figure 14). Household names from the sector include IBM, Capgemini, Oracle, WIPRO and Infosys.

Figure 15 shows the distribution of firms across different areas within subsectors. In the largest sector, tech & creative, **468 companies are active in the field of software development which is the largest area in the entire West Midlands' emerging tech sector**. Given the size of the overall tech & creative sector, other areas in the field are also relatively large, namely, software development (468), telecoms (239 companies), cloud computing (192 companies), process automation (88 companies), and cybersecurity (78 companies). However, even technologies with a small footprint in the West Midlands are of great importance to the overall ecosystem. Foundational technologies such 5G act as enablers across a range of tech applications. For example, **although 5G is small in terms of firm numbers, it is a key enabler of advances in PropTech, CAVs, MedTech**.

As is evident from Figure 14, **there is a large difference between the number of firms active in the tech & creative sector and those active in the other five sectors**. In the second largest sector, advanced manufacturing, 724 companies were identified as active in the field, which corresponds to 1.4% of all identified companies with a web presence in the region. Relative to the total number of companies within the region, advanced manufacturing is larger than the national average. Firms

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those elsewhere in the UK. As such the matching can only compare the UK-wide employment levels of firms located in the region, but not the exact employment in the region itself.

operating in advanced manufacturing mostly belong to the areas of electronics and industrial automation (481 and 216 identified companies respectively).

The modern services and smart cities sectors have 212 and 237 companies operating respectively. This corresponds to 0.4% and 0.5% of total companies with a web presence in the region (see Figure 14). In the modern services sector, prop tech is most prominent subsector with 85 active firms. In the smart cities sector, construction tech companies (84 companies) make up the largest share.

Based on absolute numbers of companies active in the West Midlands, slightly fewer companies are active in the field of future mobility (181 companies). However, **despite its relatively small size compared to other sectors in the region, the West Midlands future mobility sector accounts for 14% of the UK future mobility sector and its relative size is above the UK average.** Within this sector in the West Midlands, battery tech companies have the largest share (77 companies). Additionally, 24 companies that are active in the field of autonomous vehicles and 74 companies were identified in electric engines. In contrast, MaaS, rail tech, and urban air (1,5, and 0 companies respectively) are relatively small. **Compared with other regions in the UK and relative to the number of companies in the region, the West Midlands, traditionally the centre of the UK's automotive industry, has a leading position in the areas of autonomous vehicles, battery tech, electric engines and rail tech.** Key brands in the region include Jaguar Land Rover, ZF Group, CRRC Times Electric and Siemens Mobility.

The smallest emerging tech sector in the analysis of the West Midlands is data-driven health. Out of 2,946 emerging tech companies, only 100 were active in this sector. Within that sector, most companies (64) belong to the Med Tech area.

**Figure 15      Distribution of West Midland's emerging tech subsectors across areas (number of firms)**
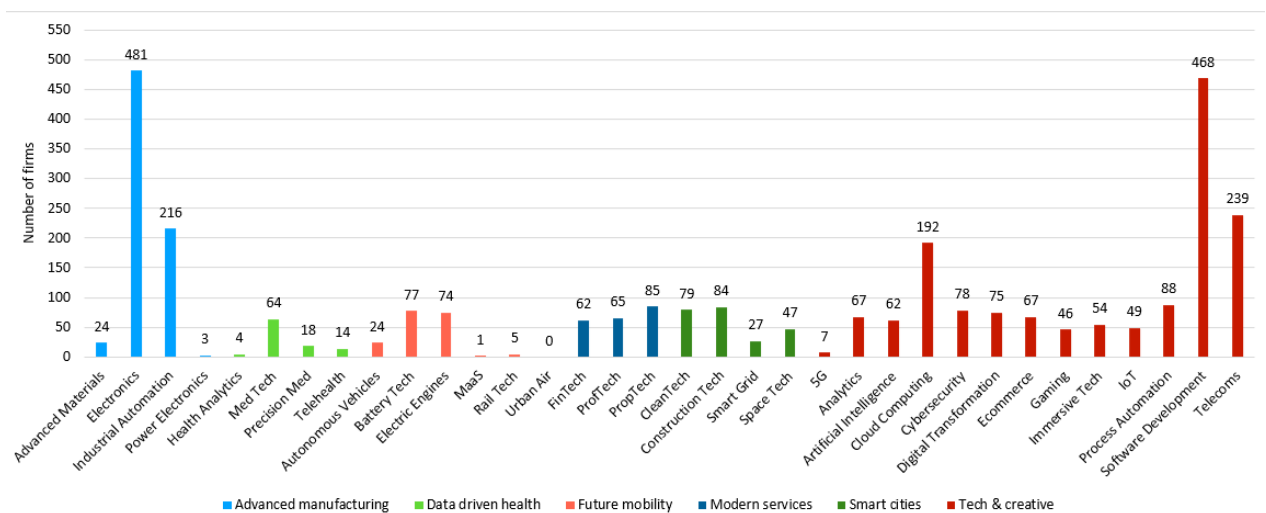


*Source: London Economics based on glass.ai*

As in Figure 8, Figure 16 compares the absolute and relative size of the sectors identified. Regions in the top right quadrant have larger than average sector in both absolute and relative terms. In other words, a region that is higher up on the vertical axis has a larger than average sector size in absolute terms (i.e. more than average firms present in the region). A region further to the right on the horizontal axis has a larger than average sector size in relative terms (i.e. a higher than average proportion of firms in the segment).

As the West Midlands appears in the upper right-hand quadrant for electronics, industrial automation, autonomous vehicles, battery tech, electric engines, rail tech and ecommerce, for each of these themes, it has an absolute as well as a relative advantage over other areas in the UK.

**Figure 16** **Regional Specialism across emerging tech themes**



Source: glass.ai

Note: This figure draws a comparison between the West Midlands and all other regions excluding London. To see how London impacts the relative strengths of each region see Figure 21 in Annex 3.

### 3.2.1    Size of emerging tech companies in the West Midlands

**Most of the emerging tech companies identified in the West Midlands are small companies with less than 10 employees** (see Figure 17). Excepting future mobility, small companies make up over 50% of the total companies in the region in all sectors. In the future mobility sector, they account for 42.9% of total companies. Additionally, very large companies (with more than 250 employees) constitute the smallest share across all sectors which shows that generally, smaller companies tend to predominate in the emerging tech sector. This is in line with the size of emerging tech companies throughout the UK; even in London between 85-90% of all emerging tech companies employ 50 or fewer people.

**Figure 17    Size of emerging tech companies in the West Midlands**
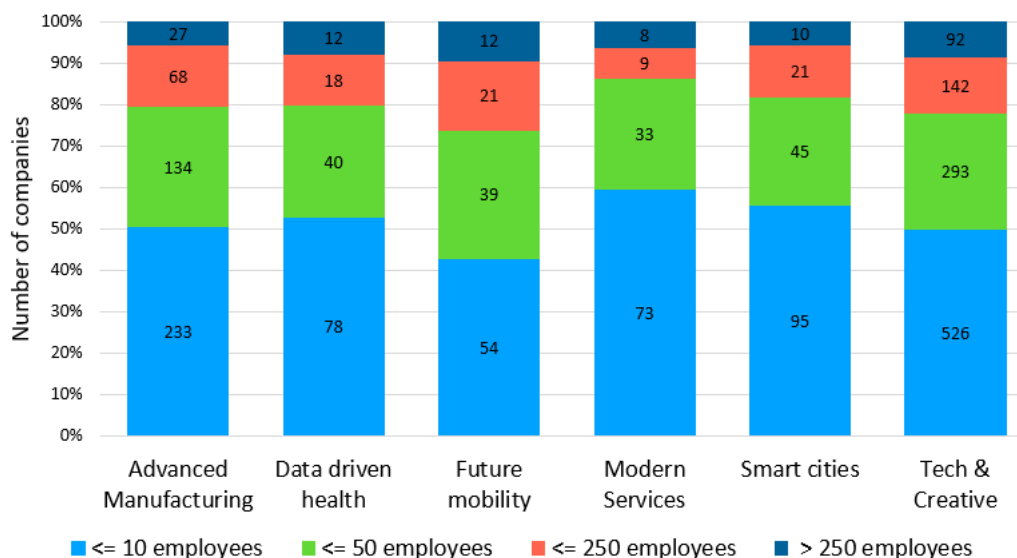


Note: the breakdown is based on companies where employment data could be identified, the size of 863 companies could not be identified

*Source: London Economics based on glass.ai*

### 3.2.2    Skills base

Figure 18 shows that tech & creative not only has the largest share of emerging tech companies, but it also has the largest number employees with associated job roles and skills. Over half of all roles identified in the emerging tech sector in the West Midlands are tech & creative. The lead is **most pronounced in the areas of telecoms and software development,** and is prominent even on a national level, where 27.8% and 23.8% of respective total roles in the country (excluding London) are in the West Midlands.

The **West Midlands also stands out nationally with a high concentration of roles in construction tech**. In fact, 27.7% of all roles in the country relating to construction tech are in the West Midlands. Compared to other areas within the West Midlands region, cloud computing in the tech & creative sector, electronics in the advanced manufacturing sector, and MedTech in the data-driven health sector also show a relatively large number of roles (see Table 40, Table 50, and Table 60 in Annex 4 for more granular data).

**Figure 18    Roles and skills in the West Midlands across sectors**
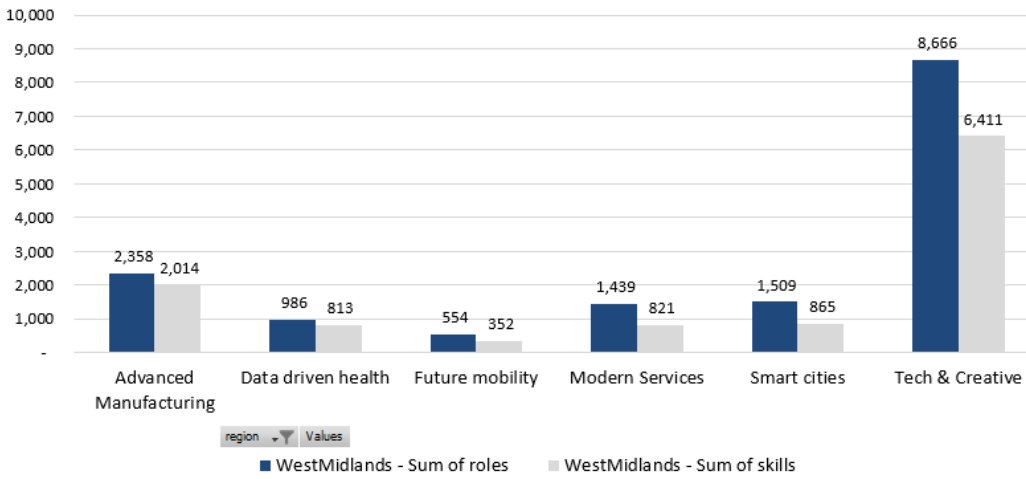


*Source: London Economics based on glass.ai*

**Figure 19     Roles and skills in the West Midlands across areas**
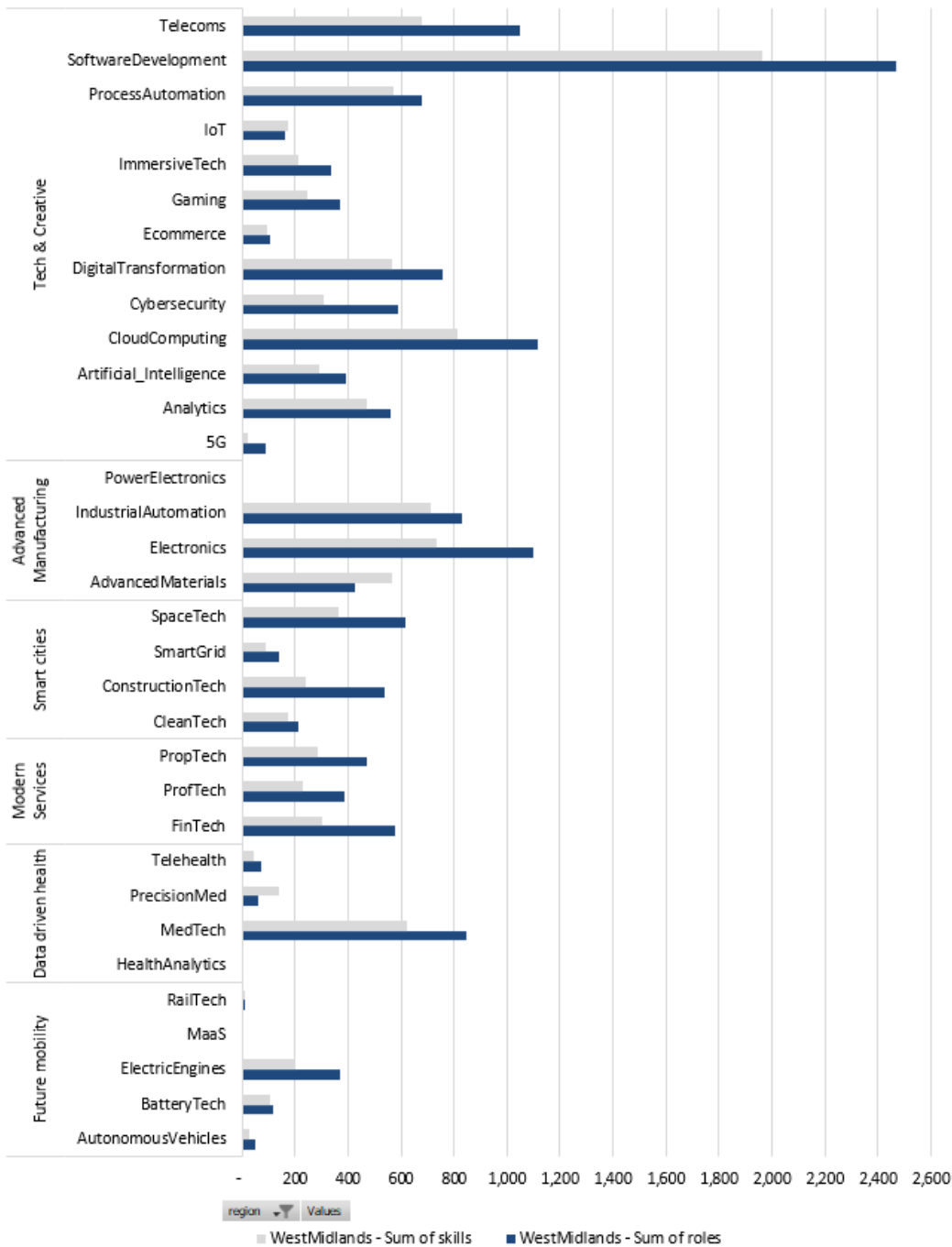


*Source: London Economics based on glass.ai*

### 3.2.3     Academic strengths

This section provides a more detailed insight into the academic strengths of the West Midlands. The West Midlands region is the **largest higher education cluster outside of London** with multiple universities: Aston University, Birmingham City University, University of Birmingham, University College Birmingham, Coventry University, Newman University, Arden University, University of Warwick, and University of Wolverhampton.

