THE
CONSULTANCY
REPORT

GLOBAL BRITAIN: A SCIENCE SUPERPOWER FOR A NEW ERA

SEPTEMBER 2022

Improved performance of institutions around the world represents progress and a great opportunity for collaboration, but it also threatens a change in status of the UK from a world leader to one among many.

The HE world is in a constant state of flux and the results from recent iterations of Times Higher Education's (THE) World University Rankings (WUR) demonstrate the potential for new institutions to gain prominence quickly. Some of the key stories from recent iterations of the WUR cover the rise of Chinese and Arab universities as well as those in other parts of the world like India, Brazil and Pakistan. The increase in prominence of these universities in our rankings reflect genuine improvements in terms of research excellence.

Within the world of science, this remains true. The UK has long seen itself as at the frontier of scientific research as well as academia. This status cannot be taken for granted however; the aforementioned improved performance of institutions around the world represents progress and opportunity for collaboration, but also threatens a change in status of the UK from a world leader to one among many.

One development within the UK that has been of note over the last 50 years has been the emergence of the Research and Innovation Cluster. The last 10 to 20 years in particular has proven to be fertile ground for the development of clusters, and although their role in driving innovation in the UK is often discussed, it is rarely placed within the broader context of the UK's status as a science superpower in the modern world.

For institutions in the UK to maintain their pre-eminence in scientific fields, they must be able to compete with new global research and innovation powerhouses. Can Britain maintain its position as a science superpower in this new era? Developments from the UK, from the Oxford-AstraZeneca COVID-19 vaccine onwards suggest that it maintains a foothold in the upper echelons of the scientific community.

With bold public-private coalitions helping to drive progress and at a time when our scientific institutions turn more and more towards clusters as a model for research and innovation, I am delighted to be introducing this report, which considers not just the role of clusters at a national level, but at an international level too.

Phil Baty
CHIEF KNOWLEDGE OFFICER
TIMES HIGHER EDUCATION

8,700

Since the first spin-out from the University of Edinburgh's research in 1967, staff and students at the university have founded over 8,700 companies

China has seen significant improvement in the science-related Subject Rankings between 2017 and 2022, with increases in terms of universities in the top 100 ranked universities in Physical Sciences (from 4 to 7), Life Sciences (from 1 to 5) and Computer Science (from 6 to 7)

CHINA STANDS AS THE KEY TREND IN TERMS OF INCREASED REPRESENTATION IN THE TOP 400 OF THE SUBJECT RANKINGS FOR LIFE SCIENCES BETWEEN 2017 AND 2022

Emerging superpowers in Physical Sciences, with dramatic increases from 2017 to 2022 in numbers of universities in the in top 400 in the Subject Ranking, include Pakistan and Saudi Arabia

£7 BILLION

Innovation Greater Manchester aims to create 100,000 jobs, generate £7 billion for the local economy and harness the educational institutions, talent and workforce in Greater Manchester

Emerging superpowers in Computer Science, with dramatic increases from 2017 to 2022 in numbers of universities in the top 400 in the Subject Ranking, include **DENMARK, SWITZERLAND, AND BRAZIL**

67,000

The Cambridge region has over 5,000 knowledge intensive firms, which employ 67,000 people, with particular strengths in Life Sciences and Computing, with over 30 science parks and strong international investment

THE UK has the second most institutions ranked in the top 100 in the science-related World University Rankings Subject Rankings for Computer Science (8), Life Sciences (13) and Physical Sciences (10),

Research and Innovation Clusters represent a key way for the UK to maintain its position as a world leader in science-related research and innovation

CAMBRIDGE has the highest number of patent applications per 1,000 residents of any area in the UK

INTRODUCTION

The position of the UK as a science superpower in the HE and industrial landscapes has, since at least the Industrial Revolution, long been assumed. Yet recent trends in international HE have seen the rise of new superpowers in terms of innovating in research and industry, with countries like China, Brazil, India and Saudi Arabia, amongst others, rising to prominence in scientific fields. The previous status of the UK as a leader in innovating in research and industry related to science has, of course, not been entirely diminished. The development of the Oxford-AstraZeneca COVID-19 vaccine has been widely lauded as an example of the power of British innovation in scientific fields, demonstrating a powerful collaboration between international private companies and the UK universities that have so long been seen as a jewel in the crown of the British knowledge economy.[1]

Despite this, in the face of increased competition from other nations, most notably China, the UK's status as a world leader is under some threat. Sir Keith Burnett, writing for Times Higher Education, noted that as public investment in research in the UK falls and it rises in China 'our edge can't last forever.'[2] Factors including the UK's struggle with productivity, Brexit, increased desire for other nations to develop themselves internally, rather than access existing knowledge bases abroad, have been noted as potential threats to the UK's position as a science and knowledge superpower.

Alongside these trends, however, sits the increasing importance of Research and Innovation Clusters to the UK knowledge and innovation economies. Clusters have developed in Cambridge, Manchester, Edinburgh, Belfast and Sheffield, amongst others, all tailored to the skillsets of the workforces and universities that are situated nearby. Many in the sector see the potential for a coalition between universities and private industry to be pointing the way towards the UK maintaining its competitive edge internationally. The Russell Group recently catalogued examples of these clusters in the UK relating to universities within the group and noted at least 20 existing or burgeoning clusters and linked this to the UK's levelling-up agenda.[3]

Many in the sector see the potential for a coalition between universities and private industry to be pointing the way towards the UK maintaining its competitive edge internationally.

This report therefore considers the role of the UK in the scientific research and innovation world before examining the position of Research and Innovation Clusters within this. To consider the status of UK HE within world academia, the performance of UK institutions within Times Higher Education's science-related Subject Rankings is used to view trends and the emergence of competing powerhouses. This is then followed by a definition of Research and Innovation Clusters and three case studies focusing on Cambridge, Edinburgh and Greater Manchester to understand the impact of the development of these clusters for UK academia, innovation and industry. This is followed by a synthesis of these ideas in which consideration is given to how this may affect the trends outlined and to understand the UK's status as a science superpower in the modern world as well as how clusters relate to this status in the present and future.

Factors including the UK's struggle with productivity, Brexit, increased desire for other nations to develop themselves internally, rather than access existing knowledge bases abroad, have been noted as potential threats to the UK's position as a science and knowledge superpower.