Among these, the University of Birmingham is the third largest university in the in terms of enrolment. The high concentration of education assets in the West Midlands is a significant growth engine for businesses in the region and the wider society.

Beyond simply their number and size, universities in the West Midlands have strong research footprints. The University of Birmingham and University of Warwick are research-heavyweights, especially in science and technology. In the 2020 Times Higher Education World university ranking they ranked 9 (University of Warwick) and 13 (University of Birmingham) in the UK and 77 and 112 in their respective worldwide rankings.[60] They were also in the top five nationally in a number of disciplines such as Aeronautical, Mechanical, Chemical and Manufacturing Engineering, Agriculture, Veterinary and Food Service, Computer Science and Informatics, and Mathematical Science. Alongside their excellent international reputation, the universities also benefit from being the focus of regional funds provided by the "Birmingham Science City" initiatives.[61]

Given the large university cluster in the West Midlands, it is no surprise that **research and teaching activity (as measured by universities' web content related to emerging technologies) is highest regionally in five out of six sectors**, namely advanced manufacturing, data-driven health, future mobility, smart cities and tech & creative. The Edinburgh region leads in the sector modern services.

The data reveals a particular strength in the sector of future mobility; **17.6% of the academic evidence on this topic across the country can be attributed to universities in the West Midlands**. Within future mobility, the West Midlands region further has a leading position in autonomous vehicles, battery tech and electric engines, and produces almost a fifth of all academic evidence on these topics in the UK.

**The leading academic position in the West Midlands is driven by its two most prestigious universities, University of Warwick and University of Birmingham.** Both universities are leading across all emerging tech sectors (see Figure 12). The University of Warwick ranks sixth in the emerging tech sector overall across the country and ranks second in future mobility. The University of Birmingham ranks fourteenth in the overall emerging tech sector with a particular strength in future mobility and modern services (ranking ninth in both subsectors). Notably, **Coventry University** contributes significantly to the academic research in the field of future mobility (tenth in this field), and is ranked in the top 20 Universities for four out of the six sectors.

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[60] https://www.timeshighereducation.com/world-university-rankings/2020/world-ranking#!/page/0/length/25/sort_by/rank/sort_order/asc/cols/stats

[61] European Commission: West Midlands – Research, Development & Innovation, https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/base-profile/west-midlands

**Figure 20    Distribution of academic evidence across regions**
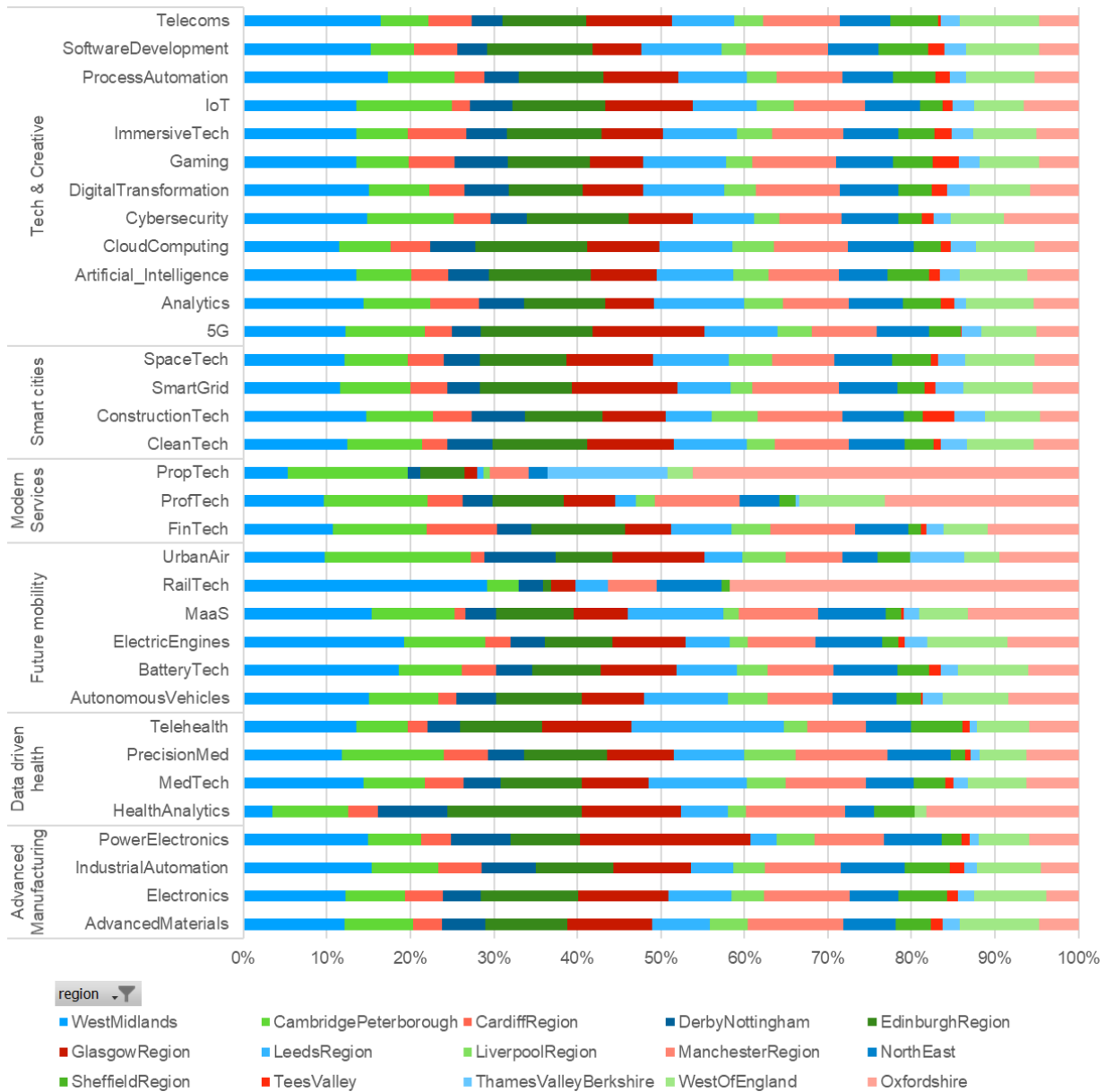


Source: London Economics based on glass.ai

# 4    West Midlands innovation ecosystem

**Box 7        Key take-away from the West Midlands innovation ecosystem**

- The West Midlands region is home to a **well-developed infrastructure network** fostering innovation and technological advances such as science parks, incubator centres and accelerator programmes which benefit new businesses.

- **West Midlands received 906 FDI (foreign direct investment) projects from 2011 to 2019** - creating over 50,000 new jobs, with the number of projects doubling from 49 to 131 per year.

■ The West Midlands has proved to be the most attractive regional location for investment outside of London for 5 years running.

## 4.1    Infrastructure and physical assets

The West Midlands region is home to a **well-developed infrastructure network** fostering innovation and technological advances such as science parks, research institutes and Research and Technology Organisations (RTOs), and incubator and accelerator programmes. New businesses thus benefit from the physical assets and infrastructure necessary to grow and develop.[62]

- There are **11 UK Science Park Associations (UKSPA)** member sites located in the West Midlands region. These offer start-ups physical spaces to grow and develop their technologies and are often focused on a particular sector such as the Innovation Birmingham Campus which focuses on digital and technology sectors.[63]

- Alongside science parks**, incubators accelerate technological advances** by supporting start-up firms through business advice. According to the Department for Business, Energy & Industrial Strategy (BEIS), 14 incubators are present in the West Midlands region which accounts for 7% of the UK total (as of 2017).[64]

- There are **10 accelerators** (supporting early-stage start-ups) identified in the region. The number of accelerators per 10,000 businesses was larger in the Greater Birmingham and Solihull area (1.43) than anywhere else in the UK (including London which has 1.32 per 10,000 businesses) as of 2017. This highlights the value of Birmingham as a centre for innovative activities.[65]

- The region is home to several leading research centres and RTOs such as:
  - the **Advanced Propulsion Centre (APC) Hub** from the University of Warwick, a global centre of excellence for low carbon propulsion development and production;[66]
  - the **Birmingham Institute of Translational Medicine (ITM)**, a central hub for clinical trials acceleration and stratification, and clinical informatics; [67]
  - the **Energy Systems Catapult (ESC)** in Birmingham aiming at transforming energy systems focusing on electricity, heat and combustible gases;[68]
  - the **Institute for Advanced Manufacturing and Engineering (IAME)** focusing on R&D in sectors such as automotive aerospace, oil and gas, power generation and rail. [69]

- **Enterprise Zones** (EZs) further provide a favourable environment for technology businesses by offering tax breaks and Government support. EZs in the West Midlands include the MIRA Technology Park, Birmingham City Centre Enterprise Zone, the Black Country EZs and Dudley's Business & Innovation Enterprise Zone.[70]

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[62] SQW (2017): A Science & Innovation audit for the West Midlands, https://www.sqw.co.uk/insights-and-publications/west-midlands-science-and-innvation-audit/
[63] UKSPA: Our Members, https://www.ukspa.org.uk/our-members/
[64] BEIS (2017): Business Incubators and Accelerators – The National Picture, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/955469/business-incubators-accelerators-uk-report.pdf
[65] Ibid.
[66] SQW (2017): A Science & Innovation audit for the West Midlands, https://www.sqw.co.uk/insights-and-publications/west-midlands-science-and-innvation-audit/
[67] Ibid.
[68] Ibid.
[69] Ibid.
[70] Ibid.

■ The infrastructure network is supported by a **well-connected and efficient transport networks** linking key external regions to the West Midlands.

## 4.2    Innovation led Foreign Direct Investment in the West Midlands

Foreign direct investment (FDI) can enhance productivity and innovation, generating employment and other benefits. FDI firms and FDI recipients are generally more productive and have access to better technology and management practices – benefitting existing firms through knowledge spillovers. Studies show that FDI benefits both investors and recipients, as well as providing positive spillover benefits across the economy more widely.[71]

**West Midlands received 906 FDI projects from 2012 to 2019** - creating over 50,000 new jobs, with the number of projects per year doubling from 49 in 2012 to 131 in 2019. This exceeded the average growth rate for FDI projects for the whole of the UK over this period (26.7%).[72] During the 2019/20 financial year, the West Midlands region secured 157 new FDI projects, accounting for 8% of the UK's total FDI projects – the strongest performance of any UK region outside of London and the South East. This created 3,883 new jobs and safeguarded an additional 2,220.[73]

This is the fourth year that the West Midlands has proved to be the most attractive regional location for investment outside of London, with the US, Germany and India being the region's three leading sources of this FDI.[74] Notable projects include:[75]

■ German laser systems and processes provider **ACSYS Lasertechnik** invested in Coventry

■ **Microland**, an Indian IT transformation company, created its European headquarters in Birmingham.

■ Iconic British brand Norton Motorcycles, acquired by Indian motorcycle firm **TVS Motors**, based its new headquarters in Solihull.

■ US-owned UPS, a specialist in temperature-controlled supply chain, expanded the footprint of its Polar Speed subsidiary in Birmingham.

■ German company **Thyssenkrupp Materials** chose to establish their new advanced manufacturing fabrication facility in Sandwell.

■ Italian-owned chemical manufacturer **MAPEI UK** invested in the Black Country.

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[71] Department for International Trade (2018), *Estimating the economic impact of FDI to support the Department for International Trade's promotion strategy.* Available at:
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/731144/DIT_FDI_analysis_report_v16_accessible.pdf

[72] West Midlands Regional Economic Development Institute Partnership (2020): State of the Region 2020 Full Report, https://www.wmca.org.uk/what-we-do/office-for-data-analytics/

[73] West Midlands retains position for FDI. (2020, July 15). *Invest in the West Midlands.* https://investwm.co.uk/2020/07/15/west-midlands-retains-fdi/

[74] Ibid.

[75] Ibid.

## 4.3 Additional enablers of tech growth in the West Midlands

**Box 8    Key takeaways from additional enablers of tech growth in the West Midlands**

- There is a strong policy focus on fostering innovation in the West Midlands region, with plans such as the **West Midlands Local Industrial Strategy,** which aims to create a regulatory framework to support innovation.

- The West Midlands region was chosen as the **first region in the UK to trial new 5G applications at scale** before a country-wide rollout

- **In 2019, the West Midlands region invested approximately £2.4 billion in R&D, accounting for 9.1% of the UK total.**

### 4.3.1    Policy support

There is a strong policy focus on fostering innovation in the West Midlands region. The **West Midlands Local Industrial Strategy** aims to create a regulatory framework to support innovation. The West Midlands aims to strengthen the foundations of productivity and take advantage of opportunities in mobility, data-driven health and life sciences, modern services, creative content, techniques, and technology.[76]

The **West Midlands Digital Roadmap** for 2021 sets out ambitious goals to become the best-connected region in the UK. The West Midlands plans on becoming a fairer, greener and healthier region by using data to improve public services, secure access to digital opportunities for everyone and harness the potential of digital to build economic resilience.[77]

The West Midlands Combined Authority places innovation at the centre of their **Strategic Economic Plan** alongside improving productivity and public service reform. Actions to strengthen innovative activities include increasing the number of businesses adopting innovations, investing in R&D, and identifying and supporting companies that pursue emerging technologies. The West Midlands Combined Authority is also committed to nurture initiatives such as Innovate UK's Small Business Research Initiative.[78]

Local authorities such as the Black County, Coventry and Warwickshire, Greater Birmingham and Solihull have also focused on nurturing innovation in their local Strategic Economic Plans by initiating projects and programmes that support small businesses engaging in in innovation.[79]

### 4.3.2    Networks and knowledge exchange

The West Midlands area is home to several successful networks which actively collaborate on the regional, national, and international level. These include academic and industrial collaborations. Examples include:

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[76] HM Government (2019): West Midlands Local Industrial Strategy, https://www.wmca.org.uk/media/3094/west-midlands-local-industrial-strategy-single-page.pdf

[77] West Midlands Combined Authority (2021) West Midlands Digital Roadmap 2021. Available at: https://www.wmca.org.uk/media/4468/west-midlands-digital-roadmap.pdf

[78] West Midlands Combined Authority: Strategic Economic Plan (SEP), https://www.wmca.org.uk/media/1382/full-sep-document.pdf

[79] SQW (2017): A Science & Innovation audit for the West Midlands, https://www.sqw.co.uk/insights-and-publications/west-midlands-science-and-innvation-audit/

- The **Birmingham Science City** is an alliance of public, private and academic stakeholders collaborating to promote innovation in science and technology;[80]

- The **Medilink West Midlands** is an industry association providing business support to health and medical technology companies;[81]

- The non-profit company **Sustainability West Midlands** has members from the business, public, and voluntary sectors providing support in the development of an environmentally sustainable region.[82]

- The Innovation Alliance is a coalition of organisations active or interested in science and technology-based innovation across the West Midlands – the organisation aims to stimulate and catalyse a pipeline of innovation activity.

- The West Midlands Academic Health Science Network (WMAHSN) drives collaboration and productivity between academia, industry, healthcare providers and local citizens.

- SuperTech is the UK's first professional services technology (ProfTech) supercluster, focused on spurring innovation across and at the intersections of the West Midlands' FinTech, LegalTech, PropTech and InsurTech sectors.

According to the Science & Innovation Audit, the West Midlands engages in complex, cross-sector networking and collaboration between public, private, RTO, and university sectors. Between 2010-2015, universities in the West Midlands supported over ~~100~~ **Knowledge Transfer Partnerships (KTPs)**[83] which represents 8% of the UK total. Data from the Higher Education-Business Community Interaction (HE-BCI) survey also indicates that the universities are very active in providing support for commercialising research through **spinouts, collaborative research, licensing, and other forms of Intellectual property.**[84]

## 4.3.3 The 5G testbed

The West Midlands region was chosen to be the **first region in the UK to trial new 5G applications at scale** before country-wide rollout. The multimillion-pound program was developed by a partnership between the West Midlands Combined Authority (WMCA) and the Department for Digital, Culture, Media and Sport (DCMS) and is now delivered by WM5G The programme is implemented in areas of distinctive strength such as health, construction, and automotive sectors. The technology will potentially boost productivity levels as well as innovative activities in the regional economy. Given that 5G provides speeds that are up to ten times faster than 4G, the potential benefit to citizen, public services, and private businesses could be significant.[85] '5PRING' is the UK's first 5G commercial innovation centre launched as a partnership between WM5G, O2, Deloitte, Wayra and the Digital Catapult.

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[80] SQW (2017): A Science & Innovation audit for the West Midlands, https://www.sqw.co.uk/insights-and-publications/west-midlands-science-and-innvation-audit/

[81] Medlink, https://www.medilinkwm.co.uk/about-us/

[82] Sustainability West Midlands https://www.sustainabilitywestmidlands.org.uk/

[83] A Knowledge Transfer Partnerships (KTP) is a partly government-funded programme which encourages collaboration between businesses and universities in the United Kingdom.

[84] SQW (2017): A Science & Innovation audit for the West Midlands, https://www.sqw.co.uk/insights-and-publications/west-midlands-science-and-innvation-audit/

[85] West Midlands Growth Company (2019): WM5G showcases the power of 5G in the West Midlands, https://wmgrowth.com/article/wm5g-showcases-the-power-of-5g-in-the-west-midlands

### 4.3.4    Funding

The funding landscape in the region has also developed in recent years. This is evidenced by increases in both R&D spending and venture capital investments. **In 2019, the West Midlands region invested approximately £2.4 billion in R&D which accounts for 9.1% of the UK total.** The number of full-time equivalent employees in the West Midlands engaged in R&D increased in the past years to 26,000 employees in 2019. This corresponds to almost 10% of the UK total.[86]

Additionally, the British Venture Capital Association (BVCA) regularly publishes reports providing information on the regional and national level of venture capital investments. **In 2019, 69 firms in the West Midlands received private equity and venture capital investments totalling £765 million.** This is a significant increase from £404 million invested in 2017 and £296 million invested in 2018. In 2019, the investment accounted for 8% of the total amount invested in the UK compared to 4% and 3% in 2017 and 2018 respectively. While the absolute amount of private equity and venture capital is significant, it is noteworthy that London and the South East together account for 52% of the total amount invested in the UK. Compared to the East Midlands and East of England, the West Midlands secured a larger amount of total investment in relative terms (East England received 6%, East Midlands received 3% of total UK investment in 2019).[87]

Alongside private funding, between 2010 and 2015 the West Midlands received 8% of the **Innovate UK grant,** a higher proportion than would seem justified by the relative number of firms and higher education institutions in the region which indicates that the level of innovation activity across West Midland's business base is relatively high.[88]

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[86] ONS (2020): Business enterprise research and development,
https://www.ons.gov.uk/economy/governmentpublicsectorandtaxes/researchanddevelopmentexpenditure/datasets/ukbusinessenterp
riseresearchanddevelopment
[87] BVCA (2020): Report on Investment Activity 2019,
https://www.bvca.co.uk/Portals/0/Documents/Research/Industry%20Activity/BVCA-RIA-2019.pdf
[88] ibid

# 5    Summary

Given the importance of innovation as a fundamental driver of economic growth in advanced economies, it is vital we understand what technologies are on the horizon to guide the West Midlands' development and future growth. Evidence shows that in particular technology clusters-- geographic gatherings of companies and institutions interested in specific subsectors—provide a bolstering environment for innovation and can increase the productivity of regional economies. As the UK is home to a world-leading research and innovation ecosystem, it is a particularly fertile ground for technology clusters, which exist in different forms all around the country.

This report seeks to find innovation strengths and opportunities by identifying and parsing these technology clusters in the West Midlands relative to other regions in the UK. In a new approach, glass.ai has mined data on companies and institutions from the open web and applied a granular keyword-based taxonomy of technology areas to overcome the limitation of traditional business statistics and provide an up-to-date picture of the technology sector. The resulting data set contains details on locations, size, and subsectors and can be used as an indicative measure of the prevalence and relative size of emerging technologies.

Comparative analysis across the UK's core city regions outside London shows the West Midlands has established a leading overall position across the breadth of emerging tech, with the highest number of companies (2,946), followed by Manchester (2,020) and Leeds (1,594).

Unlike many of the other city regions, the West Midlands is not dominated by a single large tech company or sector. A deep dive into the UK's 'tech and creative' sector reveals the West Midlands is the most established region across 10 out of 13 niches within that sector. It provides a classic example of the benefits of agglomeration economies in relation to tech and creative – the largest of the West Midlands' emerging tech industries.

- In addition to being highly concentrated, the area's technology industry is highly diverse, principally spanning digital transformation, gaming, immersive tech, process automation and software development.
- Software development is the largest niche, with 468 companies, followed by 329 in telecoms, 192 in cloud computing, 88 in process automation and 78 in cyber-security.
- The West Midlands has 212 companies operating in modern services technologies (fintTech, professional services-tech and propTech) and 237 in the smart cities' sector, with proptTech the most prominent in the former and construction tech in the latter.
- Excluding London, the West Midlands is responsible for 27.8% of the UK's telecoms roles and 23.8% of software development roles.

The region's critical mass is partly attributed to its share of supportive infrastructure and strong policy support. The report reveals the number of accelerators in Greater Birmingham and Solihull per 10,000 businesses (1.43) is higher than anywhere else in the UK, including London (1.32), highlighting the area's long-term prioritisation of entrepreneurship.

The region's emerging tech ecosystem also benefits from a well-developed system of R&D support. Analysis of its collective research and teaching activities (as measured by web content and published data) shows it leading all other regions in five out of our six target sectors. This leading academic position is mainly driven by the region's two Russell Group universities, University of Warwick and University of Birmingham, which are both significant players across all emerging tech sectors analysed in this study.

Overall, the West Midlands is well-placed to build on its existing appeal to FDI decision-makers and has the potential to sustain a competitive advantage when targeting entrepreneurs and investors in high-growth, emerging tech sectors.

# Index of tables & figures

## Tables

## Figures

# ANNEXES

# Annex 1    Methodology

Traditional sources on enterprise-level economic activity include official statistics and ad-hoc business surveys or static company data sets. Such datasets are often of limited use when looking for up-to-date, detailed, comparable and representative data. Furthermore, standard industry classifications, such as SIC codes, tend to be ill adapted to capture the dynamic nature of new and emerging sectors of the economy. In fact, businesses are often unable to place themselves within these structures and turn to generic "Other" SIC codes which offer very limited insights. A rich, detailed and up to date representation of business presence does exist though, if we turn to the open web and we read how the companies describe themselves and analyse what the companies do.

glass.ai's proprietary approach provides unique and up-to-date evidence on the regional distribution of business capabilities in selected technologies through a replicable, ad hoc discovery process: the glass.ai crawler software systematically browses the open web (including company websites, social media and official data sources) and applies machine learning that understands written language to identify businesses active in specified technology areas and geographies. The approach combines language understanding through semantic analysis with resource crawling at scale and the maintenance of a deep topic ontology.

- **Semantic Analysis**: first, the crawler classifies the content of text within unstructured web sources (e.g. company descriptions, topics, news, etc.) by applying machine learning derived "entity models" against web-scale volumes of data. These models are language templates that are applied at crawl time in a multi-layered text analysis that is able to focus on the relevant content (text) only. This process is continuously tested to improve models for accuracy through a semi-automated build-test-learn pipeline.

  Based on company descriptions and other attributes, the glass.ai crawler classifies each company with a web presence into a sector. The sector taxonomy used by glass.ai is similar to the taxonomy used by LinkedIn and the automatic sector classifier has been trained using a sample of company classifications from the LinkedIn industrial taxonomy. The current accuracy of the glass.ai sector predictions is around 95%.

- **Resource Crawling:** in a second step, glass.ai have commoditised the extraction process by developing an intelligent crawling service that targets the crawl to read content and follow links that are most likely to find the entities that it has been created to detect. By directing the crawl to find known entities and concepts 'within' the crawl instead of retrospectively filtering data returned, the process is able to get large scale information-extraction efficiently running on very modest hardware. The system can read millions of sources without the need of massive computation resources.

- **Topic Ontology**: in a third step, glass.ai have derived a 'topic map' for the data. This taxonomy includes business activities, products and services, and is key to understanding what a company does and the activities it is involved in. This allows it to query the data by subject classification. For example, a 'geospatial' search will suggest semantically related simple topics such as 'geomatics', 'drones', and others. The system currently contains around 300k topics. The topic ontology has been built and continues to be adapted from a large corpus of organisation descriptions, trying to extract a global picture of relevant business-related topics, crosschecked and enriched with information from other dictionaries and knowledge bases such as Wikipedia.

### 5.1.1    Emerging technology sector classification

The initial selection of technology areas that belong in the emerging technology sector and that were the focus of this analysis was provided by the WMGC based on potential strategic importance for the West Midlands. In addition, glass.ai applied cluster analysis on technologies represented in the company data to check whether other areas were suggested by the data. Table 1 provides an overview of the taxonomy used throughout the analysis. Six higher level sectors were defined and further broken down into activity areas. It should be noted that the sectors that were used in the analysis do not represent the entire emerging technology industry. However, throughout the report "emerging tech" refers to the identified group of sectors and areas unless stated otherwise.

**Table 1     Emerging technology sector and area classification**

| Sector | Area |
|---|---|
| **Advanced manufacturing** | Advanced Materials |
|  | Electronics |
|  | Industrial Automation |
|  | Power Electronics |
| **Data-driven health** | Health Analytics |
|  | MedTech |
|  | Precision Med |
|  | Telehealth |
| **Future mobility** | Autonomous Vehicles |
|  | Battery Tech |
|  | Electric Engines |
|  | MaaS |
|  | Rail Tech |
| **Modern services** | FinTech |
|  | Prof Tech |
|  | PropTech |
| **Smart cities** | Clean Tech |
|  | Construction Tech |
|  | Smart Grid |
|  | Space Tech |
| **Tech & creative** | 5G |
|  | Analytics |
|  | Artificial Intelligence |
|  | Cloud Computing |
|  | Cybersecurity |
|  | Digital Transformation |
|  | Ecommerce |
|  | Gaming |
|  | Immersive Tech |
|  | IoT |
|  | Process Automation |
|  | Software Development |
|  | Telecoms |

*Source: glass.ai*

## 5.1.2    Limitations

The methodology used in this study makes use of a broad range of data sources to overcome some of the limitation of official statistics and ad-hoc data sources in capturing the regional distribution of business activity in specialised technology areas. However, a number of limitations should be noted:

- The public web provides a rich context around the activities of businesses. However, **not all businesses have a website**, so our approach to capture rich content about organisations is limited to those that have an independent web presence. This may impact the representation of smaller organisations as they are less likely to have a website than larger organisations. Further, the absence of web presence can be sector dependent. That is, companies in certain sectors may be more likely to have a web presence than others. We expect this issue to be negligible for businesses active in the emerging technology sector.

- glass.ai estimate there are circa 2.5m UK organisations with an active website. At present the **crawler has not discovered all the websites** of these organisations and is currently reading 90%+ of them. To mitigate this risk for specific research, the core glass.ai dataset is augmented with external lists of known businesses and their websites, with social media and official data, and with core online resources.