[1] Pascal Soriot, Richart Hatchett, Seth Berkley (2021), 'Public-private alliance drives historic vaccination programme', World Economic Forum [accessed August 2022]

[2] Sir Keith Burnett (2018), 'I see an academic empire rising in China, and the West should take note', Times Higher Education [accessed August 2022]

[3] Russell Group (2021), 'Levelling-up through regional innovation clusters', Russell Group [Accessed August 2022], pp. 3-4

PERFORMANCE OF UK UNIVERSITIES IN THE WORLD UNIVERSITY RANKINGS

There are 101 UK universities ranked in the World University Rankings (WUR) 2022 out of the 1,662 institutions which submitted data for the rankings and met the inclusion criteria. The rank given to universities in the WUR correlates to an overall score, which is derived from 13 metrics that measure an institution's performance across teaching, research, knowledge transfer and international outlook.

Figure 1 shows the change in the number of universities which were included in the three science-based Subject Rankings in WURs from 2017 to 2020: Computer Science, Life Sciences and Physical Sciences. These subject areas are used throughout this report to analyse UK universities' strengths in science areas.

Ranking for the subject of Computer Science began in 2017, with 453 universities participating in the inaugural ranking, rising by 77% to 891 in 2022. The number of institutions ranked within the Computer Science Subject Rankings almost doubled over the same period, with the number of universities qualifying for inclusion into WUR increasing by 97% from 2017 to 2022. The Life Sciences Subject Rankings also increased, although by a smaller amount (69% increase from 2017 to 2022).

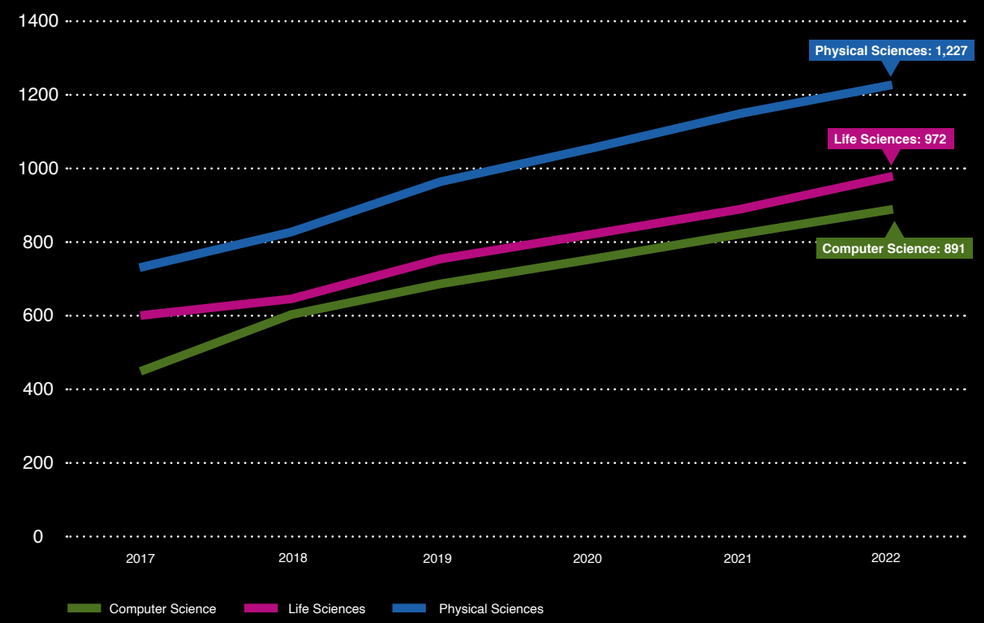
The performance of UK universities in each of the Subject Rankings, as well as at the overall level, is displayed in Figure 2. Overall, UK institutions outperform their overall ranks in subject areas such as Law and Arts and Humanities, indicating that this is an area of relative strength for the UK. The highest number of UK universities ranked within the top 100 in any of the Subject Rankings are within the Law subject Rankings (22) and the Arts and Humanities Subject Rankings (21).

In the Life Sciences Subject Rankings, there are 2 more UK institutions included in the top 100 of this Subject Rankings (13) than at the overall level (11). In the Physical Sciences Subject Rankings, 10 UK universities are ranked in the top 100, in comparison to the 11 UK universities in the overall ranking, making performance broadly comparable to the overall level. On the other hand, UK universities underperform in the Computer Science subject area, in which only 8 UK institutions are ranked within the top 100; the joint lowest number out of all the subject areas (alongside Engineering).

In the section that follows, analysis will be conducted to consider high performance of universities in each of the subject specific rankings that relate to sciences. High performance is indicated in these sections by considering the number of institutions within the UK ranking in the top 100 for each of these subject rankings.

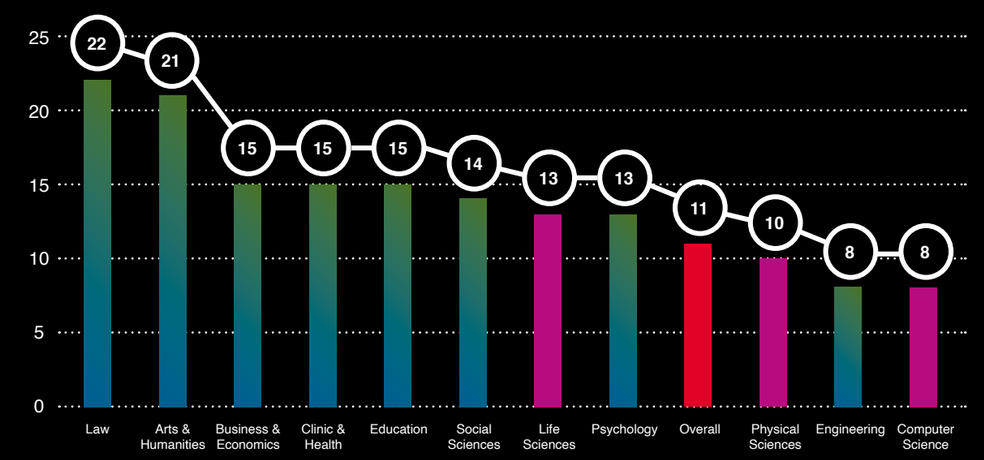
UNIVERSITIES PARTICIPATING IN SCIENCE-BASED SUBJECT RANKINGS OVER TIME

Figure 1



NUMBER OF UK INSTITUTIONS WITHIN THE TOP 100 OF THE SUBJECT RANKINGS IN WUR 2022

Figure 2



OVERALL NUMBERS RANKED IN THE WORLD UNIVERSITY RANKINGS AND SCIENCE-BASED SUBJECT RANKINGS

Figure 3 shows the number of UK institutions which were included in the top 100 best performing universities in the science-based Subject Rankings from WUR 2017 to WUR 2022. As a point of comparison, UK universities' overall performances are given as well as in the Arts and Humanities subject area, which was the highest performing subject area for UK universities since 2017 (Law was first included as a subject ranking in the WUR in 2019).