- As the web is constantly changing and **new sites are appearing and disappearing**, sites may be missing because they have not yet been discovered by the glass.ai onboarding schedule, may have been in a format or structure that our processes were not able to read, or do not match the models that are being detected. In particular because our approach is language based - relying on reading static text content - it may struggle to read image, flash or Javascript-heavy sites where content is displayed dynamically or embedded in other objects. This is likely to impact businesses in consumer-facing industries more than businesses in upstream technology industries.

- When performing targeted research on emerging technologies (as done in the West Midlands and other regions), a challenge **using specific keywords to identify activities** is that if a relevant business doesn't list those words on their website/social media or is on a page that has not been read by our directed crawl then the business may not be included in the results. This can be mitigated by supplying a broad range of topics associated with the types of companies that need to be discovered and using the topic ontology to discover topics related to the supplied list.

- Size indicators like revenues or employees are important for the research. In Companies House there are around 4 million companies out of which around 300,000 disclose revenue information (7%-9% of total). The data comes from full accounts and partial accounts. Depending on the size/type of firms, the **revenue data points will vary**. glass.ai reads Companies House and augments the revenue numbers with indicators from the web (company websites, press releases).

- In terms of number of employees, their skills and the roles they perform, the data points are more available. Company accounts sometimes mention the average number of employees, and the total employees might be mentioned on social sites like LinkedIn. glass.ai reads these sources as well as the companies' own websites, and for most companies these can be used to give a good estimate of the number of employees of a company. However, for other companies – especially larger ones with multiple establishments – **this approach cannot identify the distribution of employees across multiple sites**. To mitigate this glass.ai perform some sampling analysis of average number

of people in companies in a sector/region. glass.ai then filter out the big outlier numbers and apply an adjusted number of employees for some companies in particular sectors/regions. The bias introduced by this approach affects mainly large employers with staff distributed across multiple sites.

■ When sampling the employees of companies, glass.ai collects the **roles and skills** of the people associated with the businesses. As with sectors, certain roles are more likely to be better represented online and on social sources.

■ glass.ai has an ongoing discovery process that reads the websites and if possible, predicts the **geography of the business** (e.g. a West Midlands address). glass.ai have also developed a process to discover the websites/locations of regional businesses from official data. This, combined with addresses mentioned on social sites, gives extra validation about the total number of businesses based in a region and the location of the companies. However, the system can identify not only companies headquartered in a region but also companies with presence there. This methodology is consistent across regions which means regional comparisons are possible, but it's important to note that the total number of companies for each region also includes companies with presence that are headquartered elsewhere.

■ To understand the **capabilities of the universities** in relation to the selected sectors, glass.ai runs deep crawls of the universities' websites and other sources. This provides evidence about academic papers/publications, experts and academic programs. However, just like performing targeted research on companies, a challenge using specific keywords to identify the university capabilities is that if a university doesn't list those words on their website/news then the university may not be included in the results. This can be mitigated by supplying a broad range of topics associated with the technologies and likely academic programs that may teach them.

# Annex 2    Job roles per technology theme & area

| Theme | Area | Roles |
|-------|------|-------|
| Advanced Manufacturing | Advanced Materials | Broker; Builder; Consultant; Professor; Account Executive; Associate Consultant; Accountant; Scientist; Architect; Mechanic; Software Developer; Application Engineer; Engineer; Analyst; Developer |
| Advanced Manufacturing | Electronics | Electronics Engineer; Designer; Sales Coordinator; Electrician; Consultant; Design Engineer; Company Secretary; Financial Controller; Technical Support Specialist; Architect; Development Engineer; Technician; Electrical Engineer; Analyst; Engineer |
| Advanced Manufacturing | Industrial Automation | Analyst; Designer; Engineer; Sales Representative; Consultant; Design Engineer; Data Scientist; Graduate Engineer; Chief Executive; Systems Engineer; Mechanical Engineer; Electrical Engineer; Developer; Professor; Software Engineer |
| Advanced Manufacturing | Power Electronics | Controls Engineer; Electronics Engineer; Power Electronics Engineer; Design Engineer; Data Scientist; Financial Controller; Technician; Electrical Engineer; Mechanical Engineer; Embedded Software Engineer; Project Engineer; Engineer |
| Data driven health | Health Analytics | Consultant; Professor; Software Developer; Clinic Coordinator; Engineer |
| Data driven health | Med Tech | Business Analyst; Recruitment Consultant; Researcher; Consultant; Professor; Data Analyst; Financial Controller; Software Engineer; Chief Executive; Scientist; Technician; Design Engineer; Developer; Analyst; Engineer |
| Data driven health | Precision Med | Business Analyst; Designer; Mechanical Engineer; Care Assistant; Consultant; Design Engineer; Chief Executive; Data Analyst; Software Engineer; Scientist; Company Secretary; Software Developer; Technician; Engineer; Developer |
| Data driven health | Tele-health | Business Analyst; Designer; Mechanical Engineer; Care Assistant; Healthcare Assistant; Professor; Software Developer; Chief Executive; Financial Controller; Account Executive; Scientist; Consultant; Technician; Engineer; Developer |
| Future mobility | Autonomous Vehicles | Designer; Sales Executive; Researcher; Consultant; Professor; Accountant; Company Secretary; Chief Executive; Independent Consultant; Architect; Mechanic; Operator; Software Engineer; Analyst; Engineer |
| Future mobility | Battery Tech | Mechanical Engineer; Graphic Designer; Power Electronics Engineer; Executive Assistant; Design Engineer; Data Scientist; Company Secretary; Chief Executive; Mechanic; Consultant; Embedded Software Engineer; Engineer; Analyst; Project Engineer; Developer |
| Future mobility | Electric Engines | Data Engineer; Sales Executive; Chief Executive; Tester; Researcher; Consultant; Design Engineer; Driver; Broker; Company Secretary; Account Executive; Software Engineer; Analyst; Data Scientist; Engineer |
| Future mobility | MaaS | Recruitment Consultant; Researcher; Consultant; Driver; Broker; Development Engineer; Delivery Driver; Marketing Assistant; Operator; Engineer; Analyst; Developer |

| | | |
|---|---|---|
| Future mobility | Rail Tech | Credit Controller; Data Engineer; Planner; Consultant; Professor; Driver; Delivery Driver; Development Engineer; Graduate Engineer; Chief Executive; Marketing Assistant; Frontend Developer; Developer; Analyst; Engineer |
| Future mobility | Urban Air | Consultant; Mechanic |
| Modern Services | Fin Tech | Engineer; Chief Executive; Executive Assistant; Researcher; Consultant; Professor; Data Scientist; Broker; Account Executive; Designer; Architect; Software Developer; Developer; Analyst; Software Engineer |
| Modern Services | Prof Tech | Designer; Consultant; Recruiter; Finance Assistant; Assistant Accountant; Company Secretary; Financial Controller; Accountant; Architect; Financial Accountant; Technician; Technical Assistant; Developer; Support Consultant; Engineer |
| Modern Services | PropTech | Sales Negotiator; Lettings Negotiator; Chief Executive; Estate Agent; Consultant; Sales Consultant; Broker; Developer; Accountant; Healthcare Assistant; Executive Assistant; Associate Partner; Financial Accountant; Analyst; Software Engineer |
| Smart cities | Clean Tech | Business Analyst; Architectural Technician; Consultant; Professor; Legal Counsel; Marketing Executive; Accountant; Scientist; Architect; Executive Assistant; Business Consultant; Customer Service Representative; Architectural Assistant; Analyst; Engineer |
| Smart cities | Construction Tech | Architectural Technologist; Designer; CAD Engineer; Consultant; Quantity Surveyor; Marketing Coordinator; Structural Engineer; Architect; BIM Coordinator; Technician; Electrical Engineer; Mechanical Engineer; Architectural Assistant; Project Engineer; Engineer |
| Smart cities | Smart Grid | Designer; Sales Executive; Transport Planner; Researcher; Consultant; Professor; Company Secretary; Financial Controller; Independent Consultant; Software Developer; Technician; Engineering Technician; Analyst; Project Engineer; Engineer |
| Smart cities | Space Tech | Project Coordinator; Designer; Sales Representative; Support Engineer; Consultant; Design Engineer; Chief Executive; Recruitment Consultant; Accountant; Scientist; Systems Engineer; Financial Adviser; Technician; Sales Coordinator; Engineer |
| Tech & Creative | 5G | Designer; Sales Executive; Consultant; Architect; System Analyst; Analyst; Engineer |
| Tech & Creative | Analytics | Designer; Researcher; Consultant; Recruiter; Solutions Consultant; Data Scientist; Data Analyst; Software Engineer; Web Developer; Account Executive; Architect; Business Development Executive; Engineer; Analyst; Developer |
| Tech & Creative | Artificial Intelligence | Designer; Engineer; Researcher; Consultant; Professor; Data Scientist; Recruitment Consultant; Accountant; Scientist; Architect; Software Developer; Technician; Software Engineer; Analyst; Developer |
| Tech & Creative | Cloud Computing | Designer; Web Developer; Support Engineer; Consultant; Data Scientist; Chief Executive; Software Engineer; Technician; Accountant; Architect; Software Developer; Technical Consultant; Engineer; Analyst; Developer |
| Tech & Creative | Cyber security | Designer; CAD Engineer; Researcher; Consultant; Accountant; Security Consultant; Support Engineer; Software Engineer; |

| | | |
|---|---|---|
| | | Scientist; Architect; Technician; Associate Partner; Engineer; Analyst; Developer |
| Tech & Creative | Digital Transformation | Business Analyst; Designer; Solution Architect; Researcher; Consultant; Professor; Data Scientist; Chief Executive; Financial Controller; Software Engineer; Architect; Business Consultant; Developer; Analyst; Engineer |
| Tech & Creative | Ecommerce | Designer; Marketing Executive; Consultant; Recruiter; Software Developer; Company Secretary; Web Developer; Account Executive; Architect; Marketing Consultant; Programmer; Digital Designer; Web Designer; QA Tester; Developer |
| Tech & Creative | Gaming | Designer; Marketing Executive; Consultant; Professor; Data Scientist; Chief Executive; Developer; Account Executive; Architect; Auditor; Product Owner; Game Designer; Engineer; Analyst; Software Engineer |
| Tech & Creative | Immersive Tech | Designer; Graphic Designer; Researcher; Consultant; Professor; Chief Executive; Account Executive; Planner; Architect; Accountant; Technician; Developer; Architectural Assistant; Creative Producer; Engineer |
| Tech & Creative | IoT | Designer; Sales Executive; Support Engineer; Consultant; Finance Assistant; Data Scientist; Chief Executive; Data Analyst; Accountant; Marketing Specialist; Architect; Systems Engineer; Technician; Engineer; Developer |
| Tech & Creative | Process Automation | Business Analyst; Designer; Chief Executive; Researcher; Consultant; Professor; Broker; Marketing Executive; Software Engineer; Architect; Technician; Developer; Analyst; Project Engineer; Engineer |
| Tech & Creative | Software Development | Designer; Consultant; Professor; Data Scientist; Accountant; QA Engineer; Developer; Architect; Full Stack Developer; Product Owner; Software Developer; Account Executive; Engineer; Analyst; Software Engineer |
| Tech & Creative | Telecoms | Project Coordinator; Designer; Electrician; Solution Architect; Consultant; Design Engineer; Data Engineer; Company Secretary; Chief Executive; Architect; Service Desk Engineer; Technician; Developer; Analyst; Engineer |

# Annex 3    Figures

**Figure 21    Regional specialism across emerging tech themes**



Source: glass.ai

# Annex 4    Tables

**Table 2    Number of companies across regions, sectors, and areas (absolute count, % of companies with a website in the region)**