The greatest change in terms of number of institutions in the top 100 over time came within the Computer Science Subject Rankings, with a drop from 12 in 2017 to 8 in 2022. In the Life Sciences Subject Rankings, the number of UK institutions placing in the top 100 dropped by 3 universities between 2017 and 2022. Within the Physical Sciences Subject Rankings there is only 1 fewer UK university in 2022 in comparison to 2017.

Comparatively, UK institutions' overall performances remained fairly constant, where there was only a decrease of 1 university in the top 100 from WUR 2017 to WUR 2022. This is a smaller proportional drop compared to the Life Sciences and Computer Science Subject Rankings, showing that within these subject areas UK institutions are either performing worse in the rankings or are being out-competed by universities in other countries.

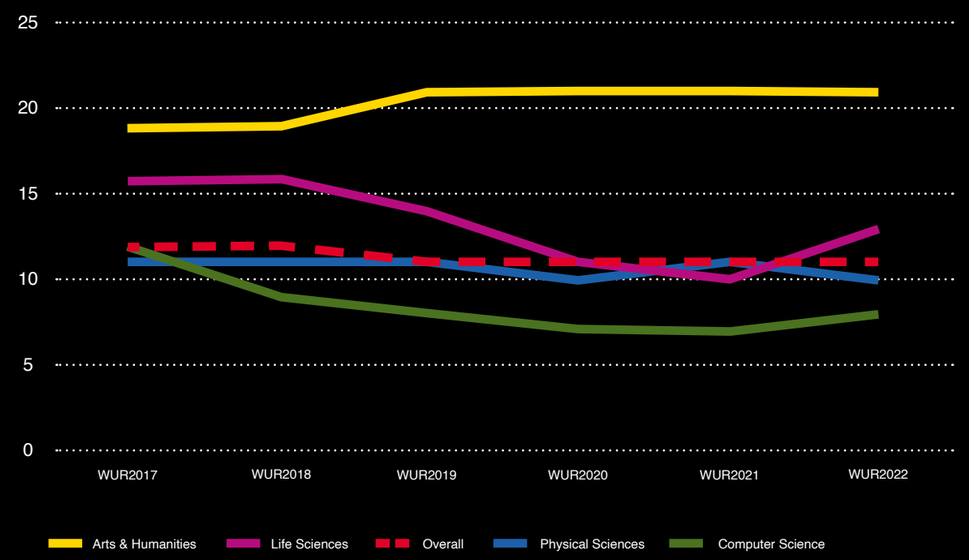
When looking at the Arts and Humanities Subject Rankings, UK institutions performed better in this area in comparison to science-based subjects. In total, 2 more UK institutions reached the top 100 in the Arts and Humanities Subject Rankings from 2017 to 2022.

Overall, the number of universities included in the Life Sciences Subject Rankings increased by 64% from 2017 to 2022, the Physical Sciences Subject Rankings increased by 68%, and the Computer Science Subject Rankings increased by 97%. There was a comparatively smaller increase in the Arts and Humanities Subject Rankings of 37% from 2017 to 2022.

With more universities ranked within a Subject Rankings, it naturally becomes more competitive for institutions to either reach or maintain their place in the rankings. Accordingly, a decrease in the number of UK institutions over time in the top 100 of science-based subject rankings does not necessarily reflect a decline in quality among UK institutions, as they may have been replaced in the top 100 by newly ranked institutions. Nevertheless, this does demonstrate that since 2017, UK institutions are not maintaining their competitive edge at the very top of the Subject Rankings in science-based subject areas. The following section will consider some international trends in terms of high performance in science-based subject areas to consider emerging powerhouses at a national level in these subject areas.

NUMBER OF UK INSTITUTIONS RANKED IN THE TOP 100 OF SCIENCE-BASED SUBJECT RANKINGS OVER TIME

Figure 3



INTERNATIONAL BENCHMARKING OF THE PERFORMANCE OF THE UK

The US has the largest number of institutions ranked within the top 100 universities for each science-related Subject Rankings. In WUR 2022, 36 US institutions are ranked in the Life Sciences Subject Ranking and 35 in the Physical Sciences and Computer Science Subject Rankings. Although, at the overall level, there are 38 US institutions in the top 100 of WUR 2022. Accordingly, US institutions underperform in the Science-based Subject Rankings, in comparison to their overall performance indicating that other subject areas may be a greater area of strength. In the US, the most significant change since 2017 is in the field of Computer Science, where the number of universities ranked in the top 100 has risen from 25 in 2017 to 35 in 2022. Since 2017, the US has improved performance in Computer Science over time, in comparison to the UK which has experienced a drop in performance.

China is an example of a nation that has seen sustained improvements in science related disciplines in WUR, in terms of the high performance of institutions. Since 2017, there has been an increase from 2 universities in the top 100 of the overall ranking to 6 in 2022. Within science-related Subject Rankings, there have been similar increases for Physical Sciences (increasing from 4 to 7) and Life Sciences (increasing from 1 to 5), while there has been a more modest increase for Computer Science (increasing from 6 to 7). With the number of participating Chinese based universities in WUR increasing from 38 to 80 for Computer Science, 24 to 58 for Life Sciences and 46 to 82 for Physical Sciences from 2016 to 2022, China is also one of the fastest growing countries in all three fields of science. The emergence of China as a leader in science-related disciplines is a key trend when looking at data emerging from the WUR.

Germany is a traditionally high performing nation in science-based subjects in WUR. Like the UK, Germany has in some fields lost some element of its competitive advantage within science-related Subject Rankings. Again, taking top 100 placing as a sign of strong performance, Germany has seen a drop at the overall level (from 9 in 2017 to 7 in 2022) as well as within Computer Science (from 11 in 2017 to 7 in 2022). This has been offset somewhat by modest increases in Physical Sciences (from 9 in 2017 to 10 in 2022) and Life Sciences (from 8 in 2017 to 10 in 2022).

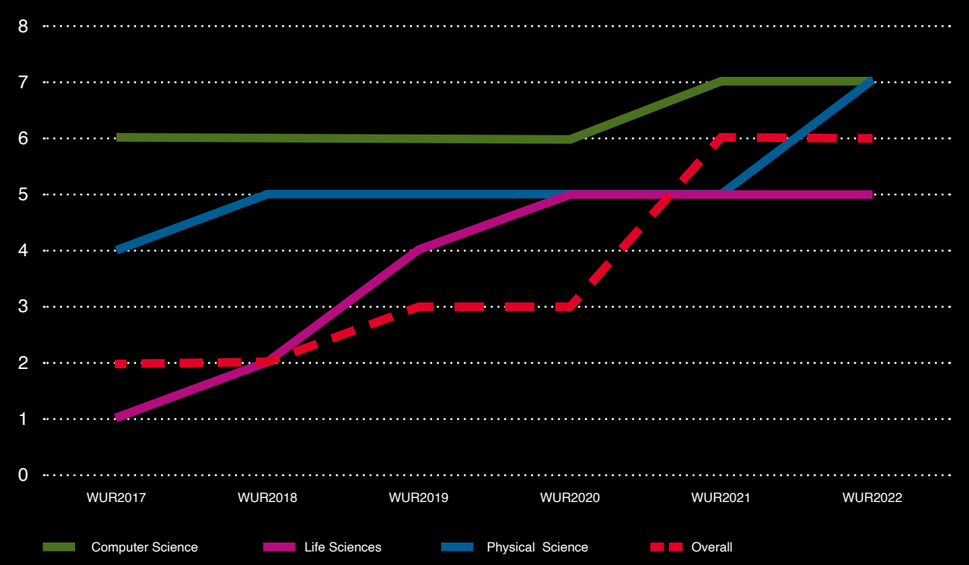
There are also several emerging powerhouses within science-related Subject Rankings, which can be best tracked when considering the number of institutions placing within the top 400 universities to broaden the definition of high performance. Utilising this lens, a few key trends emerge within Computer Science in particular, with increases between 2017 and 2022 for Denmark (from 1 to 5), Switzerland (from 2 to 7) and Brazil (from 9 to 18). In Physical Sciences, Pakistan (from 1 to 7) and Saudi Arabia (from 1 to 5) stand out as emerging powerhouses. Finally, for Life Sciences, there are fewer clear trends, although China represents

a marked increase in terms of numbers placing in the top 400 between 2017 and 2022 with an increase of 14 (from 13 to 27), as it also does for Computer Science (6 to 31) and Physical Sciences (from 14 to 27).

China is a notable example of an emerging powerhouse, with the number of top 100 institutions in each of these rankings and at the overall level shown in Figure 4. For UK institutions to maintain their competitive edge in the face of these emerging markets and nations that are demonstrating strengths in these subjects will require careful planning and strategic investment plans. Subsequent sections of this report will consider pockets of regional strength and the emergence of Research and Innovation Clusters within the UK, as well as what this may mean for the UK HE sector within science-related subjects.

NUMBER OF CHINESE INSTITUTIONS WITHIN THE TOP 100 OF THE SCIENCE-BASED SUBJECT RANKINGS AND OVERALL RANKINGS OVER TIME

Figure 4



REGIONAL ANALYSIS IN THE UK: WUR PERFORMANCE

Figure 5 shows the number of UK universities which are in the top 400 best performing universities in WUR 2022 for each science-based Subject Rankings by each region in the UK. Scotland, the South East and London have the highest number of universities in each Subject Rankings totalling 18 universities.

Scotland has the highest number of universities in the Physical Sciences subject area (8), followed by the South East (7), and then London (6). Scotland also has the highest number of universities in the Life Sciences subject area (7) followed by the South East (7) and London (6). Lastly, both London and the North West have the highest number of universities in the Computer Science Subject Rankings (6), followed by the East Midlands (5).

Figure 6 shows the change over time in the culminative number of universities that were ranked in the top 400 of the science-based Subject Rankings, from 2017 to 2022. The overall growth in universities ranked in the top 400 over this time shows that while the UK as a whole has reduced its number of universities ranked in the top 100, when this is broadened to include the top 400, their performance improves.

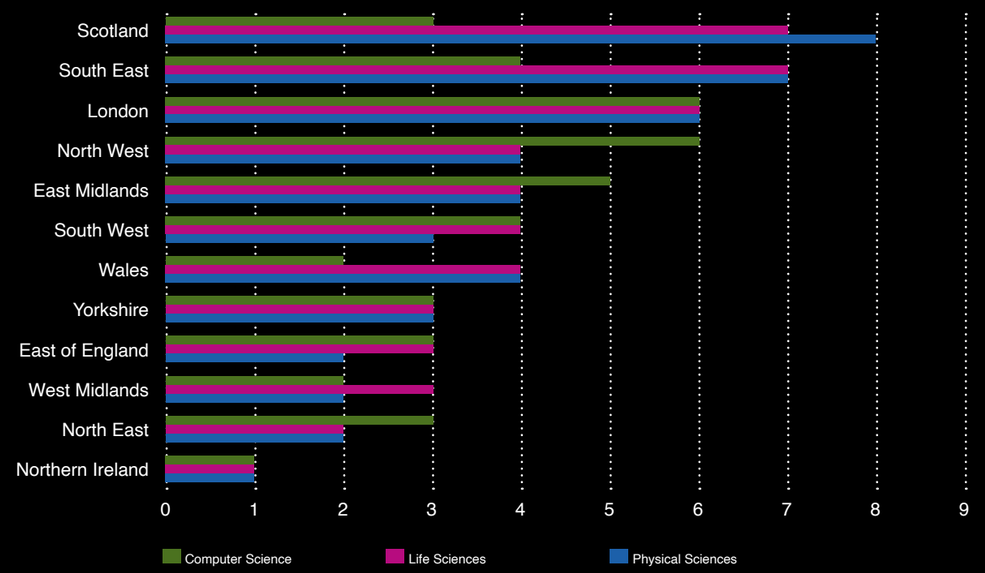
Scotland, London and the North West region experienced the greatest positive change with 4 more universities being included in the top 400 of the science-based subject rankings in WUR 2022 in comparison to WUR 2017. Notably out of those universities, the North West experienced the greatest percentage change of 40%, in comparison to 29% in London and Scotland. A small number of regions saw drops of one university ranking in the top 400 places (the South West, Yorkshire, Northern Ireland and the North East).