| | Cambridge-Peterborough | | Cardiff Region | | Derby-Nottingham | | Edinburgh Region | | Glasgow Region | | Leeds Region | | Liverpool Region | | Manchester Region | | North East | | Oxfordshire | | Sheffield Region | | Tees Valley | | Thames Valley Berkshire | | West Midlands | | West Of England | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Advanced Manufacturing** | **251** | **1.8%** | **136** | **0.9%** | **275** | **1.1%** | **135** | **0.8%** | **141** | **0.8%** | **317** | **0.9%** | **155** | **1.1%** | **367** | **1.0%** | **127** | **0.9%** | **94** | **0.8%** | **170** | **1.3%** | **54** | **1.1%** | **134** | **1.0%** | **724** | **1.4%** | **146** | **0.8%** |
| Advanced Materials | 26 | 0.2% | 6 | 0.0% | 7 | 0.0% | 8 | 0.1% | 5 | 0.0% | 4 | 0.0% | 6 | 0.0% | 18 | 0.1% | 3 | 0.0% | 4 | 0.0% | 11 | 0.1% | 1 | 0.0% | 5 | 0.0% | 24 | 0.1% | 9 | 0.1% |
| Electronics | 148 | 1.0% | 97 | 0.7% | 186 | 0.7% | 98 | 0.6% | 98 | 0.6% | 239 | 0.7% | 98 | 0.7% | 256 | 0.7% | 81 | 0.6% | 67 | 0.6% | 110 | 0.8% | 41 | 0.8% | 99 | 0.7% | 481 | 0.9% | 98 | 0.6% |
| Industrial Automation | 74 | 0.5% | 33 | 0.2% | 81 | 0.3% | 28 | 0.2% | 38 | 0.2% | 71 | 0.2% | 51 | 0.4% | 89 | 0.3% | 38 | 0.3% | 21 | 0.2% | 48 | 0.4% | 12 | 0.2% | 30 | 0.2% | 216 | 0.4% | 38 | 0.2% |
| Power Electronics | 3 | 0.0% | | | 1 | 0.0% | 1 | 0.0% | | | 3 | 0.0% | | | 4 | 0.0% | 5 | 0.0% | 2 | 0.0% | 1 | 0.0% | | | | | 3 | 0.0% | 1 | 0.0% |
| **Data driven health** | **96** | **0.7%** | **39** | **0.3%** | **33** | **0.1%** | **51** | **0.3%** | **51** | **0.3%** | **71** | **0.2%** | **30** | **0.2%** | **99** | **0.3%** | **25** | **0.2%** | **45** | **0.4%** | **26** | **0.2%** | **6** | **0.1%** | **27** | **0.2%** | **100** | **0.2%** | **54** | **0.3%** |
| Health Analytics | 8 | 0.1% | 3 | 0.0% | 1 | 0.0% | 3 | 0.0% | 1 | 0.0% | 5 | 0.0% | | | 7 | 0.0% | 1 | 0.0% | | | 1 | 0.0% | 1 | 0.0% | 3 | 0.0% | 4 | 0.0% | 5 | 0.0% |
| Med Tech | 46 | 0.3% | 23 | 0.2% | 26 | 0.1% | 28 | 0.2% | 27 | 0.2% | 42 | 0.1% | 21 | 0.1% | 57 | 0.2% | 13 | 0.1% | 35 | 0.3% | 12 | 0.1% | 4 | 0.1% | 18 | 0.1% | 64 | 0.1% | 32 | 0.2% |
| Precision Med | 20 | 0.1% | 5 | 0.0% | 3 | 0.0% | 8 | 0.1% | 11 | 0.1% | 13 | 0.0% | 4 | 0.0% | 8 | 0.0% | 5 | 0.0% | 8 | 0.1% | 4 | 0.0% | | | 4 | 0.0% | 18 | 0.0% | 8 | 0.0% |
| Telehealth | 22 | 0.2% | 8 | 0.1% | 3 | 0.0% | 12 | 0.1% | 12 | 0.1% | 11 | 0.0% | 5 | 0.0% | 27 | 0.1% | 6 | 0.0% | 2 | 0.0% | 9 | 0.1% | 1 | 0.0% | 2 | 0.0% | 14 | 0.0% | 9 | 0.1% |
| **Future mobility** | **47** | **0.3%** | **66** | **0.5%** | **45** | **0.2%** | **46** | **0.3%** | **54** | **0.3%** | **71** | **0.2%** | **36** | **0.3%** | **71** | **0.2%** | **51** | **0.4%** | **25** | **0.2%** | **39** | **0.3%** | **15** | **0.3%** | **20** | **0.1%** | **181** | **0.4%** | **56** | **0.3%** |
| Autonomous Vehicles | 7 | 0.1% | 10 | 0.1% | 6 | 0.0% | 5 | 0.0% | 11 | 0.1% | 9 | 0.0% | 8 | 0.1% | 8 | 0.0% | 7 | 0.1% | 10 | 0.1% | 2 | 0.0% | 2 | 0.0% | 5 | 0.0% | 24 | 0.1% | 7 | 0.0% |
| Battery Tech | 22 | 0.2% | 43 | 0.3% | 10 | 0.0% | 26 | 0.2% | 26 | 0.2% | 37 | 0.1% | 13 | 0.1% | 42 | 0.1% | 24 | 0.2% | 4 | 0.0% | 25 | 0.2% | 7 | 0.1% | 4 | 0.0% | 77 | 0.2% | 34 | 0.2% |
| Electric Engines | 14 | 0.1% | 13 | 0.1% | 27 | 0.1% | 10 | 0.1% | 15 | 0.1% | 22 | 0.1% | 14 | 0.1% | 19 | 0.1% | 18 | 0.1% | 11 | 0.1% | 10 | 0.1% | 6 | 0.1% | 9 | 0.1% | 74 | 0.1% | 14 | 0.1% |
| MaaS | 1 | 0.0% | | | 1 | 0.0% | 2 | 0.0% | 1 | 0.0% | 2 | 0.0% | 1 | 0.0% | | | | | | | | | | | 1 | 0.0% | 1 | 0.0% | | |
| Rail Tech | 2 | 0.0% | 0 | 0.0% | 0 | 0.0% | 1 | 0.0% | 1 | 0.0% | 1 | 0.0% | 0 | 0.0% | 1 | 0.0% | 1 | 0.0% | 0 | 0.0% | 1 | 0.0% | 0 | 0.0% | 0 | 0.0% | 5 | 0.0% | 0 | 0.0% |
| Urban Air | 1 | 0.0% | 0 | 0.0% | 1 | 0.0% | 2 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 1 | 0.0% | 1 | 0.0% | | | 1 | 0.0% | 0 | 0.0% | 1 | 0.0% | 0 | 0.0% | 1 | 0.0% |
| **Modern Services** | **63** | **0.4%** | **72** | **0.5%** | **63** | **0.2%** | **54** | **0.3%** | **66** | **0.4%** | **116** | **0.3%** | **56** | **0.4%** | **158** | **0.4%** | **54** | **0.4%** | **43** | **0.4%** | **43** | **0.3%** | **20** | **0.4%** | **50** | **0.4%** | **212** | **0.4%** | **93** | **0.5%** |

| | Cambridge-Peterborough | | Cardiff Region | | Derby-Nottingham | | Edinburgh Region | | Glasgow Region | | Leeds Region | | Liverpool Region | | Manchester Region | | North East | | Oxfordshire | | Sheffield Region | | Tees Valley | | Thames Valley Berkshire | | West Midlands | | West Of England | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FinTech | 21 | 0.2% | 22 | 0.2% | 13 | 0.1% | 21 | 0.1% | 18 | 0.1% | 30 | 0.1% | 9 | 0.1% | 47 | 0.1% | 12 | 0.1% | 10 | 0.1% | 11 | 0.1% | 3 | 0.1% | 12 | 0.1% | 62 | 0.1% | 25 | 0.1% |
| Prof Tech | 20 | 0.1% | 19 | 0.1% | 25 | 0.1% | 17 | 0.1% | 22 | 0.1% | 37 | 0.1% | 25 | 0.2% | 47 | 0.1% | 18 | 0.1% | 15 | 0.1% | 12 | 0.1% | 7 | 0.1% | 15 | 0.1% | 65 | 0.1% | 36 | 0.2% |
| PropTech | 22 | 0.2% | 31 | 0.2% | 25 | 0.1% | 16 | 0.1% | 26 | 0.2% | 49 | 0.1% | 22 | 0.2% | 64 | 0.2% | 24 | 0.2% | 18 | 0.2% | 20 | 0.2% | 10 | 0.2% | 23 | 0.2% | 85 | 0.2% | 32 | 0.2% |
| **Smart cities** | **77** | **0.6%** | **73** | **0.5%** | **129** | **0.5%** | **90** | **0.6%** | **84** | **0.5%** | **153** | **0.4%** | **59** | **0.4%** | **159** | **0.5%** | **70** | **0.5%** | **62** | **0.5%** | **58** | **0.4%** | **20** | **0.4%** | **52** | **0.4%** | **237** | **0.5%** | **80** | **0.4%** |
| Clean Tech | 32 | 0.2% | 24 | 0.2% | 44 | 0.2% | 33 | 0.2% | 28 | 0.2% | 40 | 0.1% | 11 | 0.1% | 37 | 0.1% | 18 | 0.1% | 20 | 0.2% | 17 | 0.1% | 7 | 0.1% | 11 | 0.1% | 79 | 0.2% | 31 | 0.2% |
| Construction Tech | 15 | 0.1% | 22 | 0.2% | 56 | 0.2% | 20 | 0.1% | 19 | 0.1% | 50 | 0.1% | 27 | 0.2% | 53 | 0.2% | 26 | 0.2% | 20 | 0.2% | 22 | 0.2% | 5 | 0.1% | 19 | 0.1% | 84 | 0.2% | 21 | 0.1% |
| Smart Grid | 13 | 0.1% | 12 | 0.1% | 5 | 0.0% | 17 | 0.1% | 9 | 0.1% | 29 | 0.1% | 6 | 0.0% | 31 | 0.1% | 13 | 0.1% | 5 | 0.0% | 7 | 0.1% | 5 | 0.1% | 5 | 0.0% | 27 | 0.1% | 13 | 0.1% |
| Space Tech | 17 | 0.1% | 15 | 0.1% | 24 | 0.1% | 20 | 0.1% | 28 | 0.2% | 34 | 0.1% | 15 | 0.1% | 38 | 0.1% | 13 | 0.1% | 17 | 0.1% | 12 | 0.1% | 3 | 0.1% | 17 | 0.1% | 47 | 0.1% | 15 | 0.1% |
| **Tech & Creative** | **650** | **4.6%** | **354** | **2.5%** | **531** | **2.1%** | **470** | **2.9%** | **435** | **2.5%** | **866** | **2.5%** | **313** | **2.1%** | **1166** | **3.2%** | **326** | **2.2%** | **371** | **3.1%** | **352** | **2.6%** | **107** | **2.1%** | **520** | **3.8%** | **1492** | **2.9%** | **624** | **3.5%** |
| 5G | 12 | 0.1% | 2 | 0.0% | 1 | 0.0% | 5 | 0.0% | 2 | 0.0% | 5 | 0.0% | 2 | 0.0% | 2 | 0.0% | 2 | 0.0% | 2 | 0.0% | 1 | 0.0% | | | 4 | 0.0% | 7 | 0.0% | 6 | 0.0% |
| Analytics | 40 | 0.3% | 23 | 0.2% | 17 | 0.1% | 34 | 0.2% | 26 | 0.2% | 51 | 0.2% | 19 | 0.1% | 65 | 0.2% | 13 | 0.1% | 39 | 0.3% | 13 | 0.1% | 2 | 0.0% | 29 | 0.2% | 67 | 0.1% | 40 | 0.2% |
| Artificial Intelligence | 60 | 0.4% | 20 | 0.1% | 18 | 0.1% | 28 | 0.2% | 19 | 0.1% | 43 | 0.1% | 12 | 0.1% | 49 | 0.1% | 16 | 0.1% | 25 | 0.2% | 13 | 0.1% | 4 | 0.1% | 19 | 0.1% | 62 | 0.1% | 48 | 0.3% |
| Cloud Computing | 78 | 0.6% | 48 | 0.3% | 79 | 0.3% | 59 | 0.4% | 59 | 0.4% | 129 | 0.4% | 47 | 0.3% | 201 | 0.6% | 46 | 0.3% | 43 | 0.4% | 44 | 0.3% | 15 | 0.3% | 83 | 0.6% | 192 | 0.4% | 93 | 0.5% |
| Cyber security | 43 | 0.3% | 37 | 0.3% | 19 | 0.1% | 53 | 0.3% | 37 | 0.2% | 67 | 0.2% | 14 | 0.1% | 109 | 0.3% | 14 | 0.1% | 16 | 0.1% | 26 | 0.2% | 16 | 0.3% | 25 | 0.2% | 78 | 0.2% | 47 | 0.3% |
| Digital Transformation | 21 | 0.2% | 16 | 0.1% | 14 | 0.1% | 32 | 0.2% | 33 | 0.2% | 30 | 0.1% | 24 | 0.2% | 59 | 0.2% | 18 | 0.1% | 17 | 0.1% | 13 | 0.1% | 5 | 0.1% | 20 | 0.1% | 75 | 0.1% | 32 | 0.2% |
| Ecommerce | 12 | 0.1% | 12 | 0.1% | 31 | 0.1% | 20 | 0.1% | 32 | 0.2% | 32 | 0.1% | 12 | 0.1% | 47 | 0.1% | 23 | 0.2% | 10 | 0.1% | 11 | 0.1% | 4 | 0.1% | 14 | 0.1% | 67 | 0.1% | 25 | 0.1% |
| Gaming | 14 | 0.1% | 10 | 0.1% | 21 | 0.1% | 8 | 0.1% | 13 | 0.1% | 31 | 0.1% | 12 | 0.1% | 32 | 0.1% | 12 | 0.1% | 9 | 0.1% | 13 | 0.1% | 5 | 0.1% | 10 | 0.1% | 46 | 0.1% | 19 | 0.1% |
| Immersive Tech | 13 | 0.1% | 12 | 0.1% | 27 | 0.1% | 20 | 0.1% | 19 | 0.1% | 47 | 0.1% | 22 | 0.2% | 47 | 0.1% | 16 | 0.1% | 13 | 0.1% | 9 | 0.1% | 4 | 0.1% | 13 | 0.1% | 54 | 0.1% | 37 | 0.2% |
| IoT | 43 | 0.3% | 15 | 0.1% | 31 | 0.1% | 13 | 0.1% | 14 | 0.1% | 40 | 0.1% | 12 | 0.1% | 41 | 0.1% | 13 | 0.1% | 22 | 0.2% | 20 | 0.2% | 9 | 0.2% | 30 | 0.2% | 49 | 0.1% | 21 | 0.1% |
| Process Automation | 35 | 0.3% | 25 | 0.2% | 24 | 0.1% | 25 | 0.2% | 19 | 0.1% | 59 | 0.2% | 18 | 0.1% | 61 | 0.2% | 25 | 0.2% | 27 | 0.2% | 19 | 0.1% | 2 | 0.0% | 40 | 0.3% | 88 | 0.2% | 26 | 0.2% |
| Software Development | 199 | 1.4% | 73 | 0.5% | 142 | 0.6% | 118 | 0.7% | 117 | 0.7% | 211 | 0.6% | 63 | 0.4% | 271 | 0.8% | 84 | 0.6% | 110 | 0.9% | 107 | 0.8% | 23 | 0.5% | 137 | 1.0% | 468 | 0.9% | 157 | 0.9% |
| Telecoms | 80 | 0.6% | 61 | 0.4% | 107 | 0.4% | 55 | 0.4% | 45 | 0.3% | 121 | 0.4% | 56 | 0.4% | 182 | 0.5% | 44 | 0.3% | 38 | 0.3% | 63 | 0.5% | 18 | 0.4% | 96 | 0.7% | 239 | 0.5% | 73 | 0.4% |
| **Grand Total** | **1184** | **8.3%** | **740** | **5.1%** | **1076** | **4.3%** | **846** | **5.2%** | **831** | **4.9%** | **1594** | **4.6%** | **649** | **4.4%** | **2020** | **5.6%** | **653** | **4.5%** | **640** | **5.4%** | **688** | **5.1%** | **222** | **4.4%** | **803** | **5.8%** | **2946** | **5.7%** | **1053** | **5.9%** |

*Source: glass.AI*

**Table 3**  Number of people employed by emerging tech companies across regions, sectors, and areas

| | Cambridge-Peterborough | Cardiff Region | Derby Nottingham | Edinburgh Region | Glasgow Region | Leeds Region | Liverpool Region | Manchester Region | North East | Oxfordshire | Sheffield Region | Tees Valley | Thames Valley Berkshire | West Midlands | West Of England |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Advanced Manufacturing** | 6277 | 3040 | 3852 | 3433 | 2693 | 5930 | 1861 | 6890 | 2413 | 1625 | 3136 | 1286 | 2196 | 18555 | 2640 |
| Advanced Materials | 918 | 50 | 70 | 81 | 62 | 99 | 52 | 661 | 178 | 17 | 69 | 56 | 175 | 664 | 197 |
| Electronics | 3654 | 2005 | 2333 | 2691 | 1868 | 4143 | 1153 | 4813 | 1424 | 817 | 1960 | 766 | 1638 | 10917 | 1508 |
| Industrial Automation | 1685 | 985 | 1435 | 657 | 763 | 1670 | 656 | 1398 | 801 | 780 | 1103 | 464 | 383 | 6961 | 934 |
| Power Electronics | 20 | | 14 | 4 | | 18 | | 18 | 10 | 11 | 4 | | | 13 | 1 |
| **Data driven health** | 2861 | 761 | 838 | 869 | 1379 | 1675 | 411 | 1773 | 304 | 1136 | 571 | 136 | 251 | 2332 | 1904 |
| Health Analytics | 184 | 51 | 106 | 105 | 28 | 13 | | 140 | 2 | | 9 | 28 | 17 | 36 | 590 |
| Med Tech | 1240 | 486 | 465 | 504 | 1003 | 1168 | 332 | 1246 | 161 | 833 | 271 | 106 | 200 | 1586 | 793 |
| Precision Med | 900 | 107 | 18 | 105 | 230 | 81 | 20 | 101 | 108 | 208 | 28 | | 16 | 306 | 333 |
| Telehealth | 537 | 117 | 249 | 155 | 118 | 413 | 59 | 286 | 33 | 95 | 263 | 2 | 18 | 404 | 188 |
| **Future mobility** | 441 | 1124 | 1542 | 977 | 1232 | 929 | 368 | 1086 | 568 | 511 | 836 | 89 | 628 | 5757 | 1366 |
| Autonomous Vehicles | 121 | 280 | 54 | 445 | 592 | 95 | 16 | 26 | 42 | 366 | 2 | 49 | 223 | 663 | 95 |
| Battery Tech | 150 | 728 | 293 | 327 | 256 | 512 | 159 | 744 | 381 | 73 | 473 | 7 | 149 | 2849 | 1096 |
| Electric Engines | 95 | 116 | 1168 | 133 | 313 | 244 | 157 | 283 | 130 | 72 | 350 | 33 | 256 | 2080 | 165 |
| MaaS | 30 | | 19 | 60 | 59 | 66 | 36 | | | | | | 0 | 36 | |
| Rail Tech | 37 | 0 | 0 | 4 | 12 | 12 | 0 | 21 | 7 | 0 | 8 | 0 | 0 | 129 | 0 |
| Urban Air | 8 | 0 | 8 | 8 | 0 | 0 | 0 | 12 | 8 | | 3 | 0 | 0 | 0 | 10 |
| **Modern Services** | 1524 | 1086 | 522 | 1145 | 627 | 2022 | 716 | 2537 | 522 | 447 | 531 | 288 | 608 | 3958 | 1485 |
| FinTech | 782 | 572 | 166 | 826 | 252 | 707 | 274 | 632 | 97 | 236 | 120 | 6 | 244 | 1668 | 706 |
| Prof Tech | 417 | 207 | 133 | 130 | 193 | 688 | 281 | 1054 | 242 | 103 | 108 | 189 | 129 | 984 | 439 |
| PropTech | 325 | 307 | 223 | 189 | 182 | 627 | 161 | 851 | 183 | 108 | 303 | 93 | 235 | 1306 | 340 |
| **Smart cities** | 1678 | 1318 | 1956 | 2256 | 1671 | 3294 | 833 | 2739 | 1795 | 1173 | 1274 | 231 | 583 | 5441 | 1897 |

| | Cambridge-Peter-borough | Cardiff Region | Derby Nottingham | Edinburgh Region | Glasgow Region | Leeds Region | Liverpool Region | Manchester Region | North East | Oxfordshire | Sheffield Region | Tees Valley | Thames Valley Berkshire | West Midlands | West Of England |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Clean Tech | 657 | 172 | 744 | 1379 | 457 | 662 | 202 | 670 | 303 | 236 | 200 | 65 | 219 | 1501 | 595 |
| Construction Tech | 530 | 824 | 749 | 516 | 564 | 1541 | 324 | 881 | 953 | 296 | 405 | 72 | 146 | 1891 | 391 |
| Smart Grid | 141 | 24 | 214 | 68 | 18 | 471 | 21 | 382 | 33 | 142 | 560 | 86 | 147 | 916 | 416 |
| Space Tech | 350 | 298 | 249 | 293 | 632 | 620 | 286 | 806 | 506 | 499 | 109 | 8 | 71 | 1133 | 495 |
| **Tech & Creative** | **18649** | **9099** | **8753** | **10989** | **10237** | **18999** | **5899** | **31376** | **6155** | **7403** | **7341** | **1655** | **13317** | **41761** | **16588** |
| 5G | 442 | 51 | 13 | 25 | 51 | 131 | 46 | 18 | 22 | 103 | 25 | | 10 | 125 | 154 |
| Analytics | 1184 | 859 | 585 | 701 | 623 | 1503 | 613 | 1985 | 250 | 998 | 437 | 58 | 1032 | 1873 | 1215 |
| Artificial Intelligence | 2399 | 340 | 344 | 525 | 388 | 925 | 255 | 1260 | 361 | 683 | 306 | 64 | 547 | 1713 | 1892 |
| Cloud Computing | 2442 | 1532 | 1538 | 1751 | 1416 | 2494 | 1283 | 5512 | 709 | 533 | 1168 | 182 | 1929 | 5521 | 2411 |
| Cyber security | 1798 | 722 | 346 | 1054 | 844 | 1626 | 306 | 2847 | 502 | 460 | 344 | 80 | 534 | 2544 | 792 |
| Digital Transformation | 462 | 261 | 105 | 765 | 863 | 893 | 474 | 1289 | 260 | 161 | 620 | 156 | 553 | 1996 | 1250 |
| Ecommerce | 46 | 238 | 624 | 170 | 304 | 594 | 72 | 1530 | 147 | 80 | 94 | 6 | 188 | 1425 | 648 |
| Gaming | 350 | 124 | 626 | 80 | 167 | 328 | 220 | 1342 | 459 | 309 | 303 | 35 | 85 | 660 | 373 |
| Immersive Tech | 91 | 696 | 304 | 374 | 415 | 688 | 227 | 961 | 154 | 470 | 63 | 21 | 736 | 875 | 750 |
| IoT | 1686 | 418 | 469 | 405 | 252 | 1328 | 73 | 462 | 103 | 400 | 307 | 75 | 1504 | 1549 | 498 |
| Process Automation | 594 | 382 | 622 | 1028 | 784 | 1257 | 148 | 1919 | 750 | 616 | 632 | 71 | 1227 | 2071 | 1200 |
| Software Development | 5005 | 2377 | 1636 | 2947 | 3106 | 5230 | 1607 | 8261 | 1581 | 1897 | 1644 | 422 | 2706 | 14674 | 4214 |
| Telecoms | 2150 | 1099 | 1541 | 1164 | 1024 | 2002 | 575 | 3990 | 857 | 693 | 1398 | 485 | 2266 | 6735 | 1191 |
| **Grand Total** | 31430 | 16428 | 17463 | 19669 | 17839 | 32849 | 10088 | 46401 | 11757 | 12295 | 13689 | 3685 | 17583 | 77804 | 25880 |

*Source: glass.AI*

## Table 4 Number of roles across sectors, areas, and regions

| | Cambridge-Peter-borough | Cardiff Region | Derby Nottingham | Edinburgh Region | Glasgow Region | Leeds Region | Liverpool Region | Manchester Region | North East | Oxfordshire | Sheffield Region | Tees Valley | Thames Valley Berkshire | West Midlands | West Of England |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Advanced Manufacturing** | **1370** | **557** | **448** | **836** | **738** | **786** | **515** | **1098** | **422** | **450** | **515** | **70** | **210** | **2358** | **644** |
| Advanced Materials | 376 | 56 | 50 | 234 | 19 | 52 | 93 | 292 | 6 | 37 | 21 | 4 | 7 | 426 | 129 |
| Electronics | 738 | 379 | 273 | 424 | 493 | 471 | 193 | 532 | 246 | 295 | 148 | 15 | 171 | 1100 | 350 |
| Industrial Automation | 256 | 122 | 123 | 178 | 226 | 246 | 229 | 265 | 164 | 98 | 346 | 51 | 32 | 831 | 165 |
| Power Electronics | | | 2 | | | 17 | | 9 | 6 | 20 | 0 | | | 1 | |
| **Data driven health** | **1224** | **767** | **420** | **551** | **647** | **727** | **371** | **871** | **173** | **684** | **293** | **25** | **450** | **986** | **1030** |
| Health Analytics | 41 | 15 | | 2 | | 21 | | 37 | 7 | | 2 | | 1 | 3 | 279 |
| Med Tech | 722 | 677 | 241 | 424 | 539 | 488 | 323 | 682 | 132 | 402 | 242 | 22 | 387 | 849 | 488 |
| Precision Med | 332 | 15 | 20 | 74 | 59 | 156 | 30 | 96 | 17 | 181 | 22 | | 12 | 59 | 21 |
| Telehealth | 129 | 60 | 159 | 51 | 49 | 62 | 18 | 56 | 17 | 101 | 27 | 3 | 50 | 75 | 242 |
| **Future mobility** | **412** | **131** | **318** | **114** | **309** | **189** | **234** | **71** | **112** | **113** | **77** | **12** | **84** | **554** | **478** |
| Autonomous Vehicles | 31 | 13 | 8 | 30 | 96 | 41 | 17 | 3 | 15 | 35 | | 0 | 43 | 51 | 71 |
| Battery Tech | 29 | 18 | 21 | 30 | 58 | 85 | 55 | 32 | 62 | 51 | 35 | 11 | 26 | 118 | 233 |
| Electric Engines | 293 | 100 | 172 | 15 | 137 | 44 | 160 | 32 | 34 | 15 | 41 | 1 | 6 | 368 | 174 |
| MaaS | 43 | | 44 | 39 | 14 | 11 | 2 | | | | | | 5 | 6 | |
| Rail Tech | 16 | | 59 | | 4 | 8 | 0 | 4 | 1 | 12 | 1 | | 3 | 11 | 0 |
| Urban Air | | | 14 | | | | | | | | | | 1 | | |
| **Modern Services** | **1023** | **396** | **256** | **676** | **540** | **1398** | **296** | **1103** | **277** | **177** | **333** | **126** | **221** | **1439** | **790** |
| FinTech | 486 | 146 | 49 | 221 | 286 | 447 | 161 | 345 | 129 | 107 | 239 | 26 | 51 | 580 | 273 |
| Prof Tech | 453 | 122 | 32 | 326 | 136 | 577 | 40 | 440 | 55 | 31 | 1 | 69 | 44 | 386 | 288 |
| PropTech | 84 | 128 | 175 | 129 | 118 | 374 | 95 | 318 | 93 | 39 | 93 | 31 | 126 | 473 | 229 |
| **Smart cities** | **727** | **284** | **659** | **738** | **399** | **588** | **357** | **859** | **652** | **418** | **129** | **19** | **175** | **1509** | **627** |
| Clean Tech | 443 | 27 | 298 | 271 | 164 | 161 | 128 | 75 | 60 | 38 | 86 | 10 | 17 | 212 | 200 |
| Construction Tech | 129 | 130 | 268 | 23 | 92 | 94 | 110 | 193 | 210 | 71 | 16 | 5 | 23 | 540 | 46 |
| Smart Grid | 57 | 46 | 42 | 23 | 15 | 82 | 1 | 215 | 9 | 63 | 10 | 0 | 27 | 139 | 53 |

| | Cambridge-Peter-borough | Cardiff Region | Derby Nottingham | Edinburgh Region | Glasgow Region | Leeds Region | Liverpool Region | Manchester Region | North East | Oxfordshire | Sheffield Region | Tees Valley | Thames Valley Berkshire | West Midlands | West Of England |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Space Tech | 98 | 81 | 51 | 421 | 128 | 251 | 118 | 376 | 373 | 246 | 17 | 4 | 108 | 618 | 328 |
| **Tech & Creative** | **4881** | **1681** | **1358** | **3022** | **2223** | **4057** | **1580** | **5935** | **1264** | **1965** | **1024** | **535** | **1561** | **8666** | **5530** |
| 5G | 36 | 1 | 7 | 20 | 29 | 6 | 0 | 1 | 47 | 1 | | | 15 | 88 | 101 |
| Analytics | 363 | 310 | 64 | 243 | 168 | 350 | 231 | 761 | 26 | 136 | 24 | 81 | 90 | 562 | 414 |
| Artificial Intelligence | 932 | 119 | 46 | 301 | 93 | 349 | 28 | 290 | 91 | 331 | 36 | 98 | 145 | 393 | 498 |
| Cloud Computing | 354 | 307 | 241 | 545 | 228 | 572 | 203 | 978 | 168 | 126 | 50 | 74 | 323 | 1116 | 842 |
| Cyber security | 367 | 112 | 49 | 300 | 136 | 229 | 35 | 533 | 34 | 159 | 22 | 82 | 100 | 588 | 376 |
| Digital Transformation | 628 | 46 | 59 | 216 | 404 | 190 | 283 | 393 | 68 | 270 | 30 | 11 | 99 | 755 | 649 |
| Ecommerce | 16 | 15 | 80 | 12 | 42 | 31 | 33 | 233 | 1 | 4 | 20 | | 21 | 104 | 52 |
| Gaming | 138 | 23 | 64 | 42 | 68 | 246 | 247 | 196 | 40 | 80 | 12 | 2 | 3 | 371 | 370 |
| Immersive Tech | 52 | 58 | 73 | 116 | 158 | 343 | 62 | 274 | 24 | 107 | 82 | 1 | 26 | 334 | 289 |
| IoT | 175 | 69 | 25 | 49 | 84 | 140 | 15 | 118 | 28 | 26 | 54 | 81 | 134 | 163 | 477 |
| Process Automation | 343 | 139 | 189 | 318 | 285 | 352 | 125 | 446 | 141 | 223 | 118 | 44 | 97 | 676 | 197 |
| Software Development | 1169 | 324 | 275 | 708 | 449 | 940 | 149 | 1270 | 458 | 323 | 438 | 35 | 329 | 2466 | 1008 |
| Telecoms | 308 | 158 | 186 | 152 | 79 | 309 | 169 | 442 | 138 | 179 | 138 | 26 | 179 | 1050 | 257 |
| **Grand Total** | **9637** | **3816** | **3459** | **5937** | **4856** | **7745** | **3353** | **9937** | **2900** | **3807** | **2371** | **787** | **2701** | **15512** | **9099** |