These regional pockets of excellence are increasingly being harnessed as part of the burgeoning industry of Research and Innovation Clusters in the UK. The following sections of this report will consider the definition of these clusters before looking at some case studies of existing and embryonic clusters within the UK to examine their impact upon research and innovation at a regional and national level.

These regional pockets of excellence are increasingly being harnessed as part of the burgeoning industry of Research and Innovation Clusters in the UK.

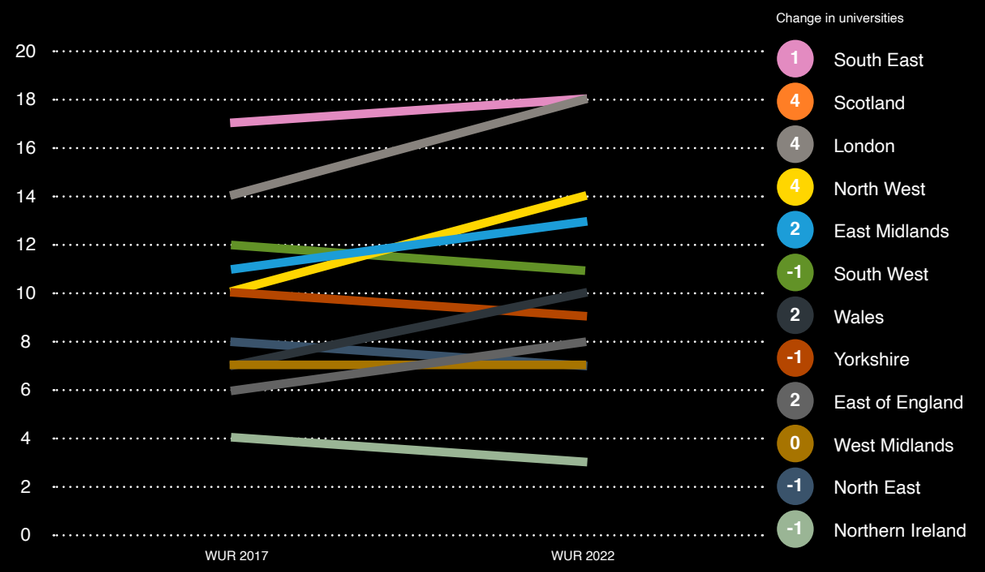
NUMBER OF UK INSTITUTIONS IN THE TOP 400 OF THE 2022 SCIENCE-BASED SUBJECT RANKINGS BY UK REGION

Figure 5



NUMBER OF UK UNIVERSITIES WITHIN THE TOP 400 OF SCIENCE-BASED SUBJECT RANKINGS OVER TIME

Figure 6



DEFINING RESEARCH AND INNOVATION CLUSTERS

A standard definition of a Research and Innovation cluster is 'an agglomeration of related business and organisations, in geographic proximity, which benefit from co-localisation and collaboration'.[4] The UK government have further defined a cluster as 'a concentration of competing, collaborating and interdependent companies and institutions which are connected by a system of market and non-market links.' [5]

Although there is not a single definition, there are common elements in various definitions.[6] These include: competition and collaboration between bodies, geographic location, as well as professional and intellectual networking. They can include both private companies as well as universities, colleges, research centres and funders, and financial and investment institutions. For the purposes of this report, all Research and Innovation Clusters discussed will be centred around an existing university or system of universities, showcasing collaboration between these institutions and the private and public enterprises in their localities.

A definition provided in Climate Exchange also added that while geographic proximity is a key element of a cluster, they are not defined solely by geography, stating that they 'are not simply an agglomeration of actors from similar industrial sectors in a concentrated geographic area.'[7] Instead, there is also 'a need for strong social links between research institutes, suppliers, manufacturers, trade groups and government.'[8] This definition highlighted the need for clusters to be situated within areas of high skilled workforces and be suited to the specific skills of the labour market in their particular areas.

A group of researchers at the Multimedia University of Malaysia highlighted that there lacks a single, unified definition for clusters, but observed similarities across existing definitions: definitions of clusters tend to be 'spatial-based, industrial sector-based, and measured variables-based.'[9] The definition that will be utilised throughout this report draws on all of these elements, and may be succinctly summarised as seeing clusters as a concentration of skills based industrial bodies and companies that are geographically centred around a knowledge intensive university or multiple universities that seek to harness workforce specialisms to drive forward economic growth, innovation and research.

GLOBAL BRITAIN:
A SCIENCE SUPERPOWER FOR A NEW ERA

SECTION 2

> **All Research and Innovation Clusters discussed will be centred around an existing university or system of universities, showcasing collaboration between these institutions and the private and public enterprises in their localities.**

[4] Gudrun Jaegersberg and Jenny Ure (2017), Renewable energy clusters: recurring barriers to cluster development in eleven countries, p.13

[5] Department of Trade and Industry (1998), 'Our competitive future: Building the knowledge driven economy, p. 22

[6] Kamarulzaman Ab. Aziz, Stanley Richardson, Nor Azlina Ab. Aziz (2011), 'Cluster Lifecycle: A case study of the Glasgow-Edinburgh Corridor', International Conference on Management and Artificial Intelligence, p. 159

[7] Kyle Parker, Mark Winskel, and Niall Kerr (2021), 'Industrial Strategy in Scotland: A review of cluster-based initiatives', Climate Exchange, pp. 1

[8] ibid.

[9] Kamarulzaman Ab. Aziz, Stanley Richardson, Nor Azlina Ab. Aziz (2011), 'Cluster Lifecycle: A case study of the Glasgow-Edinburgh Corridor', International Conference on Management and Artificial Intelligence, p. 159

CAMBRIDGE RESEARCH AND INNOVATION CLUSTER

The 'Cambridge Phenomenon', coined by the Financial Times in 1980, referred to the cluster of high tech companies operating within Cambridge,[10] and now describes its successful expansion into becoming Europe's largest technology cluster.[11] Starting in 1960 with Cambridge Consultants, which aimed to increase university based researchers' contributions to British industry, the cluster expanded after the establishment of the Cambridge Science Park in 1970.[12] Now, the Cambridge region has over 5,000 knowledge intensive firms, with particular strengths in Life Sciences and Computing,[13] boasts over 30 science parks, and has attracted world leading companies such as Apple, Huawei and AstraZeneca to open offices and facilities within the area.[14]

The University of Cambridge has been integral to the success of the cluster, initially driving its expansion in the 1970s with the opening of the Cambridge Science Park by Trinity College.[15] The university provides the region with the skills and talents of researchers and fresh graduates, with numerous examples of university representatives creating spin out companies and start-ups from the university's academic research.[16] One university spin out is Solexa which was started by two university professors in 1997, became a public company in 2005 with the help of private and university investment, was acquired in 2007 for $650 million by Illumina, and now delivers 'population scale human genome sequencing as well as large-scale clinical sequencing.'[17]

Cambridge Enterprise, the university's commercialisation group, has provided consultancy activities and enabled companies to protect and license their ideas.[18] Currently, more than 1,000 intellectual property licensing, equity and consultancy contracts are managed by Cambridge Enterprise,[19] and Cambridge has the highest number of patent applications per 1,000 residents of any area in the UK.[20]

"The cutting-edge nature of the research produced within the cluster has additionally secured a stream of investment from national and international firms.