**Table 5**    Number of roles per 100,000 people employed at companies with a website across sectors and regions

| | Cambridge-Peter-borough | Cardiff Region | Derby Nottingham | Edinburgh Region | Glasgow Region | Leeds Region | Liverpool Region | Manchester Region | North East | Oxfordshire | Sheffield Region | Tees Valley | Thames Valley Berkshire | West Midlands | West Of England |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tech & Creative | 2053 | 755 | 419 | 1168 | 858 | 804 | 730 | 1054 | 628 | 1214 | 529 | 748 | 772 | 934 | 1688 |
| Advanced Manufacturing | 576 | 250 | 138 | 323 | 285 | 156 | 238 | 195 | 210 | 278 | 266 | 98 | 104 | 254 | 197 |
| Data driven health | 515 | 345 | 129 | 213 | 250 | 144 | 171 | 155 | 86 | 423 | 151 | 35 | 223 | 106 | 314 |
| Smart cities | 306 | 128 | 203 | 285 | 154 | 117 | 165 | 152 | 324 | 258 | 67 | 27 | 87 | 163 | 191 |
| Modern Services | 430 | 178 | 79 | 261 | 208 | 277 | 137 | 196 | 138 | 109 | 172 | 176 | 109 | 155 | 241 |
| Future mobility | 173 | 59 | 98 | 44 | 119 | 37 | 108 | 13 | 56 | 70 | 40 | 17 | 42 | 60 | 146 |
| **Grand total** | **4054** | **1714** | **1066** | **2295** | **1875** | **1535** | **1548** | **1764** | **1440** | **2352** | **1225** | **1101** | **1336** | **1671** | **2778** |

**Table 6**    Number of skills across sectors, areas, and regions

| | Cambridge-Peter-borough | Cardiff Region | Derby Nottingham | Edinburgh Region | Glasgow Region | Leeds Region | Liverpool Region | Manchester Region | North East | Oxfordshire | Sheffield Region | Tees Valley | Thames Valley Berkshire | West Midlands | West Of England |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Advanced Manufacturing** | **1118** | **593** | **658** | **562** | **302** | **631** | **330** | **771** | **333** | **898** | **400** | **71** | **362** | **2014** | **631** |
| Advanced Materials | 260 | 63 | 62 | 133 | 8 | 31 | 64 | 130 | 1 | 116 | 30 | 7 | 44 | 568 | 234 |
| Electronics | 639 | 305 | 352 | 306 | 245 | 361 | 108 | 424 | 207 | 587 | 194 | 9 | 250 | 736 | 295 |
| Industrial Automation | 219 | 225 | 241 | 123 | 49 | 222 | 158 | 210 | 121 | 167 | 175 | 55 | 68 | 710 | 102 |
| Power Electronics | | | 3 | | | 17 | | 7 | 4 | 28 | 1 | | | 0 | |
| **Data driven health** | **942** | **454** | **543** | **417** | **361** | **618** | **261** | **633** | **141** | **1456** | **229** | **17** | **510** | **813** | **337** |
| Health Analytics | 57 | 3 | | 0 | | 17 | | 23 | 3 | | 2 | | 1 | 3 | 85 |

| | Cambridge-Peterborough | Cardiff Region | Derby Nottingham | Edinburgh Region | Glasgow Region | Leeds Region | Liverpool Region | Manchester Region | North East | Oxfordshire | Sheffield Region | Tees Valley | Thames Valley Berkshire | West Midlands | West Of England |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Med Tech | 565 | 387 | 395 | 314 | 289 | 464 | 213 | 511 | 110 | 1135 | 185 | 15 | 383 | 622 | 178 |
| Precision Med | 252 | 21 | 22 | 58 | 38 | 95 | 35 | 47 | 16 | 139 | 27 | | 39 | 141 | 26 |
| Telehealth | 68 | 43 | 126 | 45 | 34 | 42 | 13 | 52 | 12 | 182 | 15 | 2 | 87 | 47 | 48 |
| **Future mobility** | **141** | **145** | **382** | **110** | **206** | **122** | **157** | **67** | **94** | **279** | **44** | **25** | **177** | **352** | **247** |
| Autonomous Vehicles | 17 | 80 | 22 | 30 | 72 | 18 | 9 | 0 | 3 | 91 | | 8 | 65 | 27 | 21 |
| Battery Tech | 11 | 17 | 66 | 36 | 35 | 70 | 40 | 37 | 50 | 148 | 24 | 16 | 23 | 107 | 116 |
| Electric Engines | 87 | 48 | 156 | 10 | 70 | 25 | 108 | 27 | 40 | 29 | 18 | 1 | 18 | 204 | 110 |
| MaaS | 17 | | 59 | 34 | 26 | 4 | 0 | | | | | | | 34 | 4 |
| Rail Tech | 9 | | 73 | | 3 | 5 | 0 | 3 | 1 | 11 | 2 | | 36 | 10 | 0 |
| Urban Air | | | 6 | | | | | | | | | | 1 | | |
| **Modern Services** | **345** | **247** | **260** | **319** | **357** | **635** | **135** | **752** | **123** | **362** | **161** | **74** | **326** | **821** | **471** |
| FinTech | 146 | 104 | 60 | 127 | 152 | 211 | 73 | 216 | 52 | 161 | 123 | 17 | 96 | 305 | 180 |
| Prof Tech | 156 | 46 | 66 | 139 | 110 | 179 | 42 | 348 | 32 | 100 | 0 | 41 | 46 | 231 | 149 |
| PropTech | 43 | 97 | 134 | 53 | 95 | 245 | 20 | 188 | 39 | 101 | 38 | 16 | 184 | 285 | 142 |
| **Smart cities** | **344** | **213** | **576** | **640** | **249** | **543** | **300** | **511** | **365** | **763** | **95** | **20** | **366** | **865** | **514** |
| Clean Tech | 140 | 59 | 212 | 177 | 88 | 116 | 96 | 52 | 24 | 90 | 71 | 7 | 46 | 171 | 126 |
| Construction Tech | 63 | 48 | 167 | 18 | 56 | 83 | 63 | 117 | 84 | 159 | 5 | 6 | 55 | 239 | 33 |
| Smart Grid | 31 | 25 | 109 | 28 | 13 | 69 | 0 | 113 | 103 | 156 | 3 | 5 | 89 | 90 | 44 |
| Space Tech | 110 | 81 | 88 | 417 | 92 | 275 | 141 | 229 | 154 | 358 | 16 | 2 | 176 | 365 | 311 |
| **Tech & Creative** | **3836** | **1292** | **2208** | **2154** | **1774** | **2944** | **916** | **3776** | **1596** | **3548** | **848** | **242** | **3609** | **6411** | **3575** |
| 5G | 26 | 4 | 7 | 21 | 53 | 1 | 3 | 0 | 21 | 10 | | | 16 | 23 | 84 |
| Analytics | 401 | 186 | 91 | 218 | 129 | 306 | 126 | 400 | 213 | 321 | 30 | 7 | 214 | 470 | 284 |
| Artificial Intelligence | 569 | 87 | 56 | 302 | 145 | 257 | 32 | 206 | 62 | 395 | 33 | 27 | 312 | 293 | 360 |
| Cloud Computing | 403 | 237 | 387 | 327 | 255 | 344 | 116 | 623 | 305 | 261 | 52 | 48 | 639 | 812 | 448 |
| Cyber security | 357 | 125 | 154 | 182 | 140 | 194 | 35 | 381 | 32 | 619 | 25 | 13 | 216 | 308 | 255 |
| Digital Transformation | 223 | 27 | 54 | 125 | 188 | 249 | 127 | 263 | 233 | 376 | 18 | 5 | 213 | 564 | 315 |
| Ecommerce | 24 | 8 | 108 | 14 | 36 | 40 | 9 | 89 | 2 | 9 | 7 | | 35 | 95 | 31 |
| Gaming | 89 | 25 | 189 | 23 | 17 | 139 | 96 | 167 | 36 | 207 | 14 | 2 | 29 | 247 | 236 |

| | Cambridge-Peter-borough | Cardiff Region | Derby Nottingham m | Edinburgh Region | Glasgow Region | Leeds Region | Liverpool Region | Manchester Region | North East | Oxfordshire | Sheffield Region | Tees Valley | Thames Valley Berkshire | West Midlands | West Of England |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Immersive Tech | 32 | 63 | 80 | 72 | 92 | 115 | 27 | 68 | 11 | 145 | 74 | 1 | 117 | 214 | 192 |
| IoT | 195 | 67 | 62 | 171 | 84 | 195 | 7 | 103 | 194 | 64 | 65 | 49 | 364 | 176 | 206 |
| Process Automation | 200 | 91 | 99 | 167 | 93 | 305 | 96 | 318 | 66 | 249 | 121 | 55 | 269 | 572 | 246 |
| Software Development | 967 | 247 | 518 | 429 | 478 | 574 | 169 | 849 | 325 | 632 | 320 | 24 | 852 | 1961 | 701 |
| Telecoms | 350 | 125 | 403 | 103 | 64 | 225 | 73 | 309 | 96 | 260 | 89 | 11 | 333 | 676 | 217 |

**Table 7    University evidence across regions, sectors, and areas**

| | Cambridge-Peter-borough | Cardiff Region | Derby Nottingham m | Edinburgh Region | Glasgow Region | Leeds Region | Liverpool Region | Manchester Region | North East | Oxfordshire | Sheffield Region | Tees Valley | Thames Valley Berkshire | West Midlands | West Of England |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Advanced Manufacturing** | **2824** | **1662** | **874** | **1202** | **2044** | **2240** | **1271** | **887** | **2165** | **1421** | **979** | **314** | **367** | **1799** | **974** |
| Advanced Materials | 1255 | 849 | 354 | 538 | 1018 | 1055 | 714 | 468 | 1186 | 649 | 435 | 148 | 211 | 980 | 488 |
| Electronics | 236 | 137 | 86 | 88 | 226 | 207 | 145 | 75 | 199 | 112 | 113 | 25 | 36 | 166 | 75 |
| Industrial Automation | 1114 | 583 | 382 | 471 | 677 | 679 | 367 | 277 | 657 | 560 | 395 | 127 | 105 | 564 | 324 |
| Power Electronics | 219 | 93 | 52 | 105 | 123 | 299 | 45 | 67 | 123 | 100 | 36 | 14 | 15 | 89 | 87 |
| **Data driven health** | **2600** | **1443** | **859** | **817** | **1813** | **1529** | **2173** | **871** | **1795** | **1092** | **688** | **176** | **297** | **1266** | **1164** |
| Health Analytics | 5 | 13 | 5 | 12 | 23 | 17 | 8 | 3 | 17 | 5 | 7 | 0 | 0 | 2 | 26 |
| Med Tech | 2216 | 1126 | 724 | 678 | 1489 | 1238 | 1799 | 716 | 1487 | 880 | 579 | 154 | 267 | 1086 | 951 |
| Precision Med | 229 | 236 | 103 | 84 | 192 | 155 | 164 | 120 | 213 | 148 | 33 | 13 | 20 | 109 | 121 |
| Telehealth | 150 | 68 | 27 | 43 | 109 | 119 | 202 | 32 | 78 | 59 | 69 | 9 | 10 | 69 | 66 |
| **Future mobility** | **3210** | **1568** | **576** | **802** | **1579** | **1545** | **1396** | **635** | **1460** | **1404** | **543** | **159** | **427** | **1517** | **1450** |

| | Cambridge-Peter-borough | Cardiff Region | Derby Nottingham | Edinburgh Region | Glasgow Region | Leeds Region | Liverpool Region | Manchester Region | North East | Oxfordshire | Sheffield Region | Tees Valley | Thames Valley Berkshire | West Midlands | West Of England |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Autonomous Vehicles | 653 | 362 | 93 | 207 | 448 | 325 | 435 | 210 | 336 | 337 | 125 | 9 | 104 | 343 | 365 |
| Battery Tech | 1449 | 589 | 328 | 334 | 637 | 709 | 566 | 293 | 616 | 591 | 295 | 110 | 162 | 658 | 471 |
| Electric Engines | 863 | 440 | 134 | 188 | 360 | 396 | 240 | 93 | 367 | 357 | 88 | 36 | 119 | 433 | 383 |
| MaaS | 185 | 119 | 16 | 44 | 112 | 78 | 137 | 23 | 114 | 98 | 22 | 4 | 22 | 70 | 159 |
| Rail Tech | 30 | 4 | 0 | 3 | 1 | 3 | 4 | 0 | 6 | 8 | 1 | 0 | 0 | 0 | 43 |
| Urban Air | 30 | 54 | 5 | 26 | 21 | 34 | 14 | 16 | 21 | 13 | 12 | 0 | 20 | 13 | 29 |
| **Modern Services** | **591** | **643** | **445** | **226** | **611** | **312** | **375** | **246** | **567** | **343** | **89** | **28** | **128** | **317** | **714** |
| FinTech | 541 | 568 | 426 | 208 | 566 | 282 | 363 | 235 | 515 | 319 | 80 | 28 | 107 | 267 | 549 |
| Prof Tech | 43 | 56 | 19 | 16 | 38 | 28 | 11 | 10 | 46 | 21 | 9 | 0 | 2 | 46 | 104 |
| PropTech | 7 | 19 | 0 | 2 | 7 | 2 | 1 | 1 | 6 | 3 | 0 | 0 | 19 | 4 | 61 |
| **Smart cities** | **5533** | **3754** | **1688** | **2210** | **4866** | **4726** | **3782** | **1832** | **3863** | **3072** | **1722** | **484** | **1443** | **3641** | **2383** |
| Clean Tech | 2549 | 1848 | 621 | 1127 | 2332 | 2139 | 1782 | 696 | 1832 | 1373 | 711 | 174 | 643 | 1643 | 1111 |
| Construction Tech | 319 | 173 | 100 | 139 | 200 | 164 | 118 | 121 | 218 | 160 | 50 | 81 | 79 | 143 | 100 |
| Smart Grid | 612 | 448 | 233 | 204 | 585 | 669 | 334 | 140 | 543 | 376 | 167 | 72 | 177 | 440 | 288 |
| Space Tech | 2053 | 1285 | 734 | 740 | 1749 | 1754 | 1548 | 875 | 1270 | 1163 | 794 | 157 | 544 | 1415 | 884 |
| **Tech & Creative** | **15667** | **8612** | **5369** | **5429** | **12875** | **8897** | **9895** | **4392** | **9520** | **7266** | **4684** | **1730** | **2648** | **8294** | **6899** |
| 5G | 691 | 539 | 178 | 199 | 757 | 756 | 497 | 233 | 439 | 352 | 213 | 9 | 132 | 372 | 285 |
| Analytics | 831 | 458 | 339 | 314 | 559 | 338 | 620 | 272 | 453 | 377 | 261 | 94 | 81 | 467 | 309 |

| | Cambridge-Peter-borough | Cardiff Region | Derby Nottingham | Edinburgh Region | Glasgow Region | Leeds Region | Liverpool Region | Manchester Region | North East | Oxfordshire | Sheffield Region | Tees Valley | Thames Valley Berkshire | West Midlands | West Of England |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Artificial Intelligence | 3865 | 1882 | 1250 | 1397 | 3493 | 2235 | 2627 | 1205 | 2410 | 1644 | 1438 | 366 | 669 | 2320 | 1747 |
| Cloud Computing | 567 | 304 | 235 | 264 | 662 | 431 | 429 | 245 | 438 | 393 | 157 | 59 | 151 | 344 | 261 |
| Cyber security | 3046 | 2143 | 896 | 893 | 2501 | 1583 | 1516 | 615 | 1547 | 1389 | 589 | 278 | 432 | 1314 | 1826 |
| Digital Transformation | 1559 | 753 | 441 | 554 | 920 | 753 | 1002 | 396 | 1046 | 726 | 419 | 190 | 281 | 755 | 600 |
| Ecommerce | 863 | 402 | 351 | 412 | 626 | 410 | 633 | 204 | 640 | 440 | 300 | 203 | 161 | 451 | 304 |
| Gaming | 2432 | 1125 | 1263 | 881 | 2052 | 1316 | 1601 | 772 | 1527 | 1206 | 783 | 361 | 466 | 1375 | 904 |
| Immersive Tech | 622 | 524 | 99 | 233 | 515 | 481 | 352 | 206 | 391 | 301 | 127 | 55 | 116 | 272 | 303 |
| IoT | 617 | 285 | 127 | 150 | 361 | 320 | 295 | 128 | 279 | 216 | 181 | 65 | 69 | 292 | 188 |
| Process Automation | 359 | 122 | 123 | 84 | 298 | 140 | 226 | 70 | 230 | 144 | 140 | 47 | 59 | 208 | 111 |
| Software Development | 215 | 75 | 67 | 48 | 131 | 134 | 97 | 46 | 120 | 78 | 76 | 3 | 31 | 124 | 61 |
| Telecoms | 30425 | 17682 | 9811 | 10686 | 23788 | 19249 | 18892 | 8863 | 19370 | 14598 | 8705 | 2891 | 5310 | 16834 | 13584 |

**Table 8**  **Academic evidence across areas, universities,  and sectors**

| Universities | Advanced Manufacturing | Data driven health | Future mobility | Modern Services | Smart cities | Tech & Creative | Grand Total |
|---|---|---|---|---|---|---|---|
| **Cambridge-Peterborough** | **1662** | **1443** | **1568** | **643** | **3754** | **8612** | **17682** |
| Anglia Ruskin University | 6 | 36 | 11 | 6 | 35 | 222 | 316 |
| University Centre Peterborough (UCP) | 6 | 0 | 3 | 7 | 8 | 43 | 67 |
| University of Cambridge | 1650 | 1407 | 1554 | 630 | 3711 | 8347 | 17299 |
| **Cardiff Region** | **874** | **859** | **576** | **445** | **1688** | **5369** | **9811** |
| Cardiff Metropolitan University | 131 | 133 | 61 | 86 | 115 | 929 | 1455 |
| Cardiff University | 635 | 664 | 316 | 187 | 1199 | 2692 | 5693 |
| University Of South Wales | 100 | 60 | 196 | 121 | 362 | 1507 | 2346 |
| University of Wales | 8 | 2 | 3 | 51 | 12 | 241 | 317 |
| **Derby Nottingham** | **1202** | **817** | **802** | **226** | **2210** | **5429** | **10686** |
| Nottingham Trent University | 348 | 223 | 213 | 67 | 678 | 1879 | 3408 |
| University of Derby | 121 | 42 | 50 | 42 | 161 | 886 | 1302 |
| University of Nottingham | 733 | 552 | 539 | 117 | 1371 | 2664 | 5976 |
| **Edinburgh Region** | **2044** | **1813** | **1579** | **611** | **4866** | **12875** | **23788** |
| Edinburgh Napier University | 193 | 156 | 231 | 105 | 333 | 1594 | 2612 |
| Heriot-Watt University | 945 | 352 | 477 | 76 | 1789 | 3643 | 7282 |
| Queen Margaret University | 6 | 61 | 19 | 11 | 45 | 424 | 566 |
| University of Edinburgh | 900 | 1244 | 852 | 419 | 2699 | 7214 | 13328 |
| **Glasgow Region** | **2240** | **1529** | **1545** | **312** | **4726** | **8897** | **19249** |
| Glasgow Caledonian University | 163 | 127 | 54 | 38 | 190 | 1001 | 1573 |
| University of Glasgow | 724 | 600 | 532 | 137 | 1723 | 3640 | 7356 |
| University Of Strathclyde | 1353 | 802 | 959 | 137 | 2813 | 4256 | 10320 |
| **Greater London** | **5190** | **5761** | **5600** | **2415** | **13001** | **42031** | **73998** |
| AA School of Architecture | 39 | 0 | 16 | 1 | 69 | 216 | 341 |
| Birkbeck - University of London | 92 | 114 | 116 | 38 | 330 | 1636 | 2326 |
| City University London | 111 | 174 | 134 | 170 | 290 | 1398 | 2277 |
| Goldsmiths - University of London | 112 | 100 | 146 | 36 | 284 | 1938 | 2616 |
| Imperial College London | 836 | 790 | 1140 | 251 | 2088 | 3993 | 9098 |
| Institute of Cancer Research | 17 | 248 | 1 | 35 | 52 | 261 | 614 |
| King's College London | 269 | 561 | 184 | 101 | 596 | 2588 | 4299 |
| Kingston University London | 187 | 159 | 129 | 29 | 353 | 1175 | 2032 |
| London Business School | 87 | 60 | 112 | 92 | 116 | 829 | 1296 |
| London Metropolitan University | 92 | 36 | 47 | 58 | 149 | 836 | 1218 |

| Universities | Advanced Manufacturing | Data driven health | Future mobility | Modern Services | Smart cities | Tech & Creative | Grand Total |
|---|---|---|---|---|---|---|---|
| London School of Economics and Political Science | 324 | 490 | 492 | 413 | 1241 | 3020 | 5980 |
| London School of Hygiene and Tropical Medicine | 58 | 515 | 139 | 59 | 321 | 911 | 2003 |
| London South Bank University | 297 | 175 | 274 | 37 | 556 | 1503 | 2842 |
| Queen Mary University of London | 413 | 526 | 317 | 147 | 813 | 3014 | 5230 |
| Regent's University London | 10 | 1 | 4 | 4 | 21 | 121 | 161 |
| Royal Academy Of Music | 0 | 0 | 1 | 1 | 0 | 68 | 70 |
| Royal College of Art | 235 | 85 | 244 | 17 | 347 | 1325 | 2253 |
| Royal Holloway, University of London | 189 | 81 | 137 | 75 | 437 | 1554 | 2473 |
| Royal Veterinary College | 28 | 147 | 33 | 6 | 73 | 381 | 668 |
| School of Advanced Study | 37 | 9 | 57 | 81 | 165 | 1113 | 1462 |
| SOAS - University of London | 102 | 14 | 186 | 80 | 353 | 1114 | 1849 |
| St Mary's University | 39 | 12 | 5 | 7 | 25 | 217 | 305 |
| UCL Institute of Education | 437 | 541 | 483 | 230 | 1370 | 3113 | 6174 |
| UCL University College London | 418 | 484 | 463 | 209 | 1075 | 2838 | 5487 |
| University of East London | 140 | 113 | 133 | 81 | 309 | 1387 | 2163 |
| University of Greenwich | 178 | 84 | 137 | 25 | 370 | 1236 | 2030 |
| University of the Arts London | 217 | 42 | 190 | 42 | 456 | 1755 | 2702 |
| University of West London | 28 | 48 | 39 | 19 | 150 | 791 | 1075 |
| University of Westminster | 198 | 152 | 241 | 71 | 592 | 1700 | 2954 |
| **Leeds Region** | **1271** | **2173** | **1396** | **375** | **3782** | **9895** | **18892** |
| Leeds Beckett University | 89 | 253 | 143 | 25 | 358 | 1579 | 2447 |
| LEEDS Trinity University | 3 | 5 | 18 | 2 | 19 | 170 | 217 |
| University of Leeds | 488 | 760 | 648 | 157 | 1683 | 3023 | 6759 |
| University of York | 670 | 1124 | 559 | 151 | 1659 | 4428 | 8591 |
| York St John University | 21 | 31 | 28 | 40 | 63 | 695 | 878 |
| **Liverpool Region** | **887** | **871** | **635** | **246** | **1832** | **4392** | **8863** |
| Liverpool Hope University | 11 | 15 | 28 | 10 | 51 | 270 | 385 |
| Liverpool John Moores University | 280 | 162 | 186 | 47 | 611 | 1574 | 2860 |
| University of Liverpool | 596 | 694 | 421 | 189 | 1170 | 2548 | 5618 |
| **Manchester Region** | **2165** | **1795** | **1460** | **567** | **3863** | **9520** | **19370** |
| Manchester Business School, University of Manchester | 0 | 0 | 0 | 0 | 0 | 2 | 2 |
| Manchester Metropolitan University | 359 | 194 | 172 | 150 | 437 | 1616 | 2928 |
| University Of Bolton | 170 | 116 | 45 | 16 | 151 | 663 | 1161 |

| Universities | Advanced Manufacturing | Data driven health | Future mobility | Modern Services | Smart cities | Tech & Creative | Grand Total |
|---|---|---|---|---|---|---|---|
| University of Manchester | 1264 | 1104 | 950 | 327 | 2447 | 4845 | 10937 |
| University of Salford | 372 | 381 | 293 | 74 | 828 | 2394 | 4342 |
| **North East** | **1421** | **1092** | **1404** | **343** | **3072** | **7266** | **14598** |
| Newcastle University | 756 | 715 | 931 | 205 | 1830 | 3676 | 8113 |
| Northumbria University | 414 | 272 | 348 | 85 | 964 | 2058 | 4141 |
| University of Sunderland | 251 | 105 | 125 | 53 | 278 | 1532 | 2344 |
| **Oxfordshire** | **974** | **1164** | **1450** | **714** | **2383** | **6899** | **13584** |
| Oxford Brookes University | 129 | 125 | 223 | 32 | 392 | 1289 | 2190 |
| University of Oxford | 845 | 1039 | 1227 | 682 | 1991 | 5610 | 11394 |
| **Sheffield Region** | **979** | **688** | **543** | **89** | **1722** | **4684** | **8705** |
| Sheffield Hallam University | 526 | 386 | 266 | 62 | 829 | 2450 | 4519 |
| University Of Sheffield | 453 | 302 | 277 | 27 | 893 | 2234 | 4186 |
| **Tees Valley** | **314** | **176** | **159** | **28** | **484** | **1730** | **2891** |
| Teesside University | 314 | 176 | 159 | 28 | 484 | 1730 | 2891 |
| **Thames Valley Berkshire** | **367** | **297** | **427** | **128** | **1443** | **2648** | **5310** |
| University of Reading | 367 | 297 | 427 | 128 | 1443 | 2648 | 5310 |
| **West Midlands** | **2824** | **2600** | **3210** | **591** | **5533** | **15667** | **30425** |
| Arden University | 5 | 4 | 1 | 1 | 1 | 99 | 111 |
| Aston University | 463 | 343 | 336 | 38 | 889 | 2179 | 4248 |
| Birmingham City University | 171 | 167 | 105 | 42 | 332 | 1584 | 2401 |
| Coventry University | 518 | 257 | 648 | 76 | 791 | 2470 | 4760 |
| Newman University | 0 | 7 | 5 | 8 | 9 | 172 | 201 |
| University College Birmingham | 1 | 1 | 8 | 3 | 11 | 85 | 109 |
| University of Birmingham | 560 | 841 | 751 | 166 | 1379 | 2854 | 6551 |
| University of Warwick | 985 | 893 | 1287 | 210 | 1842 | 4543 | 9760 |
| University of Wolverhampton | 121 | 87 | 69 | 47 | 279 | 1681 | 2284 |
| **West Of England** | **1799** | **1266** | **1517** | **317** | **3641** | **8294** | **16834** |
| University of Bath | 919 | 481 | 817 | 60 | 1826 | 3001 | 7104 |
| University of Bristol | 615 | 609 | 398 | 148 | 1265 | 3302 | 6337 |
| University of the West of England | 265 | 176 | 302 | 109 | 550 | 1991 | 3393 |

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