The cutting-edge nature of the research produced within the cluster has additionally secured a stream of investment from national and international firms. Nationally, for example, Cambridge Angels, a leading business angel network of more than 60 investors, has founded a 'large number of the "Cambridge Phenomenon" success stories', for example, Abcam and Alphamosaic.[21] The cluster has also attracted investment from international investment firms, such as Amadeus Capital Partners, New Enterprise Associates and Oak Investment Partners, as well as international technology firms such as Huawei, Citrix and Toshiba.[22]

Leading international companies have opened offices and facilities within the region, covering a range of industries. In 2018, Huawei bought 500 acres of land in Cambridge with plans to open a new state of the art facility, focusing on the research, development, and manufacturing of optoelectronics products. Another example of such investments is AstraZeneca, which moved its global research and development campus to Cambridge in 2016. The Discovery Centre, which opened in 2021 with a total cost of £1 billion,[23] is 'designed to play a central role in AstraZeneca's mission to deliver life-changing medicines to patients and employs 'more than 2,000 people working across therapy areas and drug discovery and development once fully occupied'.[24] These types of investment reflect the expectation that the cluster will continue to grow, increasing job opportunities within the region, and contributing to the UK's wider economy while producing life-changing technologies for the world.[25]

As of 2022, the Greater Cambridge area has over 27,093 companies with a total turnover of £47 billion and 271,837 employees. There are over 5,000 knowledge intensive institutions, which employ 67,000 people with an average turnover of £18 billion.[26] The importance of knowledge intensive industries in enabling Cambridge to be resilient to economic shock waves during the pandemic is a particular point of success for the cluster.[27] In the period 2020/21, the Greater Cambridge area showed a positive growth in new jobs of 3.1%, whilst the UK saw an average decline in employment of 1.7%.[28] In Cambridge, employment in the Life Sciences Cluster and the Information Technology and Telecommunications Cluster grew by 10.3% and 6.9% respectively in 2020/21, compared to 0.2% net growth across all non-knowledge intensive industries.[29]

The 'Cambridge Phenomenon' is an example of a successfully established cluster which has an international reach. The University of Cambridge has been crucial to the success of the cluster from its investments to supplying the cluster with a talented work force. The cluster illustrates the opportunities that knowledge intensive industries can offer to cities and towns in the way of creating economic prosperity and job opportunities, and driving innovation.[30]

[10] Peta Levi (1980), 'Flourishing in the Cambridge parkland', Financial Times [Accessed August 2022]

[11] The University of Cambridge 'The Cambridge Cluster' [Accessed August 2022]

[12] The Royal Society (2020), 'Research and innovation clusters' Policy Briefing [Accessed August 2022], pp. 16-18

[13] Russel Group 'Levelling-up through regional innovation clusters' [Accessed August 2022]

[14] Giorgio Caselli, Andy Cosh, Peter Tyler (2021), 'The Cambridge Phenomenon; An Innovation System Built on Public Private Partnership' [Accessed August 2022]

[15] The University of Cambridge 'The Cambridge Cluster' [Accessed August 2022]

[16] Giorgio Caselli, Andy Cosh, Peter Tyler (2021), 'The Cambridge Phenomenon; An Innovation System Built on Public Private Partnership' [Accessed August 2022]

[17] The University of Cambridge 'The Cambridge Cluster' [Accessed August 2022]

[18] ibid.

[19] ibid.

[20] The University of Cambridge (2021), 'University of Cambridge launches roadmap to support future growth of life sciences cluster' [Accessed August 2022]

[21] Cambridge Angels 'Cambridge Angels Founded Companies' [Accessed August 2022]

[22] Giorgio Caselli, Andy Cosh, Peter Tyler (2021), 'The Cambridge Phenomenon; An Innovation System Built on Public Private Partnership' [Accessed August 2022]

[23] AstraZeneca (2021), 'AstraZeneca unveils The Discovery Centre (DISC) in Cambridge' [Accessed August 2022]

[24] AstraZeneca 'AstraZeneca in Cambridge' [Accessed August 2022]

[25] The Royal Society (2020), 'Research and innovation clusters' Policy Briefing [Accessed August 2022], pp. 16-18

[26] The University of Cambridge (2021), 'University of Cambridge launches roadmap to support future growth of life sciences cluster' [Accessed August 2022]

[27] Cambridge Network (2022), 'Science and Innovation sectors in Cambridge drive growth in regional employment despite pandemic turbulence') [Accessed August 2022]

[28] ibid.

[29] ibid.

[30] ibid.

EDINBURGH RESEARCH AND INNOVATION CLUSTER

The University of Edinburgh is one of the top research intensive universities in the world, ranking 4th in the UK for quality and breadth of research impact, and is the highest ranked university in Scotland. Since, the first spin out from the University of Edinburgh's research in 1967, the university's staff and students have founded over 8,700 companies.[31] The University's recent graduates solidified their entrepreneurial reputation in 2021 by founding 100 companies in the space of a year, the highest number out of the 24 leading Russell Group universities.[32] The City of Edinburgh is also home to Heriot Watt University, Edinburgh Napier University, Queen Mary University, Royal College of Surgeons and Scotland's Rural College.

Alongside this strong academic base, Edinburgh has a history of attracting major foreign direct investment and multiple industry leading companies have started in the Capital.[33] The corridor between Glasgow and Edinburgh, which includes the city of Edinburgh, was nicknamed Silicon Glen in the 1980's for producing '30% of Europe's PCs, 80% of its work stations and 65% of its ATMs.'[34] After the Scottish government's re-focus in the early 2000's to grow an innovation rather than manufacturing cluster,[35] Edinburgh has become a hub for environmental and energy technology as well as data science.[36]

The University of Edinburgh's commercialisation service, Edinburgh Innovations, bridges the gap between the university's research and the private sector. Its main function is to facilitate the university's engagement with industry and, through this, has helped the university's staff and students to commercialise their ideas by creating new companies. A recent success story is the development of the new Centre for Investing Innovations, where the University of Edinburgh, supported by Edinburgh Innovations, partnered with Abrdn plc. The company pledged £7.5 million in investment to build the centre at the University's Future Institute, with the aim of tackling critical challenges facing society.[37]

Currently, approximately 8,000 people are either employed or study at Edinburgh BioQuarter.

There are various sites within Edinburgh that make up the research cluster. Notable centres include the University of Edinburgh's Bayes Centre for Data Science which opened in 2018 and has been integral to the development of a high tech cluster. It has attracted over 50 corporate research and development teams, 15 high growth ventures, £90 million in external investment, and has created 372 high value jobs as well as an additional 117 indirect jobs.[38] Another site, Edinburgh BioQuarter, is a concentration of companies and research institutes which specialise in biosciences. Currently, approximately 8,000 people are either employed or study at the site and it generates £280 million in gross value added per year.[39] Since the announcement of the site in 2007, it has become the 'third largest bioscience community' behind Cambridge and Newcastle Helix,[40] and has Europe's largest concentration of stem cell scientists.[41]

The geographic growth of the cluster seems likely with ambitious plans for its future expansion, such as Queen Margret University's and East Lothian Council's recent announcement to build Edinburgh Innovation Park, which will receive £30 million in government funding.[42,43] Upon its completion, with building work starting in 2023, the park will combine academia and regional expertise in food, drink and health sciences.[44]

The cluster has a strong history of attracting investment from international companies; it currently attracts more foreign investment than any other tech cluster in the UK outside of London.[45] In 2022, the American based company, Motorola Solutions, opened offices in Edinburgh, which will create video security and evidence management solutions for emergency services globally, whilst also generating employment and commercial opportunities in Scotland.[46] In addition, in 2018, Huawei in partnership with the University of Edinburgh opened a joint laboratory which will 'investigate scientific and engineering research challenges relevant to academia and industry'.[47]
As a relatively new innovation cluster, Edinburgh is quickly catching up with established hubs such as London and Cambridge;[48] and is arguably fast becoming 'the best location for tech companies in the UK, with the exception of London and perhaps Cambridge.'[49] Although there are future plans for its expansion, the cluster has not become an established global innovation hub,[50] rather it is currently at a 'tipping point' from which it looks set to become one.[51] The Scottish Government has stated that the international reach of the hub must be a focal point if it is to successfully establish itself, making international investment alongside the support of universities' infrastructures crucial to the longevity of the cluster.[52]

[31] Scottish Financial News (2021), 'Edinburgh students launch 100 start-ups in a year' [Accessed August 2022]

[32] ibid.

[33] ScotlandIs (2021) 'Did You Know that Scotland Is a Tech Hotspot? Introducing Silicon Glen!' [Accessed August 2022]

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[43] Ken Symon 'Edinburgh Innovation Park, set to go ahead' (2018) Insider [Accessed August 2022]

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[51] Scottish Government (2020), 'Scottish Technology Ecosystem: Review' [Accessed August 2022]

[52] ibid

MANCHESTER: HARNESSING A BURGEONING HUB

The Research and Innovation Cluster in Manchester comprises a vast series of interlinking plans that covers more than just the city of Manchester, spreading across the region of Greater Manchester. Perhaps the most ambitious of these plans is the project Innovation Greater Manchester which aims to create 100,000 jobs, generate £7 billion for the economy and harness the educational institutions, talent and workforce located in Greater Manchester. As part of the development of this cluster in Manchester, there are, amongst others, the following plans:

■ Salford Crescent: a £2.5 billion proposal that aims to create, 1.6 million square footage of new commercial floorspace, 1.1 million square footage of new educational floorspace which is centred around the University of Salford's existing campus with learning and innovation at the heart of its strategy.[53]

■ I-D Manchester: a £1.5 billion project headed by the University of Manchester and delivered in partnership with Bruntwood SciTech and Legal & General. I-D Manchester aims to be an innovation district where businesses can be located near to other similar businesses, harness the workforce and transport links in Greater Manchester, and utilise the expertise among the teaching and student bodies at the University of Manchester.[54] The project aims to continue the history of the University of Manchester in stimulating business growth, with their official literature highlighting the University's history of commercialisation through its more than 100 spin-out companies.[55]

■ The Advanced Machinery and Productivity Institute: an industry led project, set up in Rochdale by local businesses that harnesses the university strengths in the area including the University of Huddersfield, the University of Manchester, the University of Salford, the University of Leeds as well as other regional education and training providers. The project aims to "drive innovation for the UK's advanced machinery manufacturers to meet the challenges of developing new technology and entering emerging markets."[56]

■ Skills Capital – Wigan and Leigh College Digital Skills Academy: a project that seeks to address local digital skills shortages, providing an Internet of Things Laboratory and a Cyber Security and Digital Technologies Laboratory.

Many investments are deliberately situated alongside existing industries, research specialities and skillsets that are already flourishing.

■ Innovation Accelerator: administered by Innovation Greater Manchester, this enables access to a national £100 million fund created by the UK Government to drive innovation by providing funding to businesses in four key areas: advanced materials and advanced manufacturing, digital and creative, health innovation and life sciences, and net zero.

The scope of these projects showcases the way that research and innovation clusters can harness numerous sources of funding, talent and ideas to drive growth in a region. All of these elements combine the resources of universities, local businesses, national and international businesses, local government and national level governments to drive innovation, research and growth. As these co-operative initiatives between universities and private and governmental bodies become more common, it is useful to consider the types of investment that drive success and the ways that these initiatives harness the strengths of their specific locations to do so.

Many of the investments that are being overseen by the Greater Manchester Local Enterprise Partnership (GMLEP) are deliberately situated alongside existing industries, research specialities and skillsets that are already flourishing. One example of attempts to harmonise investments with existing developments is Manchester Metropolitan' University's School of Digital Arts (SODA), which received £14.9 million of grant funding from the Local Growth Fund Programme, supported by the Greater Manchester Combined Authority and the GMLEP as part of Innovation Greater Manchester's overall programme of works. SODA aims to train students in a way that allows them to create creative content and is justified at least part by its status as helping to serve the needs of MediaCityUK, the BBC and ITV and a more general creative scene in Greater Manchester.[57]

Similarly, the University of Manchester have specifically pitched ID Manchester as something that harnesses local infrastructure as much as it drives it. While placing the project at the centre of the UK Government's levelling up agenda, the university highlighted that the project will be "adjacent to Piccadilly Railway Station, the University of Manchester campus, and the existing innovation ecosystem clustered around Oxford Road, part of the largest clinical academic campus in Europe."[58]

The clusters that are forming in Manchester represent profound developments for research and innovation, economic progress and for the upskilling of the region. The elements of a research and innovation cluster that drive success across multiple different regions are often fairly consistent, albeit being based upon different research specialities.These commonalities will be outlined in the following chapter.

[53] Crescent Salford (2021), 'Development Framework' [Accessed August 2022]

[54] The University of Manchester (2021), 'Innovation GM provides £7bn blueprint to create 100,000 jobs, boost R&D investment and level up the North' [Accessed August 2022]

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[56] AMPI, 'About AMPI' [Accessed August 2022]

[57] Greater Manchester Local Enterprise Partnership (2022), 'Local Growth Fund: Manchester Metropolitan University's School of Digital Arts (SODA)' [Accessed August 2022]

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FEATURES OF A SUCCESSFUL RESEARCH AND INNOVATION CLUSTER AND OPPORTUNITIES IN THE UK

Each of the Research and Innovation Clusters considered so far hinge around a successful partnership between existing universities and education or research centres and external influences like private businesses, investment funds and local and national government. When these actors drive clusters forwards in unison there can be very powerful results emanating from the clusters that form. The manner in which the Cambridge Research and Innovation Cluster has harnessed and galvanised local skills specialisms to drive forwards economic growth, research and innovation has been much discussed. Yet the results of the Edinburgh Research and Innovation Cluster and the existing and forthcoming clusters in Greater Manchester demonstrate that this is not an exclusively Cambridge-based phenomenon.

From the Advanced Manufacturing Research Centre, utilising the historic links in Sheffield to manufacturing and engineering companies and skills to the clusters appearing in Belfast that harness historic skill bases in Electronics, Communications and Information Technology, it is clear that the potential for effective formation of Clusters in UK cities is nascent.[59] Some of these clusters have led to highly successful private enterprises and spin-outs, including in Bristol's Science Creates incubator, which helped to establish Ziylo which was sold 'in a deal potentially worth US$800m.'[60] Research and Innovation Clusters, as has been shown, can help to drive employment, increase skills and produce innovations that can be very lucrative for individuals and communities that benefit from the clusters.

Highly productive clusters that harness the research and innovation excellence of universities and turbo-charge their development through local, national and international investment from private and public entities could be a way for the UK to re-sharpen its competitive advantage in elite scientific fields.

All of this is set against the backdrop of increased competition globally at the cutting edge of science in the HE and commercial spheres. As has been shown previously, the rise of new superpowers in the science world can be demonstrated through performance in the science-related Subject Rankings produced by Times Higher Education. In the face of this competition, highly productive clusters that harness the research and innovation excellence of universities and turbo-charge their development through local, national and international investment from private and public entities could be a way for the UK to re-sharpen its competitive advantage in elite scientific fields.

The success enjoyed by local economies and communities that stems from Research and Innovation Clusters would not be possible without the universities and educational institutions that anchor them, from the University of Cambridge, through the University of Edinburgh, the University of Manchester and Wigan and Leigh College. Yet all of this would not be possible without the public-private co-operation that has seen companies including Huawei, Brunwood SciTech, Legal & General, Roku and Toshiba invest in these clusters. It should not be overlooked that it was such a public-private coalition that helped the development of the Oxford-AstraZeneca COVID-19 vaccine, which has helped maintain the UK's vaccine and pharmacology industry's international significance and changed the lives of millions around the world.

It must be noted therefore that the UK stands well placed to benefit from its numerous outstanding institutions in scientific fields. Scotland, the South East, London, the North West and the East Midlands may lead the way in terms of high performance in the science-related Subject Rankings, yet it is a feature of the UK HE sector that excellence abounds across geographies. Harnessing localised talent in the workforce, pulling in international investment from private companies and encouraging government investment to create more productive clusters may be one key strand in ensuring that the UK remains at the forefront of research and innovation in science-related fields.

[59] Russell Group (2021), 'Levelling-up through regional innovation clusters', Russell Group [Accessed August 2022], pp.2-3

[60] Ibid., pp. 3.

CONCLUSIONS

The UK remains very competitive in terms of research in scientific fields. Its status is ensured through the world leading universities that exist in the UK, with the UK having the second most institutions ranked in the top 100 for Computer Science (8), Life Sciences (13) and Physical Sciences (10, joint with Germany), each time behind the USA. Yet this status is under threat to some degree from competition in emerging markets, and in each case the UK has fewer universities ranked in the top 100 for science-related Subject Rankings than it did in 2017.

The UK is, however, well situated to take advantage of the emerging trend of Research and Innovation Cluster development. Some of the UK's most successful public-private scientific enterprises in recent years have stemmed from such clusters. Harnessing the UK's historic strength in the HE sector, and the agglomeration of talented researchers and graduates that comes with this, should be a priority for the UK. This is magnified by the UK Government's levelling-up agenda, with the UK having rare status as a country with world-leading universities in every region and in the majority of cities too.

Clusters therefore seem to point the way to some degree regarding the future of UK scientific research and innovation. While emerging markets like China, Saudi Arabia and India are benefiting from large-scale public investment in their universities, the UK is well situated to take advantage of historic concentrations of skills in scientific areas. The success of clusters in Cambridge, Edinburgh and Greater Manchester demonstrates how the investment drawn from private companies locally, nationally and internationally can bring world-leading results in terms of economic development and in terms of the results of scientific research and innovation.

Galvanising UK productivity in scientific fields should be a priority. The results of the partnership between universities, local and national government and private companies like Huawei, Toshiba and others can have tangible benefits for the regions in which the clusters are based but can be a public good for the entire world as well. Scientific breakthroughs can deliver life changing results around the world. Creating strong concentrations of likeminded researchers, workers and companies in areas with universities of international renown in scientific spheres has led to manifest benefits for the UK's position as a science superpower in the modern world.

As clusters continue to develop and harness the potential of the UK workforce, it is worth monitoring their progress and effects on communities locally, nationally and internationally. Research and Innovation Clusters could be the key to fulfilling the UK's potential and ensuring its status a world-leader in scientific fields in this new era of increased global competition.■

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